

ABB DRIVES FOR HVAC

## **ACH180 HVAC control program**

## Firmware manual



# **ACH180 HVAC control program**

### Firmware manual

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#### **Further information**



## 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 <sup>TM</sup> ), 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.



# **Control panel**

#### Contents of this chapter

This chapter describes how to use the integrated control panel.

#### **Control panel**

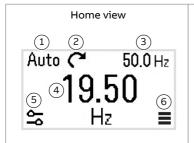
By default, ACH180 has an integrated control panel. You can also use an external control panel. For more information, refer to ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panel's user's manual (3AUA0000085685 [English]).



- 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.
- OK key. Opens the Menu in the Home view.
- 6. **Off** key. Stops the drive and switches to the Off mode.
- 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.



- 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.



Fault messages require your immediate attention.

See section Warning, fault and pure event messages (page 408) to troubleshoot the problem.



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

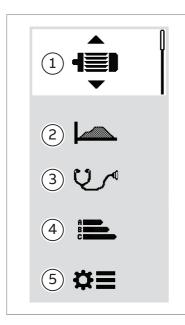
The Options menu is a quick access menu.



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

#### Main menu

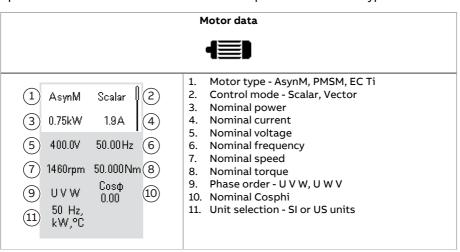
The Main menu is a scrolling menu. The menu icons represent specific groups. The groups have submenus.



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

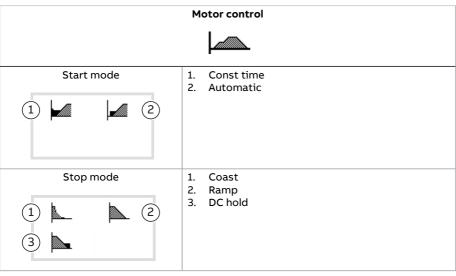
#### Submenus

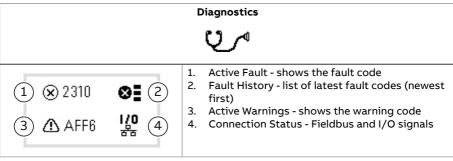
The Main menu items have submenus. Some submenus also have menus and/or option lists. The content of the submenus depends on the drive type.

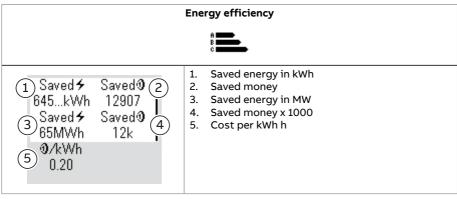


#### Motor data Motor type AsynM - Asynchronous motor PMSM - Permanent magnet synchronous motor 3. EC Ti - Ferrite assisted synchronous reluctance AsynM PMSM (2) motor EC Ti Control mode Scalar Vector 2. Scalar Vector (2 Phase order UVW UWV UWV Unit selection SI units 2. US units 60 Hz, ( 50 Hz, kW.°Ć hp.°F **Motor control** Start mode - Const time, Automatic 2. Stop mode - Coast, Ramp, DC hold 3. Acceleration time 4. Deceleration time **⊿**30.000s**≥**30.000s 5. Maximum allowed speed Maximum allowed current Max Max Minimum allowed speed 5000Hz 3.40A

Min 0.00Hz







#### **Parameters**





- Complete parameter list groups menu with complete parameters and parameter levels
- 2. Modified parameter list
- Parameter restore resets the drive to the factory default parameters

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 <b>Motor data</b> view.                                                                                                                                                                                                                                                      |  |  |
|                                                                                                                                                                                                                                                                               | Go to <b>Motor type</b> submenu. Set the motor type.                                                                                                                                                                                                                               |  |  |
|                                                                                                                                                                                                                                                                               | <ul> <li>AsynM: Asynchronous induction motor</li> <li>PMSM: Permanent magnet motor, or</li> <li>EC Ti: Ferrite assisted synchronous reluctance motors.</li> </ul>                                                                                                                  |  |  |
|                                                                                                                                                                                                                                                                               | Go to <b>Control mode</b> submenu. Set the motor control mode.                                                                                                                                                                                                                     |  |  |
|                                                                                                                                                                                                                                                                               | <ul> <li>Vector: Speed reference. The drive does an automatic stand-still ID run.</li> <li>Scalar: Frequency reference. Use this mode when:</li> <li>The number of motors can change.</li> <li>The nominal motor current is less than 20% of the nominal drive current.</li> </ul> |  |  |
|                                                                                                                                                                                                                                                                               | 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 <b>Motor control</b> view.                                                                                                                             |  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| Set the start mode.                                                                                                                                          |  |
| Set the stop mode.                                                                                                                                           |  |
| Set the acceleration time.                                                                                                                                   |  |
| <b>Note:</b> The speed acceleration ramp time is based on the values in parameters 46.01 Speed scaling / 46.02 Frequency scaling.                            |  |
| Set the deceleration time.                                                                                                                                   |  |
| <b>Note:</b> 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. |  |
| Control panel (ACT-Ar-x) of the brive composer FC 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 <b>Main menu</b> .                                                                                                                                                                                                    |  |  |
|                                                                                   | Select the <b>Parameters</b> 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.

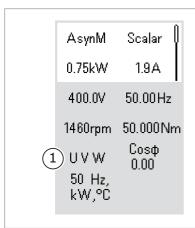
If the ID run fails, the panel shows the fault FF61 ID run.

#### 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



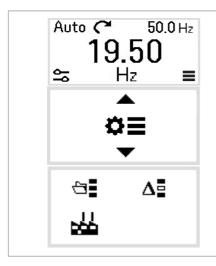
Start the motor and examine the actual rotation direction of the motor axis. If it is necessary, change the motor direction with the Phase order setting (1) in the Motor data view or change the phase order of the motor cable

### Set the speed or frequency reference



- On Home view, press Back key to go to Options menu.
- 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

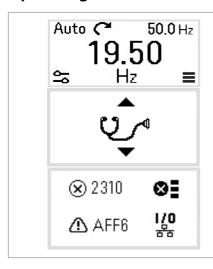


- Select the Main menu from the Home view
- 2. Go to **Parameters**. Press the OK key to open the submenu.
- 3. Select the complete parameters list with the arrow key and press the OK key, or
- 4. Select the modified parameters list with the arrow key and press the OK key.
- 5. Select the parameter and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

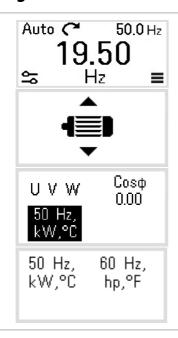
See section Parameters (page 137) for more information.

#### **Open Diagnostics**



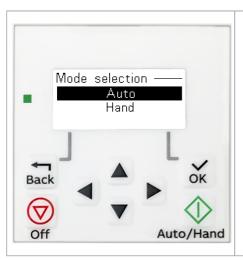
- Select the Main menu from the Home view.
- 2. Go to **Diagnostics** and press the OK key to open the submenu.
- 3. Select the warning or fault with the arrow key and press the OK key.
- See section Fault tracing (page 405) for more information.

#### Change the units



- 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



- 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.



# **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:

- Al1: 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 |         |                                            |  |  |  |  |
| 21 24V                                   | 24 V    | Aux. +24 V DC, max 200 mA                  |  |  |  |  |
| 22 DGND                                  | DGND    | Aux. voltage output common                 |  |  |  |  |
| 8 DI1                                    | DI1     | Stop (0) / Start (1)                       |  |  |  |  |
| 9 DI2                                    | DI2     | Not configured                             |  |  |  |  |
| 10 DI3                                   | DI3     | Constant speed/frequency selection         |  |  |  |  |
| 11 DI4                                   | DI4     | Start interlock 1 (1 = allow start)        |  |  |  |  |
| 12 DCOM                                  | DCOM    | Digital input common                       |  |  |  |  |
| 18 DO                                    | DO      | Not energized                              |  |  |  |  |
| 19 DO COM<br>20 DO SRC                   | DO COM  | Digital output common                      |  |  |  |  |
|                                          | DO SRC  | Digital output auxiliary voltage           |  |  |  |  |
| 5 NC                                     | NC      | Domanou control                            |  |  |  |  |
| 6 COM<br>7 NO                            | СОМ     | Damper control (Relay output 1)            |  |  |  |  |
| 7 INO                                    | NC      | (relay suspect)                            |  |  |  |  |
| Analog I/O                               |         |                                            |  |  |  |  |
| 110 kohm                                 | Al1/DI5 | Speed/frequency reference (010V)           |  |  |  |  |
| 1) 14 Al1/DI5                            | AGND    | Analog input circuit common                |  |  |  |  |
| 13 AGND 15 AI2                           | AI2     | Not used                                   |  |  |  |  |
| Max, 500 ohm                             | AGND    | Analog output circuit common               |  |  |  |  |
| 17 AO                                    | AO      | Output frequency (020mA)                   |  |  |  |  |
| 23 10V                                   | 10V     | Ref. voltage +10 V DC                      |  |  |  |  |
| 24 SCREEN                                | SCREEN  | Signal cable shield (screen)               |  |  |  |  |
| Safe torque off (STO)                    |         |                                            |  |  |  |  |
| 1 S+                                     | S+      | Safe torque off function.                  |  |  |  |  |
| 2 SGND                                   | SGND    | Connected at the factory. Drive            |  |  |  |  |
| 3 S1                                     | S1      | starts only when both circuits are closed. |  |  |  |  |
| 4 S2                                     | S2      | ciosea.                                    |  |  |  |  |

| Connection   |                | Term. Description |                               |  |
|--------------|----------------|-------------------|-------------------------------|--|
| EIA-485      |                |                   |                               |  |
|              | 25 B+          | B+                |                               |  |
|              | 26 A-          | A-                | Embedded fieldbus (EIA-485)   |  |
|              | 27 DGND        | DGND              | Embedded Heldbus (EIA-405)    |  |
|              | 28 SHIELD      | SHIELD            | _                             |  |
| Jumper       |                | '                 | '                             |  |
|              | J1 Termination | Termination       | EIA-485 termination selection |  |
| 1) Reference | signal (010V)  |                   |                               |  |

<sup>2)</sup> Terminal sizes: 0.5 mm<sup>2</sup> ... 1 mm<sup>2</sup> (22...16 AWG)

## **Program features**

## Contents of this chapter

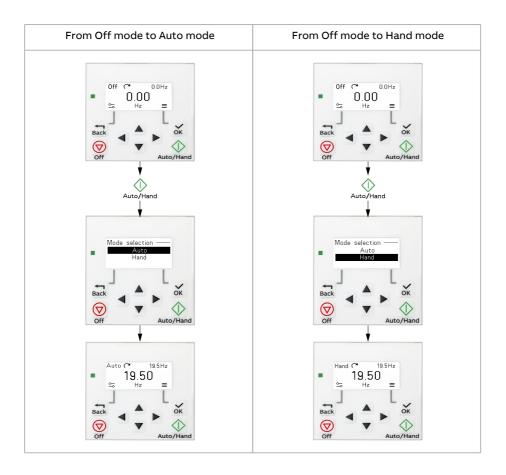
This chapter describes some of the functions within the control program, how to use them and how to program them to operate. It also explains the control locations and operating modes.

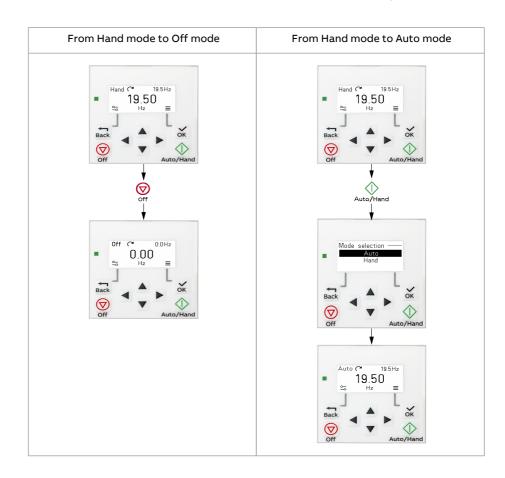
## Local control vs. external control

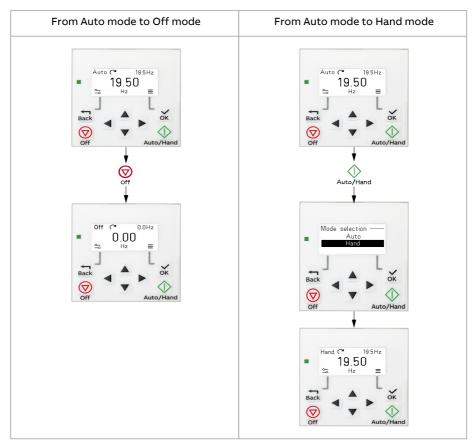
The ACH180 has two main control locations: local and external. In local control there are two different modes: Off and Hand.

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:



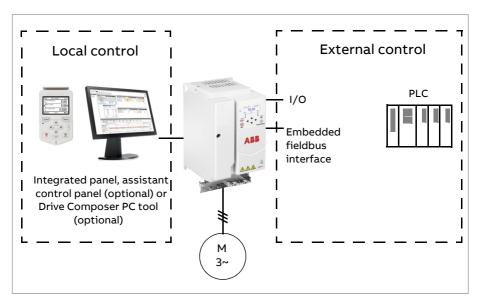




The control location can also be selected in the Drive Composer PC tool.

**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.

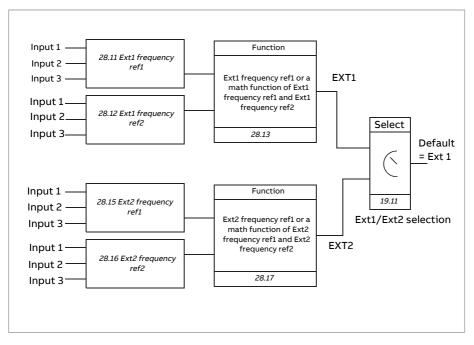
Two external control locations, EXT1 and EXT2, are available. You can select the sources of the start and stop commands separately for each location by setting parameters 20.01 Ext1 commands...20.10 Ext2 in3 source. The operating mode can be selected separately for each location, which enables quick 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.

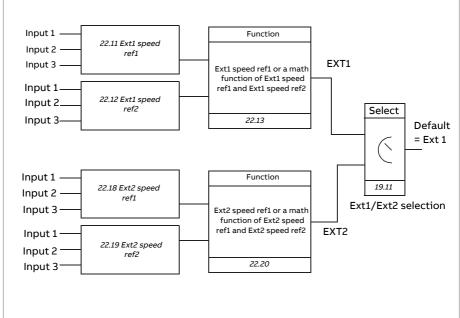
## Communication fail functionality

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

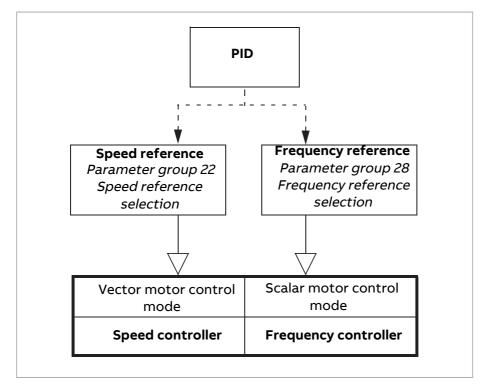


## Settings

- 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.

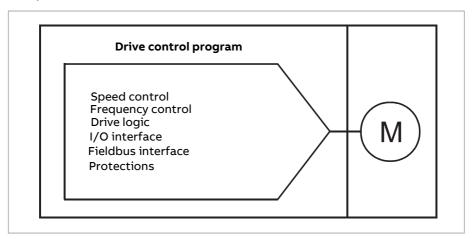
## Operating modes of the drive

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                         |  |  |
| 1/0                                      |                                |  |  |
| 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 p | program                           |
|------------------------------------|-----------------------------------|
| Al1                                | 12.11 Al1 actual value            |
| AI2                                | 12.21 Al2 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 |

## 50 Program features

| Outputs available to the adaptive program |                               |  |  |  |
|-------------------------------------------|-------------------------------|--|--|--|
| 1/0                                       |                               |  |  |  |
| RO1                                       | 10.24 RO1 source              |  |  |  |
| AO1                                       | 13.12 AO1 source              |  |  |  |
| DO1                                       |                               |  |  |  |
| START CONTROL                             | 1                             |  |  |  |
| 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                             | 1                             |  |  |  |
| 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 | 1                                  |
|-------------------------------------------|------------------------------------|
| 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. All 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 Al1 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.

| Connect                | ion   |             | Term. <sup>2)</sup> | Description                      |
|------------------------|-------|-------------|---------------------|----------------------------------|
| Digital I/O and relay  | outpu | t connec    | tions               |                                  |
|                        | 21 2  | 4V          | 24 V                | Aux. +24 V DC, max 200 mA        |
|                        | _     | GND         | DGND                | Aux. voltage output common       |
|                        | 8 D   | l1          | DI1                 | Stop (0) / Start (1)             |
|                        | 9 D   | 12          | DI2                 | Not configured                   |
|                        | 10 D  | 13          | DI3                 | Not configured                   |
|                        | 11 D  | 14          | DI4                 | Not configured                   |
|                        | 12 D  | СОМ         | DCOM                | Digital input common             |
|                        | 18 D  |             | DO                  | Not energized                    |
|                        | _     | O COM       | DO COM              | Digital output common            |
|                        | 20 D  | O SRC       | DO SRC              | Digital output auxiliary voltage |
|                        | 5 N   |             | NC                  |                                  |
|                        |       | OM          | СОМ                 | Not energized                    |
|                        | 7 N   | 0           | NO                  | (Relay output 1)                 |
| Analog I/O             |       |             | I                   |                                  |
| 4.401                  |       |             | Al1/Dl5             | Speed reference (010V)           |
| 110 kohm/              |       | AI1/DI5     | AGND                | Analog input circuit common      |
| 1)                     |       | AGND        | AI2                 | Not used                         |
|                        | -     | AI2<br>AGND | AGND                | Analog output circuit common     |
|                        |       | AGND<br>AO  | АО                  | Zero                             |
|                        |       | 0V          | 10V                 | Ref. voltage +10 V DC            |
|                        |       | CREEN       | SCREEN              | Signal cable shield (screen)     |
| 1) Reference signal (  | 010   | V)          | I.                  | 1                                |
| 2) Terminal sizes: 0.5 | 5 mm² | 1 mm²       | (2216 AWG)          |                                  |

- 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)
- Al1: 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.

| Connecti               | ion                                 | Term. <sup>2)</sup> | Description                         |
|------------------------|-------------------------------------|---------------------|-------------------------------------|
| Digital I/O and relay  | output connec                       | tions               |                                     |
|                        | 21 24V                              | 24 V                | Aux. +24 V DC, max 200 mA           |
|                        | 22 DGND                             | DGND                | Aux. voltage output common          |
|                        | 8 DI1                               | DI1                 | Stop (0) / Start (1)                |
|                        | 9 DI2                               | DI2                 | Not configured                      |
|                        | 10 DI3                              | DI3                 | Not configured                      |
| ~                      | 11 DI4                              | DI4                 | Start interlock 1 (1 = allow start) |
|                        | 12 DCOM                             | DCOM                | Digital input common                |
|                        | 18 DO COM                           | DO                  | Not energized                       |
|                        | 19 DO COM<br>20 DO SRC              | DO COM              | Digital output common               |
|                        |                                     | DO SRC              | Digital output auxiliary voltage    |
|                        | 5 NC<br>6 COM                       | NC                  |                                     |
|                        | 7 NO                                | СОМ                 | Running<br>(Relay output 1)         |
|                        | 7 NO                                | NO                  | (100)                               |
| Analog I/O             |                                     |                     | <u>'</u>                            |
| 110 kohm / 5           |                                     | Al1/Dl5             | Speed reference (010V)              |
| 1)                     | 14 AI1/DI5                          | AGND                | Analog input circuit common         |
| 1) \                   | 13 AGND<br>15 AI2                   | AI2                 | Not used                            |
|                        | 16 AGND                             | AGND                | Analog output circuit common        |
|                        | 17 AO                               | AO                  | Output frequency (020mA)            |
|                        | 23 10V                              | 10V                 | Ref. voltage +10 V DC               |
|                        | 24 SCREEN                           | SCREEN              | Signal cable shield (screen)        |
| 1) Reference signal (0 |                                     |                     |                                     |
| 2) Terminal sizes: 0.5 | mm <sup>2</sup> 1 mm <sup>2</sup> ( | (2216 AWG)          |                                     |

- 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)
- Al1: 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.

| Connection                 |             | Term. <sup>2)</sup> | Description                         |
|----------------------------|-------------|---------------------|-------------------------------------|
| Digital I/O and relay outp | ut connec   | tions               |                                     |
| 21 2                       | 24V         | 24 V                | Aux. +24 V DC, max 200 mA           |
| 22 [                       | OGND        | DGND                | Aux. voltage output common          |
| 8 [                        | DI1         | DI1                 | Stop (0) / Start (1)                |
| 9 [                        | DI2         | DI2                 | Run permissive (1 = allow start)    |
| 10                         | DI3         | DI3                 | Start interlock 2 (1 = allow start) |
|                            | 014         | DI4                 | Start interlock 1 (1 = allow start) |
|                            | DCOM        | DCOM                | Digital input common                |
|                            | 00          | DO                  | Not energized                       |
|                            | DO COM      | DO COM              | Digital output common               |
|                            |             | DO SRC              | Digital output auxiliary voltage    |
|                            | NC O        | NC                  |                                     |
|                            | NO          | СОМ                 | Damper control (Relay output 1)     |
|                            | NO          | NO                  | (Kelay Output 1)                    |
| Analog I/O                 |             | 1                   |                                     |
| 110 kohm / 5 ]             |             | Al1/Dl5             | Speed reference (010V)              |
| 1) 14                      | AI1/DI5     | AGND                | Analog input circuit common         |
| 1) ~ "                     | AGND<br>Al2 | AI2                 | Not used                            |
| 10                         | AGND        | AGND                | Analog output circuit common        |
| IWAX: 500 OIIII            | AO          | AO                  | Output frequency (020mA)            |
|                            | 10V         | 10V                 | Ref. voltage +10 V DC               |
| 24                         | SCREEN      | SCREEN              | Signal cable shield (screen)        |
| 1) Reference signal (010   | V)          | ı                   | 1                                   |
| 2) Terminal sizes: 0.5 mm² | ²1 mm² (    | (2216 AWG)          |                                     |

- 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]

| <ul> <li>Parameter 22.22 Constant speed sel1 = Always off</li> </ul> |
|----------------------------------------------------------------------|
|----------------------------------------------------------------------|

| • | Parameter | 28.22 | Constant : | freauency | / sel1 | = Alway | s 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)
- Al1: 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)
- Al2: 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

| Connection                          | Term. <sup>3)</sup> | Description                         |
|-------------------------------------|---------------------|-------------------------------------|
| Digital I/O and relay output connec | tions               |                                     |
| 21 24V                              | 24 V                | Aux. +24 V DC, max 200 mA           |
| 22 DGND                             | DGND                | Aux. voltage output common          |
| 8 DI1                               | DI1                 | Stop (0) / Start (1)                |
| 9 DI2                               | DI2                 | Not configured                      |
| 10 DI3                              | DI3                 | Start interlock 2 (1 = allow start) |
| 11 DI4                              | DI4                 | Start interlock 1 (1 = allow start) |
|                                     | DCOM                | Digital input common                |
| 18 DO                               | DO                  | Not energized                       |
| 19 DO COM                           | ро сом              | Digital output common               |
| 20 DO SRC                           | DO SRC              | Digital output auxiliary voltage    |
| 5 NC                                | NC                  |                                     |
| 6 COM                               | СОМ                 | Running (Relay output 1)            |
| 7 NO                                | NO                  | (Relay output 1)                    |
| Analog I/O                          |                     |                                     |
|                                     | Al1/DI5             | Set 1 setpoint (420mA)              |
| 14 AI1/DI5                          | AGND                | Analog input circuit common         |
| 13 AGND 15 AI2                      | AI2                 | Set 1 feedback (420mA)              |
| 2) / 1 16 AGND                      | AGND                | Analog output circuit common        |
| 17 AO                               | AO                  | Zero                                |
| 23 10V                              | 10V                 | Ref. voltage +10 V DC               |
| 24 SCREEN                           | SCREEN              | Signal cable shield (screen)        |
| 1) BAS setpoint (420 mA)            | <u> </u>            |                                     |
| 2) Transducer feedback (420 mA)     |                     |                                     |

## Required parameter adjustments

• Parameter 10.24 RO1 source = Running [7]

3) Terminal sizes: 0.5 mm<sup>2</sup>...1 mm<sup>2</sup> (22...16 AWG)

- Parameter 12.15 Al1 unit selection = mA [10]
- Parameter 12.20 All scaled at All max = 2.000
- Parameter 12.30 Al2 scaled at Al2 max = 5.000

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- 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 = Al1 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)
- Al1: 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.

| Connection                 |             | Term. <sup>2)</sup> | Description                         |
|----------------------------|-------------|---------------------|-------------------------------------|
| Digital I/O and relay outp | ut connec   | tions               |                                     |
| 21 2                       | 24V         | 24 V                | Aux. +24 V DC, max 200 mA           |
| 22 [                       | OGND        | DGND                | Aux. voltage output common          |
| 8 [                        | DI1         | DI1                 | Stop (0) / Start (1)                |
| 9 [                        | DI2         | DI2                 | Not configured                      |
| 10                         | DI3         | DI3                 | Not configured                      |
|                            | DI4         | DI4                 | Start interlock 1 (1 = allow start) |
|                            | ОСОМ        | DCOM                | Digital input common                |
|                            | DO COM      | DO                  | Not energized                       |
|                            | DO SRC      | DO COM              | Digital output common               |
|                            | NC          | DO SRC              | Digital output auxiliary voltage    |
|                            | COM         | NC                  | Durania a                           |
|                            | NO          | СОМ                 | Running (Relay output 1)            |
|                            | 10          | NO                  | (Helay Salpacity                    |
| Analog I/O                 |             |                     |                                     |
| 110 kohm / 5               |             | Al1/Dl5             | Speed reference (420 mA)            |
| 1) 14                      | AI1/DI5     | AGND                | Analog input circuit common         |
| 1) "                       | AGND<br>Al2 | AI2                 | Not used                            |
|                            | AGND        | AGND                | Analog output circuit common        |
|                            | AO          | AO                  | Output frequency (020mA)            |
| 23                         | 10V         | 10V                 | Ref. voltage +10 V DC               |
| 24                         | SCREEN      | SCREEN              | Signal cable shield (screen)        |
| 1) Reference signal (420   | mA)         | I                   |                                     |
| 2) Terminal sizes: 0.5 mm² | ²1 mm² (    | (2216 AWG)          |                                     |

- Parameter 10.24 RO1 source = Running [7]
- Parameter 12.15 Al1 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 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).

| Connection                        | Term. <sup>2)</sup> | Description                         |
|-----------------------------------|---------------------|-------------------------------------|
| Digital I/O and relay output conn | ections             |                                     |
| 21 24V                            | 24 V                | Aux. +24 V DC, max 200 mA           |
| 22 DGND                           | DGND                | Aux. voltage output common          |
| 8 DI1                             | DI1                 | Stop (0) / Start (1)                |
| 9 DI2                             | DI2                 | Not configured                      |
| 10 DI3                            | DI3                 | Not configured                      |
| 11 DI4                            | DI4                 | Start interlock 1 (1 = allow start) |
| 12 DCOM                           | DCOM                | Digital input common                |
| 18 DO                             | DO                  | Not energized                       |
| 19 DO COM<br>20 DO SRO            | DO COM              | Digital output common               |
|                                   | DO SRC              | Digital output auxiliary voltage    |
| 5 NC                              | NC                  |                                     |
| 6 COM<br>7 NO                     | СОМ                 | Running (Relay output 1)            |
| V I INO                           | NO                  | (Relay output 1)                    |
| Analog I/O                        |                     |                                     |
|                                   | AI1/DI5             | Not used                            |
| 14 AI1/DI5                        | AGND                | Analog input circuit common         |
| 13 AGND                           | AI2                 | Set 1 feedback (420mA)              |
| 15 AI2<br>16 AGND                 | AGND                | Analog output circuit common        |
| 17 AO                             | AO                  | Output frequency (020mA)            |
| 23 10V                            | 10V                 | Ref. voltage +10 V DC               |
| 24 SCREE                          | SCREEN              | Signal cable shield (screen)        |
| 1) Water temperature              |                     |                                     |
| 2) Terminal sizes: 0.5 mm²1 mm    | n² (2216 AWG)       |                                     |

- Parameter 10.24 RO1 source = Running [7]
- Parameter 12.15 Al1 unit selection = mA [10]
- Parameter 12.29 Al2 scaled at Al2 min = -30.00 (if °C) or -22.00 (if °F)
- Parameter 12.30 Al2 scaled at Al2 max = 50.00 (if °C) or 122.00 (if °F)
- Parameter 13.12 AO1 source = Zero [0]

## 68 Program features

- 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)
- Al1: 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.

## 70 Program features

## Wiring diagram

| Connection                          | Term. <sup>2)</sup> | Description                      |
|-------------------------------------|---------------------|----------------------------------|
| Digital I/O and relay output connec | tions               |                                  |
| 21 24V                              | 24 V                | Aux. +24 V DC, max 200 mA        |
| 22 DGND                             | DGND                | Aux. voltage output common       |
| 8 DI1                               | DI1                 | Stop (0) / Start (1)             |
| 9 DI2                               | DI2                 | Not configured                   |
| 10 DI3                              | DI3                 | Not configured                   |
| 11 DI4                              | DI4                 | Not configured                   |
| 12 DCOM                             | DCOM                | Digital input common             |
| 18 DO 19 DO COM                     | DO                  | Not energized                    |
| 19 DO COM<br>20 DO SRC              | DO COM              | Digital output common            |
|                                     | DO SRC              | Digital output auxiliary voltage |
| 5 NC                                | NC                  |                                  |
| 6 COM<br>7 NO                       | СОМ                 | Running (Relay output 1)         |
| V [/ INO                            | NO                  | (Kelay Output 1)                 |
| Analog I/O                          |                     | '                                |
| 110 kohm / 5                        | Al1/DI5             | Speed reference (010V)           |
| 1) 14 AI1/DI5                       | AGND                | Analog input circuit common      |
| 13 AGND 15 AI2                      | AI2                 | Not used                         |
| 46 A 6NID                           | AGND                | Analog output circuit common     |
| Max. 500 ohm 16 AGND 17 AO          | AO                  | Motor current (020mA)            |
| 23 10V                              | 10V                 | Ref. voltage +10 V DC            |
| 24 SCREEN                           | SCREEN              | Signal cable shield (screen)     |
| 1) Reference signal (010 V)         | I.                  |                                  |
| 2) Terminal sizes: 0.5 mm²1 mm²     | (2216 AWG)          |                                  |

- 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]

| <ul> <li>Parameter 22.22 Constant speed sel1 = Always off</li> </ul> |
|----------------------------------------------------------------------|
|----------------------------------------------------------------------|

| • | Parameter | 28.22 | Constant ' | frequency | / sel1 | = Alway | s 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:

- DII: Start/stop contact closure from the building automation system (BAS)
- Al1: 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. <sup>2)</sup> | Description                      |  |  |
|--------------------------------------------|-------------|---------------------|----------------------------------|--|--|
| Digital I/O and relay output connections   |             |                     |                                  |  |  |
| 21                                         | 24V         | 24 V                | Aux. +24 V DC, max 200 mA        |  |  |
| 22                                         | DGND        | DGND                | Aux. voltage output common       |  |  |
| 8                                          | DI1         | DI1                 | Stop (0) / Start (1)             |  |  |
| 9                                          | DI2         | DI2                 | Not configured                   |  |  |
| 10                                         | DI3         | DI3                 | Not configured                   |  |  |
|                                            | DI4         | DI4                 | Not configured                   |  |  |
|                                            | DCOM        | DCOM                | Digital input common             |  |  |
|                                            | DO COM      | DO                  | Not energized                    |  |  |
|                                            | DO SRC      | DO COM              | Digital output common            |  |  |
|                                            |             | DO SRC              | Digital output auxiliary voltage |  |  |
|                                            | 6 COM       | NC                  | Running (Relay output 1)         |  |  |
|                                            |             | СОМ                 |                                  |  |  |
|                                            |             | NO                  |                                  |  |  |
| Analog I/O                                 |             |                     |                                  |  |  |
| 110 kohm                                   |             | Al1/DI5             | Speed reference (010V)           |  |  |
| 1) 14                                      | AI1/DI5     | AGND                | Analog input circuit common      |  |  |
| 13                                         | AGND<br>AI2 | AI2                 | Not used                         |  |  |
| 16                                         | AGND        | AGND                | Analog output circuit common     |  |  |
| 17                                         | AO          | AO                  | Zero                             |  |  |
| 23                                         | 10V         | 10V                 | Ref. voltage +10 V DC            |  |  |
| 24                                         | SCREEN      | SCREEN              | Signal cable shield (screen)     |  |  |
| 1) Reference signal (010 V)                |             |                     |                                  |  |  |
| 2) Terminal sizes: 0.5 mm²1 mm² (2216 AWG) |             |                     |                                  |  |  |

# Required parameter adjustments

- Parameter 10.24 RO1 source = Running [7]
- Parameter 12.15 Al1 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.

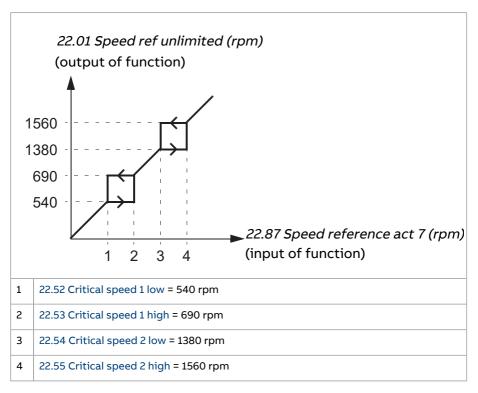
When the drive is limiting the allowed output speeds/frequencies, it limits to the absolutely lowest critical speed (critical speed low or critical frequency low) when accelerating from standstill, unless the speed reference is over the upper critical speed/ frequency limit.

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,

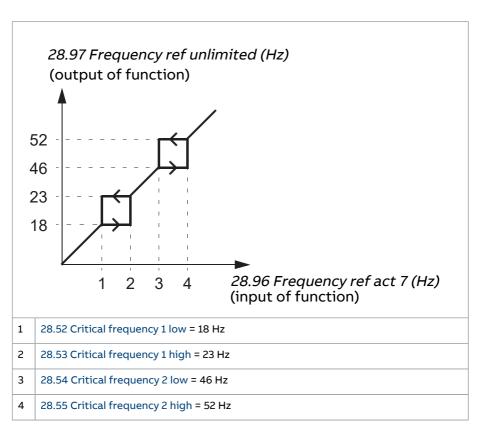
- enable the critical speeds function by turning on bit 0 of parameter 22.51
   Critical speed function, and
- set the critical speed ranges as in the figure below.



### **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.



### 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

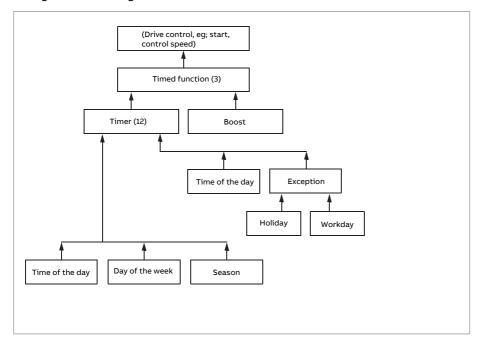
The base entity of the timed functions is called a timer. A timer can be active based on time of the day, day of the week and season of the year. In addition to these time related parameters, the timer activation can be influenced by so called days of exception (configurable as holiday or workday). For 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

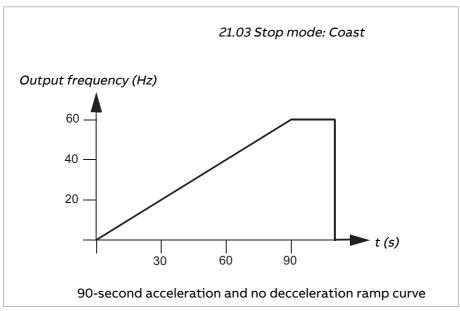
Ramps refer to acceleration and deceleration times. The ramps function adjusts the rate of how fast or slow a drive changes the motor speed with respect to the commanded speed. Ramps should be configured based on the specific application requirements.

## Functionality

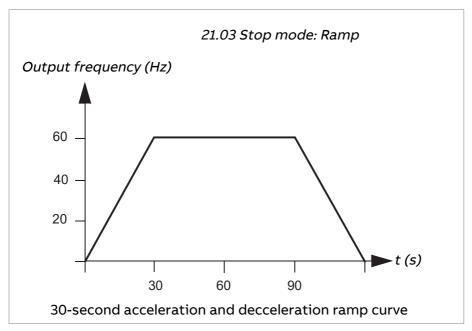
Acceleration ramps are recommended for all applications. The acceleration ramp is the amount of time required for the drive to ramp up the motor from 0 Hz to the ramp time target frequency setting.

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.



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.



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.

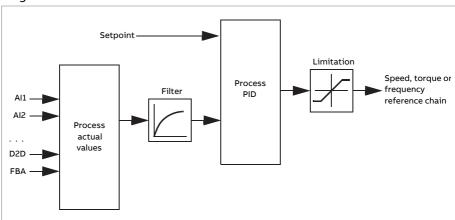
In the pump application examples, the fluid in the pipes can create enough force on the pump to cause the pump to come to a stop very quickly after the drive stops controlling the motor. This sudden stop will cause a pressure surge in the pipes, often known as water hammer. Water hammer problems include 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.

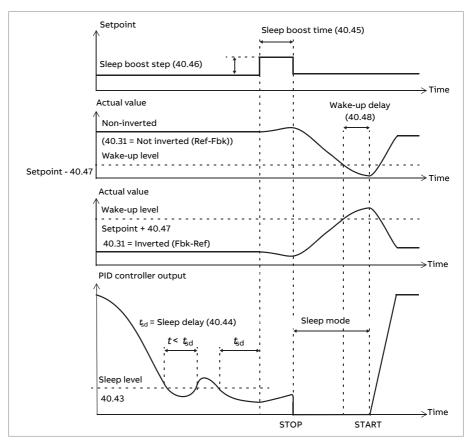
**Note:** Process PID control is only available in external control location EXT2; see section Local control vs. external control (page 39).

### 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
- 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.
- All or Al2 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. <sup>3)</sup> | Description                         |  |  |
|------------------------------------------|------------------------|---------------------|-------------------------------------|--|--|
| Digital I/O and relay output connections |                        |                     |                                     |  |  |
|                                          | 21 24V                 | 24 V                | Aux. +24 V DC, max 200 mA           |  |  |
|                                          | 22 DGND                | DGND                | Aux. voltage output common          |  |  |
|                                          | 8 DI1                  | DI1                 | Stop (0) / Start (1)                |  |  |
|                                          | 9 DI2                  | DI2                 | Start interlock 3 (1 = allow start) |  |  |
|                                          | 10 DI3                 | DI3                 | Start interlock 2 (1 = allow start) |  |  |
|                                          | 11 DI4                 | DI4                 | Start interlock 1 (1 = allow start) |  |  |
|                                          | 12 DCOM                | DCOM                | Digital input common                |  |  |
|                                          | 18 DO                  | DO                  | Not energized                       |  |  |
|                                          | 19 DO COM<br>20 DO SRC | DO COM              | Digital output common               |  |  |
| 20                                       |                        | DO SRC              | Digital output auxiliary voltage    |  |  |
|                                          | 5 NC                   | NC                  |                                     |  |  |
|                                          | 6 COM -                | СОМ                 | Running (Relay output 1)            |  |  |
|                                          | / INO                  | NO                  | (Relay Output 1)                    |  |  |
| Analog I/O                               |                        |                     |                                     |  |  |
| 1                                        |                        | Al1/Dl5             | Override                            |  |  |
| 1)                                       | 14 AI1/DI5             | AGND                | Analog input circuit common         |  |  |
| 2) 15                                    | 13 AGND -<br>15 AI2    | Al2                 | Speed reference (010V)              |  |  |
|                                          | 16 AGND                | AGND                | Analog output circuit common        |  |  |
|                                          | 17 AO                  | AO                  | Zero                                |  |  |
|                                          | 23 10V                 | 10V                 | Ref. voltage +10 V DC               |  |  |
|                                          | 24 SCREEN              | SCREEN              | Signal cable shield (screen)        |  |  |
| 1) Connected to term                     | inal 21                |                     |                                     |  |  |

- 1) Connected to terminal 21
- 2) Speed reference (0...10 V)
- 3) Terminal sizes: 0.5 mm<sup>2</sup>...1 mm<sup>2</sup> (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 Al2 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 = Al2 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
- Al2: 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

| Connection                                 | Term. <sup>2)</sup> | Description                         |  |  |
|--------------------------------------------|---------------------|-------------------------------------|--|--|
| Digital I/O and relay output connections   |                     |                                     |  |  |
| 21 24V                                     | 24 V                | Aux. +24 V DC, max 200 mA           |  |  |
| 22 DGND                                    | DGND                | Aux. voltage output common          |  |  |
| 8 DI1                                      | DI1                 | Stop (0) / Start (1)                |  |  |
| 9 DI2                                      | DI2                 | Run permissive (1 = allow start)    |  |  |
| 10 DI3                                     | DI3                 | Start interlock 2 (1 = allow start) |  |  |
| 11 DI4                                     | DI4                 | Start interlock 1 (1 = allow start) |  |  |
|                                            | рсом                | Digital input common                |  |  |
| 18 DO                                      | DO                  | Not energized                       |  |  |
| 19 DO COM                                  | ■ DO COM            | Digital output common               |  |  |
| 20 DO SRC                                  | DO SRC              | Digital output auxiliary voltage    |  |  |
| 5 NC                                       | NC                  |                                     |  |  |
| 6 COM                                      | СОМ                 | Not energized                       |  |  |
| 7 NO                                       | NO                  |                                     |  |  |
| Analog I/O                                 |                     |                                     |  |  |
|                                            | Al1/Dl5             | Override                            |  |  |
| 14 AI1/DI5                                 | AGND                | Analog input circuit common         |  |  |
| 13 AGND                                    | AI2                 | Not used                            |  |  |
| 15 AI2<br>16 AGND                          | AGND                | Analog output circuit common        |  |  |
| 17 AO                                      | АО                  | Zero                                |  |  |
| 23 10V                                     | 10V                 | Ref. voltage +10 V DC               |  |  |
| 24 SCREEN                                  | SCREEN              | Signal cable shield (screen)        |  |  |
| 1) Pressure signal                         |                     |                                     |  |  |
| 2) Terminal sizes: 0.5 mm²1 mm² (2216 AWG) |                     |                                     |  |  |

### 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, AFFO 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.

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.
- 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.
- 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.

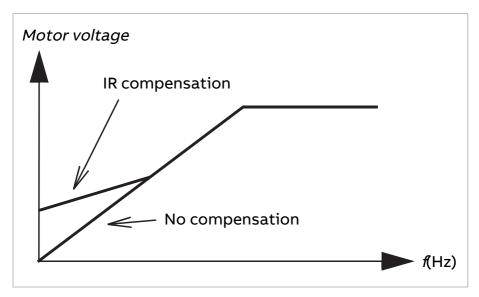
In scalar control, some standard features are not available.

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.

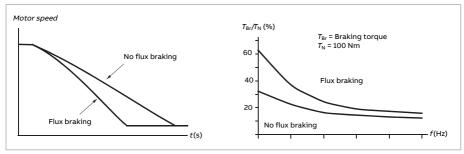
The U/f function cannot be used with energy optimization; if parameter 45.11 Energy optimizer is set to Enable, parameter 97.20 U/F Ratio is ignored.

## 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.

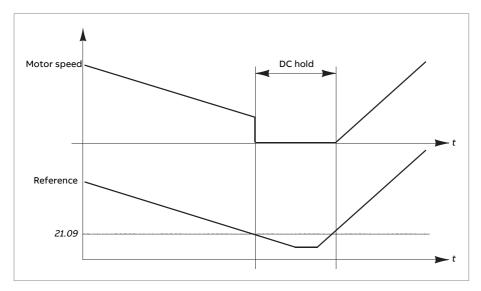
### Settings and diagnostics

- 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.

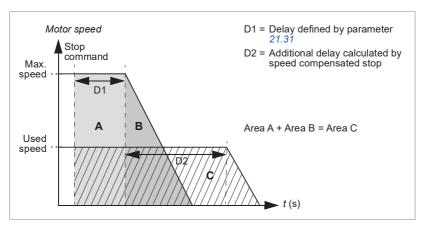
**Example 2**: If the reference switching frequency is set to 12 kHz and the minimum switching frequency is set to the smallest available value, the drive maintains the highest possible switching frequency to reduce motor noise and only when the drive heats will it decrease the switching frequency. This 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!

LEC 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 Al1 and Al2 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 Al1 and Al2 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).

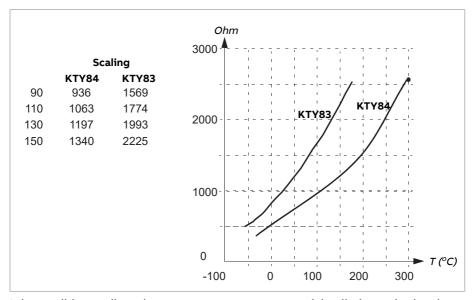
For the wiring of the sensor, see section Al1 and Al2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (page 110).

#### 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  $1.0\,\mathrm{mA}$  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.



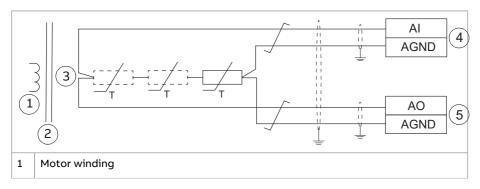
It is possible to adjust the motor temperature supervision limits and select how the drive reacts when overtemperature is detected.

See section Insulation (page 108).

For the wiring of the sensor, see section Al1 and Al2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (page 110).

#### All and Al2 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.



| 2 | Double or reinforced insulation                                                                                                                                               |
|---|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3 | 13 × (Pt100 or Pt1000) or 1 × (Ni1000 or KTY83 or KTY84)                                                                                                                      |
| 4 | Select the input type to voltage for analog input Al1 or Al2 with parameters. Set the appropriate analog input unit to V (volt) in parameter group 12 Standard Al (page 173). |
| 5 | Select the excitation mode in parameter group 13 Standard AO (page 179).                                                                                                      |



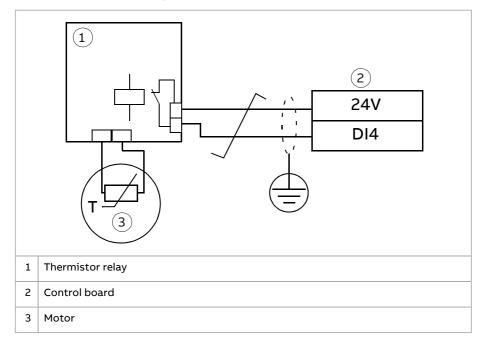
#### WARNING!

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).



#### 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.

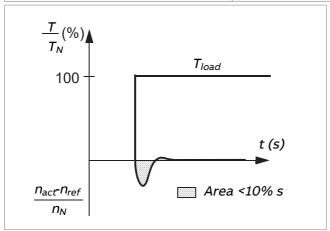
#### Settings

- 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)

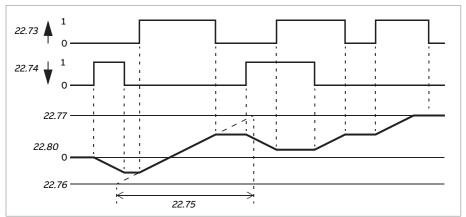
The Floating point control (parameters are named Motor potentiometer, however) is, in effect, a counter whose value can be adjusted up and down using two digital signals selected by parameters 22.73 Motor potentiometer up source and 22.74 Motor potentiometer down source.

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.

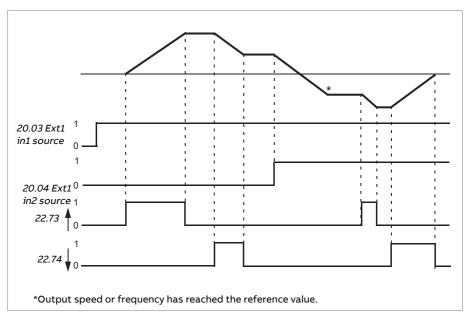
The change rate is defined in parameter 22.75 Motor potentiometer ramp time as the time it would take for the value to change from the minimum (parameter 22.76 Motor potentiometer min value) to the maximum (parameter 22.77 Motor potentiometer max value) or vice versa. If the up and down signals are simultaneously 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.



#### Settings

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

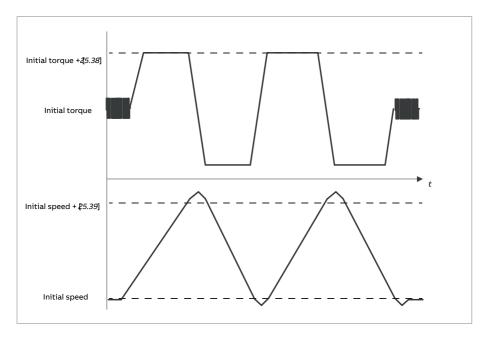
### Speed controller autotune

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:

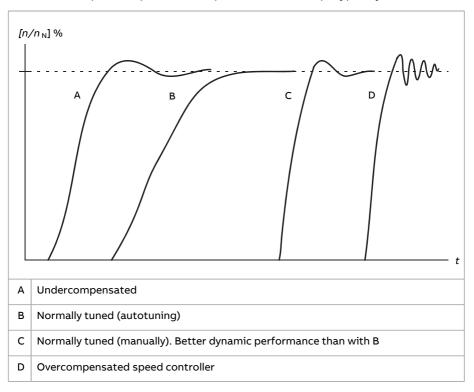
- · The motor identification run (ID run) has been successfully completed
- Speed and torque limits (parameter group 30 Limits (page 249)) have been set, and
- speed error filtering (parameter group 24 Speed reference conditioning (page 228)) and zero speed (parameters 21.06 Zero speed limit and 21.07 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%).



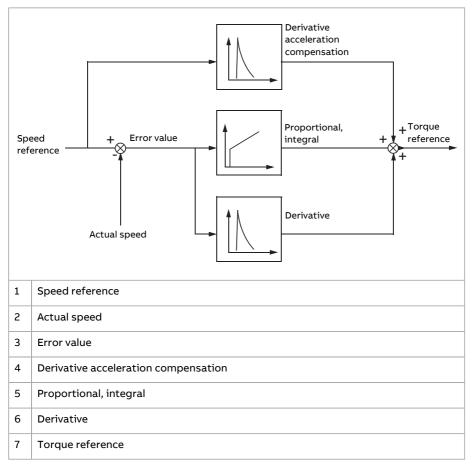
#### Autotune results

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

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

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

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



## 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.

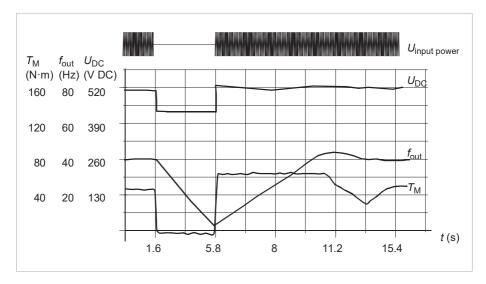
See also section Voltage control and trip limits (page 120).

## 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.



UDC = Intermediate circuit voltage of the drive

fout = Output frequency of the drive

T<sub>M</sub> = 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 ( $\rm U_{DC}$ ) 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                                                             | 95.01 Supply vol                         | 95.01 Supply voltage                     |                                          |                               |  |  |  |
|------------------------------------------------------------------------------|------------------------------------------|------------------------------------------|------------------------------------------|-------------------------------|--|--|--|
| [V]<br>See parameter<br>95.01 Supply<br>voltage.                             | AC supply<br>voltage range<br>[V] 208240 | AC supply<br>voltage range<br>[V] 380415 | AC supply<br>voltage range<br>[V] 440480 | Automatic / Not selected      |  |  |  |
| Overvoltage<br>fault limit                                                   | 421                                      | 842                                      | 842                                      | 842                           |  |  |  |
| Overvoltage control limit                                                    | 389                                      | 779                                      | 779                                      | 779                           |  |  |  |
| Internal brake<br>chopper start<br>limit                                     | 389                                      | 779                                      | 779                                      | 779                           |  |  |  |
| Internal brake<br>chopper stop<br>limit                                      | 379                                      | 759                                      | 759                                      | 759                           |  |  |  |
| Overvoltage<br>warning limit                                                 | 372                                      | 745                                      | 745                                      | 745                           |  |  |  |
| Undervoltage<br>warning limit                                                | 0.85×1.41×par.<br>95.03 value            | 0.85×1.41×par.<br>95.03 value            | 0.85×1.41×par.<br>95.03 value            | 0.85×1.41×par.<br>95.03 value |  |  |  |
| Undervoltage<br>control limit                                                | 0.78×1.41×par.<br>95.03 value            | 0.78×1.41×par.<br>95.03 value            | 0.78×1.41×par.<br>95.03 value            | 0.78×1.41×par.<br>95.03 value |  |  |  |
| Charging relay<br>closing limit /<br>charging deactiv-<br>ation              | 0.78×1.41×par.<br>95.03 value            | 0.78×1.41×par.<br>95.03 value            | 0.78×1.41×par.<br>95.03 value            | 0.78×1.41×par.<br>95.03 value |  |  |  |
| Charging relay<br>opening limit /<br>charging activa-<br>tion                | 0.73×1.41×par.<br>95.03 value            | 0.73×1.41×par.<br>95.03 value            | 0.73×1.41×par.<br>95.03 value            | 0.73×1.41×par.<br>95.03 value |  |  |  |
| DC voltage at<br>upper bound of<br>supply voltage<br>range ( <i>U</i> DCmax) | 324                                      | 560                                      | 648                                      | (variable)                    |  |  |  |
| DC voltage at<br>lower bound of<br>supply voltage<br>range (UDCmin)          | 281                                      | 513                                      | 594                                      | (variable)                    |  |  |  |
| Standby limit 3)                                                             | 0.73×1.41×par.<br>95.03 value            | 0.73×1.41×par.<br>95.03 value            | 0.3×1.41×par.<br>95.03 value             | 0.73×1.41×par.<br>95.03 value |  |  |  |

| DC voltage level | 95.01 Supply voltage |               |               |                          |  |
|------------------|----------------------|---------------|---------------|--------------------------|--|
| See parameter    | AC supply            | AC supply     | AC supply     | Automatic / Not selected |  |
| 95.01 Supply     | voltage range        | voltage range | voltage range |                          |  |
| voltage.         | [V] 208240           | [V] 380415    | [V] 440480    |                          |  |

**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<br>level [V]                                                | 95.01 Supply Voltage           |                        |                        |                          |                        |  |
|------------------------------------------------------------------------|--------------------------------|------------------------|------------------------|--------------------------|------------------------|--|
| See paramet-                                                           | AC supply                      | AC supply voltage      | AC supply voltage      | Automatic / Not selected |                        |  |
| er 95.01 Supply voltage.                                               | voltage<br>range [V]<br>208240 | range [V]<br>380415    | range [V]<br>440480    | if 95.03 < 456<br>V AC   | if 95.03 > 456<br>V AC |  |
| Overvoltage<br>fault limit                                             | 421                            | 842                    | 842                    | 842                      | 842                    |  |
| Overvoltage control limit                                              | 389                            | 779                    | 779                    | 779                      | 779                    |  |
| Internal<br>brake chop-<br>per start lim-<br>it                        | 389                            | 779                    | 779                    | 779                      | 779                    |  |
| Internal<br>brake chop-<br>per stop lim-<br>it                         | 379                            | 759                    | 759                    | 759                      | 759                    |  |
| Overvoltage<br>warning limit                                           | 372                            | 745                    | 745                    | 745                      | 745                    |  |
| Under-<br>voltage<br>warning limit                                     | 0.85×1.35×208<br>= 239         | 0.85×1.35×380<br>= 436 | 0.85×1.35×440<br>= 504 | 0.85×1.35×380<br>= 436   | 0.85×1.35×440<br>= 505 |  |
| Under-<br>voltage con-<br>trol limit                                   | 0.78×1.35×208<br>= 219         | 0.78×1.35×380<br>= 400 | 0.78×1.35×440<br>= 463 | 0.78×1.35×380<br>= 400   | 0.78×1.35×440<br>= 463 |  |
| Charging re-<br>lay closing<br>limit / char-<br>ging deactiv-<br>ation | 0.78×1.35×208<br>= 219         | 0.78×1.35×380<br>= 400 | 0.78×1.35×440<br>= 463 | 0.78×1.35×380<br>= 400   | 0.78×1.35×440<br>= 463 |  |

| DC voltage<br>level [V]                                                      | 95.01 Supply Voltage           |                                |                                |                          |                        |
|------------------------------------------------------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------|------------------------|
| See paramet-                                                                 | AC supply                      |                                | AC supply                      | Automatic / Not selected |                        |
| er 95.01 Sup-<br>ply voltage.                                                | voltage<br>range [V]<br>208240 | voltage<br>range [V]<br>380415 | voltage<br>range [V]<br>440480 | if 95.03 < 456<br>V AC   | if 95.03 > 456<br>V AC |
| Charging re-<br>lay opening<br>limit / char-<br>ging activa-<br>tion         | 0.73×1.35×208<br>= 205         | 0.73×1.35×380<br>= 374         | 0.73×1.35x440<br>= 433         | 0.73×1.35x380<br>= 374   | 0.73×1.35×440<br>= 433 |
| DC voltage<br>at upper<br>bound of<br>supply<br>voltage<br>range<br>(UDCmax) | 324                            | 560                            | 648                            | (variable)               | (variable)             |
| DC voltage<br>at lower<br>bound of<br>supply<br>voltage<br>range<br>(UDCmin) | 281                            | 513                            | 594                            | (variable)               | (variable)             |
| Standby limit                                                                | 0.73×1.35×208<br>= 205         | 0.73×1.35×380<br>= 374         | 0.73×1.35×440<br>= 433         | 0.73×1.35×380<br>= 374   | 0.73×1.35×440<br>= 433 |
| Under-<br>voltage fault<br>limit 1)                                          | 0.73×1.35×208<br>= 205         | 0.73×1.35×380<br>= 374         | 0.73×1.35×440<br>= 433         | 0.73×1.35×380<br>= 374   | 0.73×1.35×440<br>= 433 |

## 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).

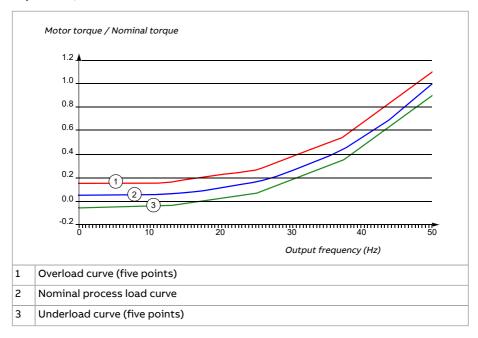
For example, a fan bearing is beginning to fail due to lack of lubrication. The bearing surfaces are beginning to bind, causing the motor current draw to exceed its normal level. The supervisory function indicates the load is drawing higher current than normal. As a result, service personnel can investigate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



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

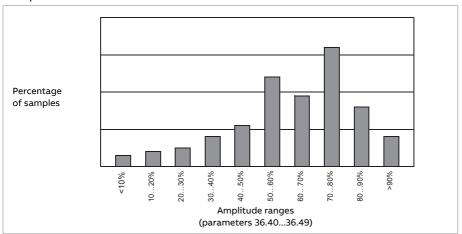
The user can select a signal to be monitored by a peak value logger. The logger records the peak value of the signal along with the time the peak occurred, as well as motor current, DC voltage and motor speed at the time of the peak. The peak value is sampled at 2 ms intervals.

## **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 (/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 Al.1.0 to 10%...36.29 Al.1.0 ver 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.

#### Al 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.

#### <u>Settings</u>

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

#### Al dead band

Users can define a dead band value for the analog input signals with parameter 12.110 Al dead band. The value is valid for analog inputs Al1 and Al2, 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:

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

• Al 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.



# **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.                                                                                                                                                              |
|                   | <b>Note:</b> Certain configurations or optional equipment may require specific default values.                                                                                                                             |
| FbEq<br>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.                                                                                                                             |

## 138 Parameters

| 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<br>number in<br>square<br>brackets] | The value of the parameter.                                                                            |

## Parameter group summary

| Group                           | Contents                                                                                                                           | Page |
|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------|------|
| 01 Actual values                | Basic signals for monitoring the drive.                                                                                            | 141  |
| 03 Input references             | Values of references received from various sources.                                                                                | 146  |
| 04 Warnings and faults          | Information on warnings and faults that occurred last.                                                                             | 147  |
| 05 Diagnostics                  | Various run-time-type counters and measurements related to drive maintenance.                                                      | 150  |
| 06 Control and status words     | Drive control and status words.                                                                                                    | 153  |
| 07 System info                  | Drive hardware and firmware information.                                                                                           | 159  |
| 10 Standard DI, RO              | Configuration of digital inputs and relay outputs.                                                                                 | 160  |
| 11 Standard DIO, FI, FO         | Configuration of the frequency input.                                                                                              | 168  |
| 12 Standard Al                  | Configuration of standard analog inputs.                                                                                           | 173  |
| 13 Standard AO                  | Configuration of standard analog outputs.                                                                                          | 179  |
| 19 Operation mode               | Selection of local and external control location sources and operating modes.                                                      | 184  |
| 20 Start/stop/direction         | Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection. | 186  |
| 21 Start/stop mode              | Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings.                                  | 198  |
| 22 Speed reference selection    | Speed reference selection; Floating point control (Motor potentiometer) settings.                                                  | 210  |
| 23 Speed reference ramp         | Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive).                              | 223  |
| 24 Speed reference conditioning | Speed error calculation; speed error window control configuration; speed error step.                                               | 228  |
| 25 Speed control                | Speed controller settings.                                                                                                         | 230  |
| 28 Frequency reference chain    | Settings for the frequency reference chain.                                                                                        | 236  |
| 30 Limits                       | Drive operation limits.                                                                                                            | 249  |
| 31 Fault functions              | Configuration of external events; selection of behavior of the drive upon fault situations.                                        | 260  |
| 32 Supervision                  | Configuration of signal supervision functions 13.                                                                                  | 272  |
| 34 Timed functions              | Configuration of the timed functions.                                                                                              | 285  |
|                                 |                                                                                                                                    |      |

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| Group                             | Contents                                                                                                                                                                             | Page |
|-----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 35 Motor thermal protection       | Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration; motor overload protection.               | 296  |
| 36 Load analyzer                  | Peak value and amplitude logger settings.                                                                                                                                            | 304  |
| 37 User load curve                | Settings for user load curve.                                                                                                                                                        | 308  |
| 40 Process PID set 1              | Parameter values for process PID control.                                                                                                                                            | 312  |
| 41 Process PID set 2              | A second set of parameter values for process PID control.                                                                                                                            | 331  |
| 43 Brake chopper                  | Settings for the internal brake chopper.                                                                                                                                             | 335  |
| 45 Energy efficiency              | Settings for the energy saving calculators as well as peak and energy loggers.                                                                                                       | 338  |
| 46 Monitoring/scaling<br>settings | Speed supervision settings; actual signal filtering; general scaling settings.                                                                                                       | 343  |
| 47 Data storage                   | Data storage parameters that can be written to and read from using other parameters source and target settings.                                                                      | 347  |
| 49 Panel port communication       | Communication settings for the control panel port on the drive.                                                                                                                      | 348  |
| 58 Embedded fieldbus              | Configuration of the embedded fieldbus (EFB) interface.                                                                                                                              | 350  |
| 70 Override                       | Enabling/disabling of override function, override activation signal and override speed/frequency and pass code.                                                                      | 361  |
| 95 HW configuration               | Various hardware-related settings.                                                                                                                                                   | 368  |
| 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. | 371  |
| 97 Motor control                  | Switching frequency; slip gain; voltage reserve; flux braking; anti-cogging (signal injection); IR compensation.                                                                     | 382  |
| 98 User motor parameters          | Motor values supplied by the user that are used in the motor model.                                                                                                                  | 387  |
| 99 Motor data                     | Motor configuration settings.                                                                                                                                                        | 390  |

# **Parameter listing**

| No.   | Name / Range /<br>Selection  | Description                                                                                                                                                                                                                                                                                                                                                                                           | Def / Type<br>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<br>30000.00 rpm    | Estimated motor speed. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                                                                                                                                                | 1 = 1 rpm / 100 = 1<br>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<br>30000.00 rpm    | Estimated motor speed.                                                                                                                                                                                                                                                                                                                                                                                | 1 = 1 rpm / 100 = 1<br>rpm   |
| 01.03 | Motor speed %                | Motor speed in percent of the synchronous motor speed.                                                                                                                                                                                                                                                                                                                                                | 0.00 percent / real32        |
|       | -1000.00 1000.00<br>%        | 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<br>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.<br>See also parameter 01.30 Nominal torque scale.                                                                                                                                                                                                                                                                                                | 0.0 percent / real32         |
|       |                              | A filter time constant for this signal can be defined by parameter 46.13 Filter time motor torque.                                                                                                                                                                                                                                                                                                    |                              |
|       | -1600.0 1600.0 %             | Motor torque.                                                                                                                                                                                                                                                                                                                                                                                         | 10 = 1 % / 10 = 1 %          |

| No.   | Name / Range /<br>Selection        | Description                                                                                                                                                                                                       | Def / Type<br>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                               |
|       | 02000 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 /<br>real32                  |
|       | -32768.00<br>32767.00 kW or hp     | Output power.                                                                                                                                                                                                     | 1 = 1 kW or hp / 100<br>= 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 /<br>real32                  |
|       | -32768.00<br>32767.00 kW or hp     | Motor shaft power.                                                                                                                                                                                                | 1 = 1 kW or hp / 100<br>= 1 kW or hp       |
| 01.18 | Inverter GWh<br>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                             |
|       | 065535 GWh                         | Energy in GWh.                                                                                                                                                                                                    | 1=1GWh/1=1GWh                              |
| 01.19 | Inverter MWh<br>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                             |
|       | 01000 MWh                          | Energy in MWh.                                                                                                                                                                                                    | 1 = 1 MWh / 1 = 1<br>MWh                   |
| 01.20 | Inverter kWh<br>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                             |
|       | 01000 kWh                          | Energy in kWh.                                                                                                                                                                                                    | 10 = 1 kWh / 1 = 1<br>kWh                  |
| 01.24 | Flux actual %                      | Used flux reference in percent of nominal flux of motor.                                                                                                                                                          | 0 percent / real32                         |
|       | 0200 %                             | 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.                                                                                                  | 0.000 Nm or lbft /<br>uint32               |
|       |                                    | <b>Note</b> : This value is copied from parameter 99.12 Motor nominal torque, if entered. Otherwise the value is calculated from other motor data.                                                                |                                            |
|       | 0.000<br>4000000.000 Nm<br>or lbft | Nominal torque.                                                                                                                                                                                                   | 1 = 100 Nm or lbft /<br>100 = 1 Nm or lbft |

| No.   | Name / Range /<br>Selection          | Description                                                                                                                                                            | Def / Type<br>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. | 0.00 kWh / real32            |
|       |                                      | If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.                                |                              |
|       | 0.00 1000000.00<br>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.                      | 0.00 kWh / real32            |
|       |                                      | If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.                                |                              |
|       | 0.00 1000000.00<br>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.     | 0.00 kWh / real32            |
|       |                                      | If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.                                |                              |
|       | 0.00 1000000.00<br>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.                           | 0.00 kWh / real32            |
|       |                                      | If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.                                |                              |
|       | 0.00 1000000.00<br>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<br>200000000.0 kWh      | Energy in kWh.                                                                                                                                                         | 10 = 1 kWh / 1 = 1<br>kWh    |
| 01.55 | Inverter GWh<br>counter (resettable) | Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero.                                            | 0 GWh / uint16               |
|       |                                      | You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters 01.5501.58 resets all of them.               |                              |
|       | 065535 GWh                           | Energy in GWh.                                                                                                                                                         | 1=1GWh/1=1GWh                |

## 144 Parameters

| No.   | Name / Range /<br>Selection             | Description                                                                                                                                                                                                                    | Def / Type<br>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. | 0 MWh / uint16               |
|       |                                         | You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters 01.5501.58 resets all of them.                                                                       |                              |
|       | 01000 MWh                               | Energy in MWh.                                                                                                                                                                                                                 | 1 = 1 MWh / 1 = 1<br>MWh     |
| 01.57 | Inverter kWh<br>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. | 0 kWh / real32               |
|       |                                         | You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters 01.5501.58 resets all of them.                                                                       |                              |
|       | 01000 kWh                               | Energy in kWh.                                                                                                                                                                                                                 | 10 = 1 kWh / 1 = 1<br>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                                               | 0.0 kWh / real32             |
|       |                                         | pressing the Reset softkey for 3 seconds. Resetting any of parameters 01.5501.58 resets all of them.                                                                                                                           |                              |
|       | -200000000.0<br>200000000.0 kWh         | Energy in kWh.                                                                                                                                                                                                                 | 10 = 1 kWh / 1 = 1<br>kWh    |
| 01.61 | Abs motor speed used                    | Absolute value of parameter 01.01 Motor speed used.                                                                                                                                                                            | 0.00 rpm / real32            |
|       | 0.00 30000.00<br>rpm                    | Estimated motor speed.                                                                                                                                                                                                         | 1 = 1 rpm / 100 = 1<br>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<br>% 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 /<br>Selection | Description                                          | Def / Type<br>FbEq 16b / 32b         |
|-------|-----------------------------|------------------------------------------------------|--------------------------------------|
| 01.68 | Abs motor shaft power       | Absolute value of parameter 01.17 Motor shaft power. | 0.00 kW or hp /<br>real32            |
|       | 0.00 32767.00 kW<br>or hp   | Motor shaft power.                                   | 1 = 1 kW or hp / 100<br>= 1 kW or hp |

| No.   | Name / Range /<br>Selection    | Description                                                                                                  | Def / Type<br>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<br>100000.00        | Control panel or PC tool reference.                                                                          | 1 = 10 / 100 = 1             |
| 03.02 | Panel reference re-<br>mote    | Reference 2 given from the control panel or PC tool.                                                         | 0.00 NoUnit / real32         |
|       | -100000.00<br>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<br>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<br>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<br>100000.00        | Integrated control panel reference.                                                                          | 1 = 10 / 100 = 1             |
| 03.18 | Integrated Panel ref<br>remote | Remote mode reference given from the integrated control panel.                                               | 0.00 NoUnit / real32         |
|       | -100000.00<br>100000.00        | Integrated control panel reference.                                                                          | 1 = 10 / 100 = 1             |

| No.   | Name / Range /<br>Selection | Description                                                                                                                               | Def / Type<br>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               |
|       | 0000hFFFFh                  | 1st active fault.                                                                                                                         | 1 = 1                        |
| 04.02 | Active fault 2              | Code of the 2nd active fault.                                                                                                             | 0000h / uint16               |
|       | 0000hFFFFh                  | 2nd active fault.                                                                                                                         | 1 = 1                        |
| 04.03 | Active fault 3              | Code of the 3rd active fault.                                                                                                             | 0000h / uint16               |
|       | 0000hFFFFh                  | 3rd active fault.                                                                                                                         | 1 = 1                        |
| 04.06 | Active warning 1            | Code of the 1st active warning.                                                                                                           | 0000h / uint16               |
|       | 0000hFFFFh                  | 1st active warning.                                                                                                                       | 1 = 1                        |
| 04.07 | Active warning 2            | Code of the 2nd active warning.                                                                                                           | 0000h / uint16               |
|       | 0000hFFFFh                  | 2nd active warning.                                                                                                                       | 1 = 1                        |
| 04.08 | Active warning 3            | Code of the 3rd active warning.                                                                                                           | 0000h / uint16               |
|       | 0000hFFFFh                  | 3rd active warning.                                                                                                                       | 1 = 1                        |
| 04.11 | Latest fault                | Code of the 1st stored (non-active) fault.                                                                                                | 0000h / uint16               |
|       | 0000hFFFFh                  | 1st stored fault.                                                                                                                         | 1 = 1                        |
| 04.12 | 2nd latest fault            | Code of the 2nd stored (non-active) fault.                                                                                                | 0000h / uint16               |
|       | 0000hFFFFh                  | 2nd stored fault.                                                                                                                         | 1 = 1                        |
| 04.13 | 3rd latest fault            | Code of the 3rd stored (non-active) fault.                                                                                                | 0000h / uint16               |
|       | 0000hFFFFh                  | 3rd stored fault.                                                                                                                         | 1 = 1                        |
| 04.16 | Latest warning              | Code of the 1st stored (non-active) warning.                                                                                              | 0000h / uint16               |
|       | 0000hFFFFh                  | 1st stored warning.                                                                                                                       | 1 = 1                        |
| 04.17 | 2nd latest warning          | Code of the 2nd stored (non-active) warning.                                                                                              | 0000h / uint16               |
|       | 0000hFFFFh                  | 2nd stored warning.                                                                                                                       | 1 = 1                        |
| 04.18 | 3rd latest warning          | Code of the 3rd stored (non-active) warning.                                                                                              | 0000h / uint16               |
|       | 0000hFFFFh                  | 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 04.4104.71. | 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 /<br>Selection | Description                                                                                                                             | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| b15   | User bit 15                 | 1 = Event selected by parameter 04.71 is active                                                                                         |                              |
|       | 0000hFFFFh                  |                                                                                                                                         | 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. | 0000h / uint16               |
|       |                             | The event codes are listed in chapter Fault tracing (page 405).                                                                         |                              |
|       |                             | This parameter is adjustable.                                                                                                           |                              |
|       | 0000hFFFFh                  | 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. | 0000h / uint16               |
|       |                             | The event codes are listed in chapter Fault tracing (page 405).                                                                         |                              |
|       |                             | This parameter is adjustable.                                                                                                           |                              |
|       | 0000hFFFFh                  | Default fault 3210 DC link overvoltage.                                                                                                 | 1 = 1                        |
| 04.45 | Event word 1 bit 2 code     | Default fault 4310 Excess temperature.                                                                                                  | 0000h / uint16               |
|       |                             | This parameter is adjustable.                                                                                                           |                              |
|       | 0000hFFFFh                  |                                                                                                                                         | 1 = 1                        |
| 04.47 | Event word 1 bit 3 code     | Default fault 2340 Short circuit.                                                                                                       | 0000h / uint16               |
|       |                             | This parameter is adjustable.                                                                                                           |                              |
|       | 0000hFFFFh                  |                                                                                                                                         | 1 = 1                        |
| 04.49 | Event word 1 bit 4 code     | No default fault.                                                                                                                       | 0000h / uint16               |
|       |                             | This parameter is adjustable.                                                                                                           |                              |
|       | 0000hFFFFh                  |                                                                                                                                         | 1 = 1                        |
| 04.51 | Event word 1 bit 5          | Default fault 3220 DC link undervoltage.                                                                                                | 0000h / uint16               |
|       | code                        | This parameter is adjustable.                                                                                                           |                              |
|       | 0000hFFFFh                  |                                                                                                                                         | 1 = 1                        |
| 04.53 | Event word 1 bit 6          | Default fault 80A0 AI supervision fault.                                                                                                | 0000h / uint16               |
|       | code                        | This parameter is adjustable.                                                                                                           |                              |
|       | 0000hFFFFh                  |                                                                                                                                         | 1 = 1                        |
| 04.55 | Event word 1 bit 7          | No default fault.                                                                                                                       | 0000h / uint16               |
|       | code                        | This parameter is adjustable.                                                                                                           |                              |
|       | 0000hFFFFh                  |                                                                                                                                         | 1 = 1                        |
| 04.57 | Event word 1 bit 8          | Default fault 7122 Motor overload.                                                                                                      | 0000h / uint16               |
|       | code                        | This parameter is adjustable.                                                                                                           |                              |
|       | 0000hFFFFh                  |                                                                                                                                         | 1 = 1                        |

| No.   | Name / Range /<br>Selection | Description                                                                                                                              | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 04.59 | Event word 1 bit 9          | Default fault 7081 Control panel loss.                                                                                                   | 0000h / uint16               |
|       | code                        | This parameter is adjustable.                                                                                                            |                              |
|       | 0000hFFFFh                  |                                                                                                                                          | 1 = 1                        |
| 04.61 | Event word 1 bit 10         | Default fault FF61 ID run.                                                                                                               | 0000h / uint16               |
|       | code                        | This parameter is adjustable.                                                                                                            |                              |
|       | 0000hFFFFh                  |                                                                                                                                          | 1 = 1                        |
| 04.63 | Event word 1 bit 11         | Default fault 7121 Motor stall.                                                                                                          | 0000h / uint16               |
|       | code                        | This parameter is adjustable.                                                                                                            |                              |
|       | 0000hFFFFh                  |                                                                                                                                          | 1 = 1                        |
| 04.65 | Event word 1 bit 12 code    | Default fault 4110 Control board temperature.                                                                                            | 0000h / uint16               |
|       |                             | This parameter is adjustable.                                                                                                            |                              |
|       | 0000hFFFFh                  |                                                                                                                                          | 1 = 1                        |
| 04.67 | Event word 1 bit 13 code    | Default fault 9081 External event 1.                                                                                                     | 0000h / uint16               |
|       |                             | This parameter is adjustable.                                                                                                            |                              |
|       | 0000hFFFFh                  |                                                                                                                                          | 1 = 1                        |
| 04.69 | Event word 1 bit 14 code    | Default fault 9082 External event 2.                                                                                                     | 0000h / uint16               |
|       |                             | This parameter is adjustable.                                                                                                            |                              |
|       | 0000hFFFFh                  |                                                                                                                                          | 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. | 0000h / uint16               |
|       |                             | Default fault 2330 Earth leakage.                                                                                                        |                              |
|       |                             | The events are listed in chapter Fault tracing (page 405).                                                                               |                              |
|       |                             | This parameter is adjustable.                                                                                                            |                              |
|       | 0000hFFFFh                  | Code of event.                                                                                                                           | 1 = 1                        |

| No.   | Name / Range /<br>Selection    | Description                                                                                                             | Def / Type<br>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                     |
|       | 065535 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                     |
|       | 065535 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<br>h           | Hours.                                                                                                                  | - / 10 = 1 h                        |
| 05.04 | Fan on-time<br>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                     |
|       | 065535 days                    | Cooling fan run-time counter.                                                                                           | 1 = 1 days / 1 = 1 days             |
| 05.10 | Control board tem-<br>perature | Measured temperature of the control board.                                                                              | 0 °C or °F / real32                 |
|       | -100300 °C or °F               | Control board temperature in degrees Celsius or Fahrenheit.                                                             | 1 = 1 °C or °F / 10 = 1<br>°C or °F |
| 05.11 | Inverter temperat-<br>ure      | Estimated drive temperature in percent of fault limit. The fault limit varies according to the type of the drive.       | 0.0 percent / real32                |
|       |                                | 0.0% = 0 °C (32 °F)                                                                                                     |                                     |
|       |                                | 100.0% = Fault limit                                                                                                    |                                     |
|       | -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<br>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 /<br>Selection | Description                                                                                                                                      | Def / Type<br>FbEq 16b / 32b    |
|-------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| b8    | Reserved                    |                                                                                                                                                  |                                 |
| b9    | Device overtemp flt         | 1 = Drive has tripped on fault 4310 Excess temperature.                                                                                          |                                 |
| b1015 | Reserved                    |                                                                                                                                                  |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                  | 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<br>0000 / uint16 |
| b09   | Reserved                    |                                                                                                                                                  |                                 |
| b10   | Motor overtemp flt          | 1 = Drive has tripped on fault 4981 External temperature 1.                                                                                      |                                 |
| b1115 | Reserved                    |                                                                                                                                                  |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                  | 1=1/1=1                         |
| 05.22 | Diagnostic word 3           | Diagnostic word 3.                                                                                                                               | 0000 0000 0000<br>0000 / uint16 |
| b08   | Reserved                    |                                                                                                                                                  |                                 |
| b9    | kWh pulse                   | 1 = kWh pulse is active.                                                                                                                         |                                 |
| b10   | Reserved                    |                                                                                                                                                  |                                 |
| b11   | Fan command                 | 1 = Drive fan is rotating above idle speed.                                                                                                      |                                 |
| b1215 | Reserved                    |                                                                                                                                                  |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                  | 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 05.8005.89 are shown for each fault in the fault log. | 0.00 rpm / real32               |
|       | -30000.00<br>30000.00 rpm   | Estimated motor speed.                                                                                                                           | 1 = 1 rpm / 100 = 1<br>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<br>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              |
|       | -16001600 %                 | 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                  |
|       | 0000hFFFFh                  |                                                                                                                                                  | 1=1/1=1                         |

| No.   | Name / Range /<br>Selection        | Description                                                                                                                                                                               | Def / Type<br>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                      |
|       | 0000hFFFFh                         |                                                                                                                                                                                           | 1=1/1=1                             |
| 05.87 | Inverter temperat-<br>ure 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                 |
|       | -40160 °C or °F                    | Drive temperature in Celsius or Farenheit.                                                                                                                                                | 1 = 1 °C or °F / 10 = 1<br>°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<br>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                      |
|       | 0000hFFFFh                         |                                                                                                                                                                                           | 1 = 1 / 1 = 1                       |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                | Def / Type<br>FbEq 16b / 32b    |
|-------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 06    | Control and status          | Drive control and status words.                                                                                                                                            |                                 |
|       | 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).                             | 0000h / uint16                  |
|       |                             | 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.  |                                 |
|       |                             | <b>Note:</b> When using fieldbus control, this parameter value is not same as the Control word value that the drive receives from PLC.                                     |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                                            | 1/1                             |
| 06.11 | Main status word            | Main status word of the drive.                                                                                                                                             | 0000h / uint16                  |
|       |                             | 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. |                                 |
|       |                             | <b>Note:</b> When using fieldbus control, this parameter value is not same as the Status word value that the drive sends to PLC.                                           |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                                            | 1/1                             |
| 06.16 | Drive status word 1         | Drive status word 1.                                                                                                                                                       | 0000 0000 0000<br>0000 / uint16 |
| b0    | Enabled                     | 1 = If start interlock signals (parameters 20.4120.44) 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 /<br>Selection | Description                                                                                                                                                                  | Def / Type<br>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                    |                                                                                                                                                                              |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                                              | 1/1                             |
| 06.17 | Drive status word 2         | Drive status word 2.                                                                                                                                                         | 0000 0000 0000<br>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<br>failed    | 1 = Emergency stop failed (see parameters 31.32<br>Emergency ramp supervision and 31.33 Emergency<br>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<br>the drive is stopping after receiving an emergency<br>stop command.                                                    |                                 |
| b12   | Reserved                    |                                                                                                                                                                              |                                 |
| b13   | Start delay active          | 1 = Start delay (parameter 21.22 Start delay) active.                                                                                                                        |                                 |
| b1415 | Reserved                    |                                                                                                                                                                              |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                                              | 1/1                             |

| No.   | Name / Range /<br>Selection  | Description                                                                                                                                                                   | Def / Type<br>FbEq 16b / 32b    |
|-------|------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 06.18 | Start inhibit status<br>word | Start inhibit status word. This word specifies the source of the inhibiting signal that is preventing the drive from starting.                                                | 0000 0000 0000<br>0000 / uint16 |
|       |                              | 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.                                                                                                                          |                                 |
| 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                     |                                                                                                                                                                               |                                 |
|       | 0000hFFFFh                   |                                                                                                                                                                               | 1/1                             |
| 06.19 | Speed control status word    | Speed control status word.                                                                                                                                                    | 0000 0000 0000<br>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.                                                                                             |                                 |
| b36   | 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 /<br>Selection | Description                                                                                                                                                                                                         | Def / Type<br>FbEq 16b / 32b    |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| b815  | Reserved                    |                                                                                                                                                                                                                     |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                     | 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<br>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.                                                                                                                                                                         |                                 |
| b715  | Reserved                    |                                                                                                                                                                                                                     |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                     | 1/1                             |
| 06.21 | Drive status word 3         | Drive status word 3.                                                                                                                                                                                                | 0000 0000 0000<br>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<br>known     | 1 = Rotor position is known.                                                                                                                                                                                        |                                 |
| b5    | DC brake active             | 1 = Brake is active.                                                                                                                                                                                                |                                 |
| b615  | Reserved                    |                                                                                                                                                                                                                     |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                     | 1/1                             |
| 06.22 | HVAC status word            | ACH180 specific status word.                                                                                                                                                                                        | 0000 0000 0000<br>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 /<br>Selection | Description                                                                                                                                          | Def / Type<br>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.                                                                                                                        |                              |
| b56   | 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,<br>Start interlock 3 or Start interlock 4 is not present,<br>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.                  |                              |
| b1315 | Reserved                    |                                                                                                                                                      |                              |
|       | 0000hFFFFh                  |                                                                                                                                                      | 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 /<br>Selection | Description                                                                                                                                   | Def / Type<br>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 /<br>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 /<br>Selection | Description                                                                                                                                                                                               | Def / Type<br>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           |
|       | 0100 %                      | Microprocessor load.                                                                                                                                                                                      | 1 = 1 % / 1 = 1 %            |
| 07.30 | Adaptive program status     | Shows the status of the adaptive program.                                                                                                                                                                 | 0000h / uint16               |
|       |                             | See section Adaptive programming (page 48).                                                                                                                                                               |                              |
| 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.                                                                                                                                                                             |                              |
| b413  | Reserved                    |                                                                                                                                                                                                           |                              |
| b14   | State changing              | 1 = State change in progress in adaptive programming engine.                                                                                                                                              |                              |
| b15   | Faulted                     | 1 = Error in adaptive program.                                                                                                                                                                            |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                           | 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            |
|       | 020                         |                                                                                                                                                                                                           | 1 = 1 / 1 = 1                |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                          | Def / Type<br>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.                                                                                                                                                                                                                                                                                                    | 0000h / uint16               |
|       |                             | This parameter is read-only.                                                                                                                                                                                                                                                                                                                         |                              |
| 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.                                                                                                                                                                                                                                                                                                                           |                              |
| b515  | Reserved                    |                                                                                                                                                                                                                                                                                                                                                      |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                                      | 1 = 1 / 1 = 1                |
| 10.02 | DI delayed status           | Displays the delayed status of digital inputs.                                                                                                                                                                                                                                                                                                       | 0000h / uint16               |
|       |                             | This word is updated only after activation / deactivation delays.                                                                                                                                                                                                                                                                                    |                              |
|       |                             | This parameter is read-only.                                                                                                                                                                                                                                                                                                                         |                              |
| 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.                                                                                                                                                                                                                                                                                                                           |                              |
| b514  | Reserved                    |                                                                                                                                                                                                                                                                                                                                                      |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                                      | 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).                                                                                                                                                                                                                                                                |                              |
| b515  | Reserved                    |                                                                                                                                                                                                                                                                                                                                                      |                              |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                               | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                           | 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.                                                                                                                                                                   |                              |
| b514  | Reserved                    |                                                                                                                                                                                                                                                           |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                           | 1=1/1=1                      |
| 10.05 | DI1 ON delay                | Defines the activation delay for digital input DI1.                                                                                                                                                                                                       | 0.00 s / uint32              |
|       |                             | *DI status  *Delayed                                                                                                                                                                                                                                      |                              |
|       |                             | *Electrical status of digital input. Indicated by parameter 10.01 DI status.                                                                                                                                                                              |                              |
|       | 0.00 3000.00 s              | **Indicated by parameter 10.02 DI delayed status.  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 /<br>Selection | Description                                                                                           | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------|------------------------------|
| 10.07 | DI2 ON delay                | Defines the activation delay for digital input DI2.                                                   | 0.00 s / uint32              |
|       |                             | *DI status  1 O Time                                                                                  |                              |
|       |                             | t <sub>On</sub> = parameter 10.07 DI2 ON delay                                                        |                              |
|       |                             | t <sub>Off</sub> = 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 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.<br>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.                                                   | 0.00 s / uint32              |
|       |                             | *DI status 1  *DI status 0  **Delayed 1  DI status 0  ton toff to |                              |
|       |                             | t <sub>On</sub> = parameter 10.09 DI3 ON delay                                                        |                              |
|       |                             | t <sub>Off</sub> = 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 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.<br>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 /<br>Selection | Description                                                                                                                   | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 10.11 | DI4 ON delay                | Defines the activation delay for digital input DI4.                                                                           | 0.00 s / uint32              |
|       |                             | *DI status  1  *DI status  DI status  DI status  Time                                                                         |                              |
|       |                             | t <sub>On</sub> = parameter 10.11 DI4 ON delay                                                                                |                              |
|       |                             | t <sub>Off</sub> = 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 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.<br>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                | befines the activation delay for digital input DI5.  *DI status  *Delayed                                                     | 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.<br>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.<br>1 = Energized.                                                                                           |                              |
| b115  | Reserved                    |                                                                                                                               |                              |
|       | 0000hFFFFh                  |                                                                                                                               | 1=1/1=1                      |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                  | Def / Type<br>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)                                                                                                                                                                                                                                                         |                              |
| b115  | Reserved                    |                                                                                                                                                                                                                                                                                                                                              |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                              | 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                                                                                                             | 0000h / uint16               |
|       |                             | (parameters 10.22 and 10.23).                                                                                                                                                                                                                                                                                                                |                              |
| b0    | RO1                         | 1 = Force the value of this bit to RO1, if so defined in parameter 10.22 RO force selection.                                                                                                                                                                                                                                                 |                              |
| b115  | Reserved                    |                                                                                                                                                                                                                                                                                                                                              |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                              | 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 /<br>Selection | Description                                                                                                                                                                                              | Def / Type<br>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<br>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 $04.4104.71$ is on.                               | 53                           |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                     | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Damper control              | See the figure below.  Drive started  Start/stop                                                                                                | 54                           |
|       |                             | command Group 20 Start/stop/directic                                                                                                            |                              |
|       |                             | signal   (parameters   20.4120.44)   Relay energized                                                                                            |                              |
|       |                             | Relay de-energized Damper control relay status (Group 10 Damper open Standard DI, RO)                                                           |                              |
|       |                             | Damper closed Damper status                                                                                                                     |                              |
|       |                             | Damper opening time closing time closing time closing time signal from the damper end switch when the damper is fully opened. (parameter 20.41) |                              |
|       |                             | Acceleration time Drive coasts to a stop (parameter 23.12)                                                                                      |                              |
|       | 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<br>word      | 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.       | 62                           |
|       | Other [bit]                 | See Terms and abbreviations (page 137).                                                                                                         | -                            |
| 10.25 | RO1 ON delay                | Defines the activation delay for relay output RO1.  Status of selected 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0                                    | 0.0 s / uint32               |
|       |                             | t <sub>On</sub> = 10.25 RO1 ON delay                                                                                                            |                              |
|       |                             | t <sub>Off</sub> = 10.26 RO1 OFF delay                                                                                                          |                              |

| No.    | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                         | Def / Type<br>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.<br>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<br>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 58.10158.114) 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.                                                                                                                                                                                                                                                                                                                                                                                    |                              |
| b17    | Reserved                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                              |
| b8     | DIO1                        | Source bit for digital output DO1. See parameter 11.6 DO1 output source.                                                                                                                                                                                                                                                                                                                                                                            |                              |
| b915   | Reserved                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                              |
|        | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 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            |
|        | 04294967000                 | State change count.                                                                                                                                                                                                                                                                                                                                                                                                                                 | -/1=1                        |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                       | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 11    | Standard DIO, FI,<br>FO     | Configuration of the frequency input.                                                                                                                                                                                                                                                                                                             |                              |
| 11.02 | DIO delayed status          | Displays the delayed status of digital output DO1.                                                                                                                                                                                                                                                                                                | 0000h / uint16               |
|       |                             | This word is updated only after activation/deactivation delays (if any are specified).                                                                                                                                                                                                                                                            |                              |
|       |                             | <b>Example:</b> 0001 = DO1 is on.                                                                                                                                                                                                                                                                                                                 |                              |
|       |                             | This parameter is read-only.                                                                                                                                                                                                                                                                                                                      |                              |
| b0    | DO1                         | 1 = Digital or frequency output DO1 is ON.                                                                                                                                                                                                                                                                                                        |                              |
| b115  | Reserved                    |                                                                                                                                                                                                                                                                                                                                                   |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                                   | 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)                                                                                                                                                                                                                                                              |                              |
| b115  | Reserved                    |                                                                                                                                                                                                                                                                                                                                                   |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                                   | 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.                                                                                                                                                                                                                                                                                                                                 |                              |
| b115  | Reserved                    |                                                                                                                                                                                                                                                                                                                                                   |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                                   | 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 /<br>Selection | Description                                                                                                                                                                                              | Def / Type<br>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<br>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 $04.4104.71$ is on.                               | 53                           |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                 | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Damper control              | See the figure below.                                                                                                                                                                                                                                                                                                                       | 54                           |
|       |                             | Drive started  Start/stop command (Group 20 Start/stop/directic  Start interlock signal (parameters 20.4120.44)  Damper control relay status (Group 10 Standard DI, RO)  Damper closed  Damper status Closing time closing time closing time closing time closing time fully opened. (parameter 20.41)  Acceleration time (parameter 23.12) |                              |
|       | 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<br>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 /<br>Selection | Description                                                                                                                                                                                                               | Def / Type<br>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.<br>See parameter 11.42 Freq in 1 min.                                                                                                                             | 0 Hz / real32                |
|       |                             | This parameter is read-only.                                                                                                                                                                                              |                              |
|       | 016000 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 /<br>real32     |
|       | -32768.000<br>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 11.4211.45 as follows:  11.45  11.45  11.45  11.46  11.47 | 0 Hz / real32                |
|       | 016000 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            |
|       | 016000 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<br>32767.000     | Value corresponding to minimum of frequency input 1.                                                                                                                                                                      | 1 = 1 / 1000 = 1             |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                        | Def / Type<br>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<br>(95.20 b0) NoUnit /<br>real32 |
|       | -32768.000<br>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.                                                                                                        | 0 Hz / real32                                       |
|       |                             | This parameter is read-only.                                                                                                                                                       |                                                     |
|       | 016000 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.                                                                                                        | 0.000 NoUnit /<br>real32                            |
|       |                             | This parameter is read-only.                                                                                                                                                       |                                                     |
|       | -32768.000<br>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                                       |
|       | 016000 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                                   |
|       | 016000 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 /<br>real32                            |
|       | -32768.000<br>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 /<br>real32                        |
|       | -32768.000<br>32767.000     | Value corresponding to maximum of frequency input 2.                                                                                                                               | 1 = 1 / 1000 = 1                                    |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                         | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 12    | Standard Al                 | Configuration of standard analog inputs.                                                                                                                                                                                                                            |                              |
| 12.02 | Al 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.                            | 0000h / uint16               |
|       |                             | Note: Al filter times (parameters 12.16 Al1 filter time and 12.26 Al2 filter time) have no effect on forced Al values (parameters 12.13 Al1 forced value and 12.23 Al2 forced value). Boot and power cycle reset the force selections (parameters 12.02 and 12.03). |                              |
| b0    | Al1                         | 1 = Force Al1 to value of parameter 12.13 Al1 forced value.                                                                                                                                                                                                         |                              |
| b1    | AI2                         | 1 = Force Al2 to value of parameter 12.23 Al2 forced value.                                                                                                                                                                                                         |                              |
| b215  | Reserved                    |                                                                                                                                                                                                                                                                     |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                     | 1=1/1=1                      |
| 12.03 | Al 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.                                                                                                                                    | No action / uint16           |
|       |                             | The supervision applies a margin of $0.5\mathrm{V}$ or $1.0\mathrm{mA}$ to the limits. For example, if the maximum limit for the input is $7.000\mathrm{V}$ , the maximum limit supervision activates at $7.500\mathrm{V}$ .                                        |                              |
|       |                             | The inputs and the limits to be observed are selected by parameter 12.04 Al supervision selection.                                                                                                                                                                  |                              |
|       | 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 low-pass filtering.                                 | 3                            |
|       |                             | WARNING! Make sure that it is safe to continue operation in case of a communication break.                                                                                                                                                                          |                              |

| No.   | Name / Range /<br>Selection      | Description                                                                                                                                                                                                                                                                                                  | Def / Type<br>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 | Al supervision selection         | Specifies the analog input limits to be supervised. See parameter 12.03 Al supervision function.                                                                                                                                                                                                             | 0000h / uint16                         |
| b0    | AI1 < MIN                        | 1 = Minimum limit supervision of Al1 active.                                                                                                                                                                                                                                                                 |                                        |
| b1    | AI1 > MAX                        | 1 = Maximum limit supervision of Al1 active.                                                                                                                                                                                                                                                                 |                                        |
| b2    | AI2 < MIN                        | 1 = Minimum limit supervision of AI2 active.                                                                                                                                                                                                                                                                 |                                        |
| b3    | AI2 > MAX                        | 1 = Maximum limit supervision of AI2 active.                                                                                                                                                                                                                                                                 |                                        |
| b415  | Reserved                         |                                                                                                                                                                                                                                                                                                              |                                        |
|       | 0000hFFFFh                       |                                                                                                                                                                                                                                                                                                              | 1 = 1 / 1 = 1                          |
| 12.05 | Al supervision force             | each control location (see section Local control vs. external control (page 39).                                                                                                                                                                                                                             | 0000h / uint16                         |
|       |                                  | 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.                                                                                              |                                        |
| b0    | All Ext1                         | 1 = Al1 supervision is active when EXT1 is used.                                                                                                                                                                                                                                                             |                                        |
| b1    | Al1 Ext2                         | 1 = Al1 supervision is active when EXT2 is used.                                                                                                                                                                                                                                                             |                                        |
| b2    | Al1 Local                        | 1 = Al1 supervision is active when local control is used.                                                                                                                                                                                                                                                    |                                        |
| b3    | Reserved                         |                                                                                                                                                                                                                                                                                                              |                                        |
| b4    | AI2 Ext1                         | 1 = Al2 supervision is active when EXT1 is used.                                                                                                                                                                                                                                                             |                                        |
| b5    | AI2 Ext2                         | 1 = Al2 supervision is active when EXT2 is used.                                                                                                                                                                                                                                                             |                                        |
| b6    | AI2 Local                        | 1 = AI2 supervision is active when local control is used.                                                                                                                                                                                                                                                    |                                        |
| b715  | Reserved                         |                                                                                                                                                                                                                                                                                                              |                                        |
|       | 0000hFFFFh                       |                                                                                                                                                                                                                                                                                                              | 1 = 1 / 1 = 1                          |
| 12.11 | Al1 actual value                 | Displays the value of analog input Al1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting).                                                                                                                                                                       | 0.000 V or mA /<br>real32              |
|       |                                  | This parameter is read-only.                                                                                                                                                                                                                                                                                 |                                        |
|       | 0.000 11.000<br>(22.000) V or mA | Value of analog input Al1.                                                                                                                                                                                                                                                                                   | 1000 = 1 V or mA /<br>1000 = 1 V or mA |
| 12.12 | Al1 scaled value                 | Displays the value of analog input Al1 after scaling.<br>See parameters 12.19 Al1 scaled at Al1 min and 12.20<br>Al1 scaled at Al1 max.                                                                                                                                                                      | 0.000 NoUnit /<br>real32               |
|       |                                  | This parameter is read-only.                                                                                                                                                                                                                                                                                 |                                        |

| No.   | Name / Range /<br>Selection      | Description                                                                                                                                                   | Def / Type<br>FbEq 16b / 32b           |
|-------|----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|
|       | -32768.000<br>32767.000          | Scaled value of analog input AI1.                                                                                                                             | 1 = 1 / 1000 = 1                       |
| 12.13 | All forced value                 | Forced value that can be used instead of the true reading of the input. See parameter 12.02 Al force selection.                                               | 0.000 V or mA /<br>real32              |
|       | 0.000 11.000<br>(22.000) V or mA | Forced value of analog input Al1.                                                                                                                             | 1000 = 1 V or mA /<br>1000 = 1 V or mA |
| 12.15 | Al1 unit selection               | Selects the unit for readings and settings related to analog input Al1.                                                                                       | V / uint16                             |
|       | V                                | Volts.                                                                                                                                                        | 2                                      |
|       | mA                               | Milliamperes.                                                                                                                                                 | 10                                     |
| 12.16 | Al1 filter time                  | Defines the filter time constant for analog input Al1.  "Unfiltered signal 100                                                                                | 0.100 s / real32                       |
|       |                                  | Filtered signal                                                                                                                                               |                                        |
|       |                                  | $O = I \times (1 - e^{-t/T})$                                                                                                                                 |                                        |
|       |                                  | I = filter input (step)                                                                                                                                       |                                        |
|       |                                  | O = filter output                                                                                                                                             |                                        |
|       |                                  | t = time                                                                                                                                                      |                                        |
|       |                                  | T = filter time constant                                                                                                                                      |                                        |
|       |                                  | <b>Note:</b> The signal is also filtered due to the signal interface hardware (approximately 0.25 ms time constant). This cannot be changed by any parameter. |                                        |
|       | 0.000 30.000 s                   | Filter time constant.                                                                                                                                         | 1000 = 1 s / 1000 = 1<br>s             |
| 12.17 | Al1 min                          | Defines the minimum site value for analog input Al1.                                                                                                          | 0.000 V or mA /                        |
|       |                                  | Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.                                                   | real32                                 |
|       |                                  | See also parameter 12.19 Al1 scaled at Al1 min.                                                                                                               |                                        |
|       | 0.000 11.000<br>(22.000) V or mA | Minimum value of Al1.                                                                                                                                         | 1000 = 1 V or mA /<br>1000 = 1 V or mA |

| No.   | Name / Range /<br>Selection      | Description                                                                                                                                                                                                                                                      | Def / Type<br>FbEq 16b / 32b                    |
|-------|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|
| 12.18 | Al1 max                          | Defines the maximum site value for analog input AI1.                                                                                                                                                                                                             | 10.000 V or mA /                                |
|       |                                  | Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting.                                                                                                                                                      | real32                                          |
|       |                                  | See also parameter 12.19 Al1 scaled at Al1 min.                                                                                                                                                                                                                  |                                                 |
|       | 0.000 11.000<br>(22.000) V or mA | Maximum value of Al1.                                                                                                                                                                                                                                            | 1000 = 1 V or mA /<br>1000 = 1 V or mA          |
| 12.19 | Al1 scaled at Al1 min            | Defines the real internal value that corresponds to the minimum analog input Al1 value defined by parameter 12.17 Al1 min. (Changing the polarity settings of parameters 12.19 and 12.20 can effectively invert the analog input.)  Al <sub>scaled</sub> (12.12) | 0.000 NoUnit /<br>real32                        |
|       |                                  | 12.20 — — — — — — — — — — — — — — — — — — —                                                                                                                                                                                                                      |                                                 |
|       | -32768.000<br>32767.000          | Real value corresponding to minimum Al1 value.                                                                                                                                                                                                                   | 1 = 1 / 1000 = 1                                |
| 12.20 | Al1 scaled at Al1<br>max         | Defines the real internal value that corresponds to the maximum analog input Al1 value defined by parameter 12.18 Al1 max. See the drawing at parameter 12.19 Al1 scaled at Al1 min.                                                                             | 50.000; 60.000<br>(95.20 b0) NoUnit /<br>real32 |
|       | -32768.000<br>32767.000          | Real value corresponding to maximum Al1 value.                                                                                                                                                                                                                   | 1 = 1 / 1000 = 1                                |
| 12.21 | AI2 actual value                 | Displays the value of analog input Al2 in mA or V (depending on whether the input is set to current or voltage by a hardware setting).                                                                                                                           | 0.000 V or mA /<br>real32                       |
|       |                                  | This parameter is read-only.                                                                                                                                                                                                                                     |                                                 |
|       | 0.000 11.000<br>(22.000) V or mA | Value of analog input AI2.                                                                                                                                                                                                                                       | 1000 = 1 V or mA /<br>1000 = 1 V or mA          |
| 12.22 | Al2 scaled value                 | Displays the value of analog input AI2 after scaling.<br>See parameters 12.29 AI2 scaled at AI2 min and 12.101<br>AI1 percent value.                                                                                                                             | 0.000 NoUnit /<br>real32                        |
|       |                                  | This parameter is read-only.                                                                                                                                                                                                                                     |                                                 |
|       | -32768.000<br>32767.000          | Scaled value of analog input AI2.                                                                                                                                                                                                                                | 1 = 1 / 1000 = 1                                |

| No.   | Name / Range /<br>Selection      | Description                                                                                                                                                                                                                                                              | Def / Type<br>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 Al force selection.                                                                                                                                                          | 0.000 V or mA /<br>real32              |
|       | 0.000 11.000<br>(22.000) V or mA | Forced value of analog input AI2.                                                                                                                                                                                                                                        | 1000 = 1 V or mA /<br>1000 = 1 V or mA |
| 12.25 | Al2 unit selection               | Selects the unit for readings and settings related to analog input Al2.                                                                                                                                                                                                  | mA / uint16                            |
|       | V                                | Volts.                                                                                                                                                                                                                                                                   | 2                                      |
|       | mA                               | Milliamperes.                                                                                                                                                                                                                                                            | 10                                     |
| 12.26 | Al2 filter time                  | Defines the filter time constant for analog input AI2.<br>See parameter 12.16 AI1 filter time.                                                                                                                                                                           | 0.100 s / real32                       |
|       | 0.000 30.000 s                   | Filter time constant.                                                                                                                                                                                                                                                    | 1000 = 1 s / 1000 = 1<br>s             |
| 12.27 | AI2 min                          | Defines the minimum site value for analog input AI2.                                                                                                                                                                                                                     | 4.000 V or mA /                        |
|       |                                  | Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.                                                                                                                                                              | real32                                 |
|       | 0.000 11.000<br>(22.000) V or mA | Minimum value of AI2.                                                                                                                                                                                                                                                    | 1000 = 1 V or mA /<br>1000 = 1 V or mA |
| 12.28 | AI2 max                          | Defines the maximum site value for analog input Al2.  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 /<br>real32             |
|       | 0.000 11.000<br>(22.000) V or mA | Maximum value of AI2.                                                                                                                                                                                                                                                    | 1000 = 1 V or mA /<br>1000 = 1 V or mA |
| 12.29 | Al2 scaled at Al2 min            | Defines the real value that corresponds to the minimum analog input Al2 value defined by parameter 12.27 Al2 min. (Changing the polarity settings of parameters 12.29 and 12.101 can effectively invert the analog input.)  Al scales (12.22)  12.27  Ala (12.21)  12.29 | 0.000 NoUnit / real32                  |
|       | -32768.000<br>32767.000          | Real value corresponding to minimum AI2 value.                                                                                                                                                                                                                           | 1 = 1 / 1000 = 1                       |

| No.    | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                         | Def / Type<br>FbEq 16b / 32b |
|--------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 12.30  | AI2 scaled at AI2<br>max    | Defines the real value that corresponds to the minimum analog input Al2 value defined by parameter 12.28 Al2 max. See the drawing at parameter of 12.29 Al2 scaled at Al2 min.                                                                      | 50.000 NoUnit /<br>real32    |
|        | -32768.000<br>32767.000     | Real value corresponding to maximum AI2 value.                                                                                                                                                                                                      | 1 = 1 / 1000 = 1             |
| 12.101 | Al1 percent value           | Value of analog input Al1 in percent of Al1 scaling (12.18 Al1 max - 12.17 Al1 min).                                                                                                                                                                | 0.00 percent / real32        |
|        | 0.00 100.00 %               | Al1 value.                                                                                                                                                                                                                                          | 100 = 1 % / 100 = 1 %        |
| 12.102 | AI2 percent value           | Value of analog input Al2 in percent of Al2 scaling (12.28 Al2 max - 12.27 Al2 min).                                                                                                                                                                | 0.00 percent / real32        |
|        | 0.00 100.00 %               | Al2 value.                                                                                                                                                                                                                                          | 100 = 1 % / 100 = 1 %        |
| 12.110 | Al dead band                | Al dead band value in percentage where 100% = 10V in voltage mode and 100% = 20mA in current mode. Applicable for both Al1 and Al2.  Note: 10% of Al dead band value is internally added in firmware as Al dead band hysteresis positive and negat- | 0.40 percent / real32        |
|        |                             | ive. See section AI dead band (page 134).                                                                                                                                                                                                           |                              |
|        | 0.00 100.00 %               | Al dead band value.                                                                                                                                                                                                                                 | 100 = 1 % / 100 = 1 %        |

| No.   | Name / Range /<br>Selection      | Description                                                                                                                                                                                                                                                                                          | Def / Type<br>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 over- ridden, 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 | 0000h / uint16                         |
| h0    | AO1                              | (parameters 13.02 and 13.11).  1 = Force AO1 to value of parameter 13.13 AO1 forced                                                                                                                                                                                                                  |                                        |
| 50    | A01                              | value. (0 = Normal mode)                                                                                                                                                                                                                                                                             |                                        |
| b115  | Reserved                         |                                                                                                                                                                                                                                                                                                      |                                        |
|       | 0000hFFFFh                       |                                                                                                                                                                                                                                                                                                      | 1=1/1=1                                |
| 13.11 | AO1 actual value                 | Displays the value of AO1 in mA or V.                                                                                                                                                                                                                                                                | 0.000 V or mA /                        |
|       |                                  | This parameter is read-only.                                                                                                                                                                                                                                                                         | real32                                 |
|       | 0.000 11.000<br>(22.000) V or mA | Value of AO1.                                                                                                                                                                                                                                                                                        | 1000 = 1 V or mA /<br>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 /<br>Selection      | Description                                                                                                  | Def / Type<br>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 /<br>real32              |
|       | 0.000 11.000<br>(22.000) V or mA | Forced value for AO1.                                                                                        | 1000 = 1 V or mA /<br>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.  "  "  "  "  "  "  "  "  "  "  "  "  "            | 0.100 s / real32                       |
|       | 0.000 30.000 s                   | Filter time constant.                                                                                        | 1000 = 1 s / 1000 = 1<br>s             |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                      | Def / Type<br>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).    Incolumn | 0.0 NoUnit / real32          |
|       |                             | 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.                            |                              |

| No. | Name / Range /<br>Selection | Desc | cription                               |                                                          | Def / Type<br>FbEq 16b / 32b                             |  |
|-----|-----------------------------|------|----------------------------------------|----------------------------------------------------------|----------------------------------------------------------|--|
|     |                             |      | 13.12 AO1<br>source                    | 13.17 AO1<br>source min                                  | 13.18 AO1<br>source max                                  |  |
|     |                             | 0    | Zero                                   | N/A (Output is                                           | constant zero.)                                          |  |
|     |                             | 1    | Motor speed used                       | 0                                                        | 46.01 Speed scaling                                      |  |
|     |                             | 3    | Output fre-<br>quency                  | 0                                                        | 46.02 Frequency scaling                                  |  |
|     |                             | 4    | Motor current                          | 0                                                        | Max. value of<br>30.17 Maximum<br>current                |  |
|     |                             | 5    | Motor current<br>% of motor<br>nominal | 0%                                                       | 100%                                                     |  |
|     |                             | 6    | Motor torque                           | 0                                                        | 46.03 Torque scaling                                     |  |
|     |                             | 7    | DC voltage                             | Min. value of<br>01.11 DC<br>voltage                     | Max. value of<br>01.11 DC<br>voltage                     |  |
|     |                             | 8    | Output power                           | 0                                                        | 46.04 Power scaling                                      |  |
|     |                             | 10   | Speed ref ramp<br>in                   | 0                                                        | 46.01 Speed scaling                                      |  |
|     |                             | 11   | Speed ref ramp<br>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<br>out                     | Min. value of<br>40.01 Process<br>PID output ac-<br>tual | Max. value of<br>40.01 Process<br>PID output ac-<br>tual |  |
|     |                             | 20   | Temp sensor 1 excitation               | N/A (Analog ou<br>scaled; it is det<br>sensor's trigge   | ermined by the                                           |  |
|     |                             | 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                                     |  |

| No.   | Name / Range /<br>Selection      | Desc                                                                                                                                                                                                                     | cription                                                                                      | Def / Type<br>FbEq 16b / 32b                            |                                            |                                        |
|-------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------|----------------------------------------|
|       |                                  |                                                                                                                                                                                                                          | 13.12 AO1<br>source                                                                           | 13.17 AO1<br>source min                                 | 13.18 AO1<br>source max                    |                                        |
|       |                                  | 31                                                                                                                                                                                                                       | Abs output<br>power                                                                           | 0                                                       | 46.04 Power scaling                        |                                        |
|       |                                  | 32                                                                                                                                                                                                                       | Abs motor<br>shaft power                                                                      | 0                                                       | 46.04 Power scaling                        |                                        |
|       |                                  |                                                                                                                                                                                                                          | Other                                                                                         | Min. value of<br>the selected<br>parameter              | Max. value of<br>the selected<br>parameter |                                        |
|       | -32768.0 32767.0                 |                                                                                                                                                                                                                          | signal value corr<br>⁄alue.                                                                   | esponding to m                                          | inimum AO1 out-                            | 1 = 1 / 10 = 1                         |
| 13.18 | AO1 source max                   | by para                                                                                                                                                                                                                  | nes the real maxi<br>arameter 13.12 A<br>maximum requir<br>meter 13.20 AO1<br>17 AO1 source n | 50.0; 60.0 (95.20 b0)<br>NoUnit / real32                |                                            |                                        |
|       | -32768.0 32767.0                 |                                                                                                                                                                                                                          | signal value cori<br>out value.                                                               | 1 = 1 / 10 = 1                                          |                                            |                                        |
| 13.19 | AO1 out at AO1 src<br>min        | AO1.                                                                                                                                                                                                                     |                                                                                               | ·                                                       | or analog output  AO1 source min.          | 0.000 V or mA /<br>real32              |
|       | 0.000 11.000<br>(22.000) V or mA | Mini                                                                                                                                                                                                                     | mum AO1 outpu                                                                                 | t value.                                                |                                            | 1000 = 1 V or mA /<br>1000 = 1 V or mA |
| 13.20 | AO1 out at AO1 src<br>max        | AO1.                                                                                                                                                                                                                     |                                                                                               |                                                         | or analog output  AO1 source min.          | 10.000 V or mA / real32                |
|       | 0.000 11.000<br>(22.000) V or mA | Maxi                                                                                                                                                                                                                     | imum AO1 outpu                                                                                | ıt value.                                               |                                            | 1000 = 1 V or mA /<br>1000 = 1 V or mA |
| 13.91 | AO1 data storage                 | Storage parameter for controlling analog output AO1, for example, through the embedded fieldbus interface. In parameter 13.12 AO1 source, select AO1 data storage. Then set this parameter as the target of the incoming |                                                                                               |                                                         |                                            | 0.00 NoUnit / real32                   |
|       |                                  | simp                                                                                                                                                                                                                     | oly set the target                                                                            | embedded fieldl<br>selection paran<br>.58.114) to AO1 o | neter of that par-                         |                                        |
|       | -327.68 327.67                   | Stor                                                                                                                                                                                                                     | age parameter f                                                                               | or AO1.                                                 |                                            | 100 = 1 / 100 = 1                      |
|       |                                  |                                                                                                                                                                                                                          |                                                                                               |                                                         |                                            |                                        |

| No.   | Name / Range /<br>Selection | Description                                                                                  | Def / Type<br>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            | Displays the operating mode currently used.                                                  | Scalar (Hz) / uint16         |
|       | mode                        | See parameter 19.11 Ext1/Ext2 selection.                                                     |                              |
|       |                             | This parameter is read-only.                                                                 |                              |
|       | 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.                        | EXT1 / uint32                |
|       |                             | O = EXT1                                                                                     |                              |
|       |                             | 1 = EXT2                                                                                     |                              |
|       | 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 /<br>Selection | Def / Type<br>FbEq 16b / 32b                                                                                                                                                                                                   |                   |
|-------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 19.18 | HAND/OFF disable            | Selects the source for Hand/Off disable.                                                                                                                                                                                       | Not used / uint32 |
|       | source                      | 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                    | 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                 |

| No.   | Name / Range /<br>Selection                                                                                                                                                                                                                                                                      | Description                                                      | Def / Type<br>FbEq 16b / 32b |         |                                     |   |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------|------------------------------|---------|-------------------------------------|---|
| 20    | Start/stop/direction                                                                                                                                                                                                                                                                             | Start/stop/direct<br>source selection; p<br>signal source selec  |                              |         |                                     |   |
|       |                                                                                                                                                                                                                                                                                                  | For information or control vs. externa                           |                              |         |                                     |   |
| 20.01 | Ext1 commands                                                                                                                                                                                                                                                                                    | Selects the source mands for externa                             | In1 Start / uint16           |         |                                     |   |
|       |                                                                                                                                                                                                                                                                                                  | See parameter 20. of the actual direc 20.0220.05.                |                              |         |                                     |   |
|       | Not selected                                                                                                                                                                                                                                                                                     | No start or stop co                                              | ommand :                     | sources | selected.                           | 0 |
|       | In1 Start                                                                                                                                                                                                                                                                                        | The source of the s<br>by parameter 20.0<br>itions of the source | 1                            |         |                                     |   |
|       |                                                                                                                                                                                                                                                                                                  | State of source 1                                                | (20.03)                      | (       | Command                             |   |
|       |                                                                                                                                                                                                                                                                                                  | 0 → 1 (20.02 = I                                                 | Edge)                        |         | Start                               |   |
|       |                                                                                                                                                                                                                                                                                                  | 1 (20.02 = Le                                                    | vel)                         |         |                                     |   |
|       |                                                                                                                                                                                                                                                                                                  | 0                                                                |                              |         | Stop                                |   |
|       | In1 Start; In2 Dir  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:  State of source 1 State of source (20.04) |                                                                  |                              |         | ed by parameter<br>e direction. The | 2 |
|       |                                                                                                                                                                                                                                                                                                  |                                                                  |                              |         | Command                             |   |
|       |                                                                                                                                                                                                                                                                                                  | 0 Any Stop                                                       |                              |         |                                     |   |
|       |                                                                                                                                                                                                                                                                                                  | 0 → 1 (20.02 =                                                   | С                            | )       | Start forward                       |   |
|       |                                                                                                                                                                                                                                                                                                  | Edge)<br>1 (20.02 = Level)                                       | 1                            | L       | Start forward                       |   |

| No. | Name / Range /<br>Selection     | Description                                                                                          | Def / Type<br>FbEq 16b / 32b |               |  |
|-----|---------------------------------|------------------------------------------------------------------------------------------------------|------------------------------|---------------|--|
|     | In1 Start fwd; In2<br>Start rev | The source selecter is the forward star parameter 20.04 E signal. The state to terpreted as follows: | 3                            |               |  |
|     |                                 | State of source 1 (20.03)                                                                            | State of source<br>2 (20.04) | Command       |  |
|     |                                 | 0                                                                                                    | 0                            | Stop          |  |
|     |                                 | 0 → 1 (20.02 =<br>Edge)                                                                              | 0                            | Start forward |  |
|     |                                 | 1 (20.02 = Level)                                                                                    |                              |               |  |
|     |                                 | 0                                                                                                    | 0 → 1 (20.02 =<br>Edge)      | Start reverse |  |
|     |                                 |                                                                                                      | 1 (20.02 = Level)            |               |  |
|     |                                 | 1                                                                                                    |                              |               |  |
|     | In1P Start; In2 Stop            | The sources of the ted by parameters in 2 source. The sta interpreted as follows:                    | 4                            |               |  |
|     |                                 | State of source 1<br>(20.03)                                                                         | State of source<br>2 (20.04) | Command       |  |
|     |                                 | 0 → 1                                                                                                | 1                            | Start         |  |
|     |                                 | Any                                                                                                  | 0                            | Stop          |  |
|     |                                 | Note: Run permissiv put ON before en. Parameter 20.0 only at startuş start input is C is powered up  |                              |               |  |

| No. | Name / Range /<br>Selection                 | Description                                                                                                                                                 | Def / Type<br>FbEq 16b / 32b                                                                                                                                                                                                                                                 |                                 |                    |    |  |
|-----|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|--------------------|----|--|
|     | In1P Start; In2 Stop;<br>In3 Dir            | ted by parame<br>in2 source. Th<br>Ext1 in3 source                                                                                                          | 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: |                                 |                    |    |  |
|     |                                             | State of<br>source 1<br>(20.03)                                                                                                                             | State of<br>source 2<br>(20.04)                                                                                                                                                                                                                                              | State of<br>source 3<br>(20.05) | Command            |    |  |
|     |                                             | 0 → 1                                                                                                                                                       | 1                                                                                                                                                                                                                                                                            | 0                               | Start for-<br>ward |    |  |
|     |                                             | 0 → 1                                                                                                                                                       | 1                                                                                                                                                                                                                                                                            | 1                               | Start re-<br>verse |    |  |
|     |                                             | Any                                                                                                                                                         | 0                                                                                                                                                                                                                                                                            | Any                             | Stop               |    |  |
|     | In1P Start fwd; In2P<br>Start rev; In3 Stop | Run perm put ON be en.     Paramete only at st. start inpu is powere.  The sources o ted by param in 2 source and ted by param the stop. The interpreted a: |                                                                                                                                                                                                                                                                              |                                 |                    |    |  |
|     |                                             | State of source 1 (20.03)                                                                                                                                   | State of<br>source 2<br>(20.04)                                                                                                                                                                                                                                              | State of<br>source 3<br>(20.05) | Command            |    |  |
|     |                                             | 0 → 1                                                                                                                                                       | Any                                                                                                                                                                                                                                                                          | 1                               | Start for-<br>ward |    |  |
|     |                                             | Any                                                                                                                                                         | 0 → 1                                                                                                                                                                                                                                                                        | 1                               | Start re-<br>verse |    |  |
|     |                                             | Any                                                                                                                                                         | Any                                                                                                                                                                                                                                                                          | 0                               | Stop               |    |  |
|     |                                             | Note: Run perm put ON been. Paramete with this                                                                                                              |                                                                                                                                                                                                                                                                              |                                 |                    |    |  |
|     | Control panel                               | The start and control panel connector).                                                                                                                     |                                                                                                                                                                                                                                                                              |                                 |                    | 11 |  |

| No.   | Name / Range /<br>Selection |                                                                                                                                                                                     |                     |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
|       | Embedded fieldbus           | The start and stop commands are taken from the embedded fieldbus interface.                                                                                                         | 14                  |
|       |                             | <b>Note:</b> Set also parameter 20.02 Ext1 start trigger type to Level.                                                                                                             |                     |
| 20.02 | Ext1 start trigger<br>type  | Defines whether the start signal for external control location EXT1 is edge-triggered or level-triggered.                                                                           | Level / uint16      |
|       |                             | <b>Note</b> : 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. |                     |
|       | 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.                                                                                                                                 | Always off / uint32 |
|       |                             | For the available selections, see parameter 20.03 Ext1 in1 source.                                                                                                                  |                     |
| 20.05 | Ext1 in3 source             | Selects source 3 for parameter 20.01 Ext1 commands.                                                                                                                                 | Always off / uint32 |
|       |                             | For the available selections, see parameter 20.03 Ext1 in1 source.                                                                                                                  |                     |

| No.   | Name / Range /<br>Selection     |                                                                                                                                                                                                                                  |                                           |                          |                                   | Def / Type<br>FbEq 16b / 32b |
|-------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|--------------------------|-----------------------------------|------------------------------|
| 20.06 | Ext2 commands                   | Selects the source mands for externa                                                                                                                                                                                             | Not selected / uint16                     |                          |                                   |                              |
|       |                                 | See parameter 20. of the actual direct                                                                                                                                                                                           |                                           | on for th                | e determination                   |                              |
|       |                                 | See also paramete                                                                                                                                                                                                                |                                           |                          |                                   |                              |
|       | Not selected                    | No start or stop co                                                                                                                                                                                                              | ommand                                    | sources s                | selected.                         | 0                            |
|       | In1 Start                       | The source of the s<br>by parameter 20.0<br>itions of the source                                                                                                                                                                 | 8 Ext2 in                                 | source.                  | The state trans-                  | 1                            |
|       |                                 | State of source 1                                                                                                                                                                                                                | (20.08)                                   | (                        | Command                           |                              |
|       |                                 | 0 → 1 (20.07 = 1                                                                                                                                                                                                                 | Edge)                                     |                          | Start                             |                              |
|       |                                 | 1 (20.07 = Le                                                                                                                                                                                                                    | vel)                                      |                          |                                   |                              |
|       |                                 | 0                                                                                                                                                                                                                                |                                           |                          | Stop                              |                              |
|       | In1 Start; In2 Dir              | 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 |                                           |                          |                                   | 2                            |
|       |                                 | State of source 1<br>(20.08)                                                                                                                                                                                                     | State of<br>2 (20                         |                          | Command                           |                              |
|       |                                 | 0                                                                                                                                                                                                                                | Ar                                        | ny                       | Stop                              |                              |
|       |                                 | 0 → 1 (20.07 =                                                                                                                                                                                                                   | C                                         | )                        | Start forward                     |                              |
|       |                                 | Edge)<br>1 (20.07 = Level)                                                                                                                                                                                                       |                                           | 1 Start forward          |                                   |                              |
|       | In1 Start fwd; In2<br>Start rev | The source selecte<br>is the forward star<br>parameter 20.09 E<br>signal. The state t<br>terpreted as follow                                                                                                                     | rt signal; t<br>Ext2 in2 so<br>ransitions | the source<br>ource is t | e selected by<br>he reverse start | 3                            |
|       |                                 | State of source 1<br>(20.08)                                                                                                                                                                                                     | State of<br>2 (20                         |                          | Command                           |                              |
|       |                                 | 0                                                                                                                                                                                                                                | C                                         | )                        | Stop                              |                              |
|       |                                 | 0 → 1 (20.07 =<br>Edge)                                                                                                                                                                                                          | C                                         | )                        | Start forward                     |                              |
|       |                                 | 1 (20.07 = Level)                                                                                                                                                                                                                |                                           |                          |                                   |                              |
|       |                                 | 0                                                                                                                                                                                                                                | 0 → 1 (2<br>Edg                           | ge)                      | Start reverse                     |                              |
|       |                                 |                                                                                                                                                                                                                                  | 1 (20.07                                  | -                        |                                   |                              |
|       |                                 | 1                                                                                                                                                                                                                                | 1                                         |                          | Stop                              |                              |

| No. | Name / Range /<br>Selection      | Description                                                                                                                                                                                                                                                                  |                                         |                                                             |                                                                        |                                                                                                                     | Def / Type<br>FbEq 16b / 32b |
|-----|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|-------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------|
|     | In1P Start; In2 Stop             | The sources of ted by parame Ext2 in2 source bits are interp                                                                                                                                                                                                                 | 4                                       |                                                             |                                                                        |                                                                                                                     |                              |
|     |                                  | State of sour<br>(20.08)                                                                                                                                                                                                                                                     | ce 1                                    | State of<br>2 (20                                           | source<br>0.09)                                                        | Command                                                                                                             |                              |
|     |                                  | 0 → 1                                                                                                                                                                                                                                                                        | $\dashv$                                | 1                                                           | L                                                                      | Start                                                                                                               |                              |
|     |                                  | Any                                                                                                                                                                                                                                                                          |                                         | (                                                           | )                                                                      | Stop                                                                                                                |                              |
|     | In1D Start- In2 Stone            | put ON be<br>en. • Paramete<br>only at sta<br>start inpu<br>is powere                                                                                                                                                                                                        | r 20.0<br>artup<br>t is ON<br>d up,     | or after to<br>7 Ext2 st<br>of the d<br>N and 20<br>the mot | the start p<br>art trigger<br>rive with t<br>.07 = Leve<br>or will sta |                                                                                                                     | t                            |
|     | In1P Start; In2 Stop;<br>In3 Dir | 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: |                                         |                                                             |                                                                        |                                                                                                                     | 5                            |
|     |                                  | State of<br>source 1<br>(20.08)                                                                                                                                                                                                                                              | sou                                     | ate of<br>urce 2<br>0.09)                                   | State of<br>source<br>(20.10                                           | 3                                                                                                                   |                              |
|     |                                  | 0 → 1                                                                                                                                                                                                                                                                        |                                         | 1                                                           | 0                                                                      | Start for-<br>ward                                                                                                  |                              |
|     |                                  | 0 → 1                                                                                                                                                                                                                                                                        |                                         | 1                                                           | 1                                                                      | Start re-<br>verse                                                                                                  |                              |
|     |                                  | Any                                                                                                                                                                                                                                                                          |                                         | 0                                                           | Any                                                                    | Stop                                                                                                                |                              |
|     |                                  | put ON be<br>en. • Paramete<br>only at sta                                                                                                                                                                                                                                   | efore of<br>r 20.0°<br>artup<br>t is ON | or after t<br>7 Ext2 st<br>of the d<br>N and 20             | the start part trigger<br>trive with t<br>.07 = Leve                   | ck signals can be<br>oulse has been giv<br>type has an effect<br>his setting. If the<br>I (1) when the drive<br>rt. | t                            |

| No.   | Name / Range /<br>Selection                 | Description                                                                          | Def / Type<br>FbEq 16b / 32b                                                                                           |                                                      |                    |                     |  |  |
|-------|---------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------|--------------------|---------------------|--|--|
|       | In1P Start fwd; In2P<br>Start rev; In3 Stop | The sources o ted by param in2 source and ted by param the direction. are interprete | 6                                                                                                                      |                                                      |                    |                     |  |  |
|       |                                             | State of source 1 (20.08)                                                            | State of<br>source 2<br>(20.09)                                                                                        | State of<br>source 3<br>(20.10)                      | Command            |                     |  |  |
|       |                                             | 0 → 1                                                                                | Any                                                                                                                    | 1                                                    | Start for-<br>ward |                     |  |  |
|       |                                             | Any                                                                                  | 0 → 1                                                                                                                  | 1                                                    | Start re-<br>verse |                     |  |  |
|       |                                             | Any                                                                                  | Any                                                                                                                    | 0                                                    | Stop               |                     |  |  |
|       |                                             | Note: Run perm put ON been. Paramete with this                                       |                                                                                                                        |                                                      |                    |                     |  |  |
|       | Control panel                               | The start and control panel connector).                                              | 11                                                                                                                     |                                                      |                    |                     |  |  |
|       | Embedded fieldbus                           | bedded fieldb                                                                        | ous interface.                                                                                                         |                                                      | from the em-       | 14                  |  |  |
| 20.07 | Ext2 start trigger<br>type                  |                                                                                      | is edge-trigg<br>ameter is not<br>ted. See the de                                                                      | ered or level-<br>effective if a p<br>escriptions of |                    |                     |  |  |
|       | Edge                                        | The start sign                                                                       | al is edge-trig                                                                                                        | ggered.                                              |                    | 0                   |  |  |
|       | Level                                       | The start sign                                                                       | al is level-trig                                                                                                       | gered.                                               |                    | 1                   |  |  |
| 20.08 | Ext2 in1 source                             |                                                                                      | Selects source 1 for parameter 20.06 Ext2 commands. For the available selections, see parameter 20.03 Ext1 in1 source. |                                                      |                    |                     |  |  |
| 20.09 | Ext2 in2 source                             | Selects source<br>For the availa<br>in1 source.                                      | •                                                                                                                      |                                                      |                    | Always off / uint32 |  |  |
| 20.10 | Ext2 in3 source                             | Selects source<br>For the availa<br>in1 source.                                      | ·                                                                                                                      |                                                      |                    | Always off / uint32 |  |  |

| No.   | Name / Range /<br>Selection | Description                                                                                                                             |                                                                                                                                                                  |                                                                                                                                                                      |                                        | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------------------------|
| 20.21 | Direction                   | drive rather t<br>some cases.<br>In the table the<br>function of po-<br>command (fr                                                     | rection lock. D<br>han the sign of<br>he actual drive<br>arameter 20.2<br>om parameter                                                                           | of the reference<br>erotation is sh<br>1 Direction an                                                                                                                | nown as a<br>d Direction               | Forward / uint16             |
|       |                             | 20.06 Ext2 co                                                                                                                           | Direction<br>command =                                                                                                                                           | Direction<br>command =<br>Reverse                                                                                                                                    | Direction<br>command<br>not defined    |                              |
|       |                             | Par. 20.21<br>Direction =<br>Forward                                                                                                    | Forward                                                                                                                                                          | Forward                                                                                                                                                              | Forward                                |                              |
|       |                             | Par. 20.21<br>Direction =<br>Reverse                                                                                                    | Reverse                                                                                                                                                          | Reverse                                                                                                                                                              | Reverse                                |                              |
|       |                             | Par. 20.21<br>Direction =<br>Request                                                                                                    | potentiomet-<br>er, PID, Safe<br>speed, Last,<br>Jogging or<br>Panel refer-<br>ence, refer-<br>ence used<br>as is.<br>-If reference<br>from the<br>network, ref- | stant, PID or<br>Jogging ref-<br>erence, refer-<br>ence used<br>as is If reference<br>from the<br>network,<br>Panel, Ana-<br>log input,<br>Motor poten-<br>tiometer, | Forward                                |                              |
|       | Request                     | tion comman<br>20.06 Ext2 co<br>If the referen<br>speeds/frequentiomete<br>ence or Panel<br>If the referen<br>if the dire<br>is used as | ce comes fron<br>uencies), Float<br>er), PID, Speed<br>reference, the<br>ce comes fron<br>ction commar<br>is<br>ction commar                                     | 20.01 Ext1 con<br>in Constant (con<br>ing point con<br>in ref safe, Last<br>e reference is<br>in a fieldbus:<br>and is forward,                                      | onstant<br>trol (Motor<br>speed refer- | 0                            |

| No.   | Name / Range /<br>Selection        | Description                                                                                                                                                                                                               | Def / Type<br>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<br>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.                                                                   |                              |
| b215  | Reserved                           |                                                                                                                                                                                                                           |                              |
|       | 0000hFFFFh                         |                                                                                                                                                                                                                           | 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 /<br>Selection | Description                                                                                                      | Def / Type<br>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.                         | 15                           |
|       |                             | DCU profile: Inverse of control word bit 6 received through the embedded fieldbus interface.                     |                              |
|       | Other [bit]                 | See Terms and abbreviations (page 137).                                                                          | -                            |
| 20.41 | Start interlock 1           | Selects the source of the Start interlock 1 signal.                                                              | DI4 / uint32                 |
|       |                             | Value 0 of the source deactivates the Start interlock 1 signal and inhibits starting.                            |                              |
|       |                             | Value 1 of the source activates the Start interlock 1 signal and allows starting.                                |                              |
|       | Not used                    | 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. | 15                           |
|       |                             | 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.             |                              |
|       | Other [bit]                 | See Terms and abbreviations (page 137).                                                                          | -                            |
| 20.42 | Start interlock 2           | Selects the source of the Start interlock 2 signal.                                                              | Not used / uint32            |
|       |                             | For the selections, see parameter 20.41 Start interlock 1.                                                       |                              |

| No.   | Name / Range /<br>Selection  | Description                                                                                                                                                      | Def / Type<br>FbEq 16b / 32b |
|-------|------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 20.43 | Start interlock 3            | Selects the source of the Start interlock 3 signal.                                                                                                              | Not used / uint32            |
|       |                              | Start interlock 3 is not supported over the Embedded fieldbus.                                                                                                   |                              |
|       |                              | For the other selections than 15, see parameter 20.41 Start interlock 1.                                                                                         |                              |
| 20.44 | Start interlock 4            | Selects the source of the Start interlock 4 signal.                                                                                                              | Not used / uint32            |
|       |                              | Start interlock 4 is not supported over the Embedded fieldbus.                                                                                                   |                              |
|       |                              | For the other selections than 15, see parameter 20.41 Start interlock 1.                                                                                         |                              |
| 20.45 | Start interlock stop<br>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.                                                                                                                  | 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.        | uint16                       |
|       | Run permissive               |                                                                                                                                                                  | 0                            |
|       | Damper end switch            |                                                                                                                                                                  | 1                            |
|       | Valve opening                |                                                                                                                                                                  | 2                            |
|       | Pre-lube cycle               |                                                                                                                                                                  | 3                            |
|       | Interlock open               |                                                                                                                                                                  | 5                            |
| 20.47 | Start interlock 1            | Alternative alarm texts for the start interlock 1.                                                                                                               | Start interlock 1 /          |
|       | text                         | 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. | 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 /<br>Selection | Description                                                                                                                                                  | Def / Type<br>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 ig-<br>nored / uint16 |
|       | Start command ig-<br>nored  | Start interlock warnings are displayed if the interlocks are missing.                                                                                        | 0                                   |
|       | Start command required      | Start command must be present before the start inter-<br>lock warnings are displayed if the interlocks are miss-<br>ing.                                     | 1                                   |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                      | Def / Type<br>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.                                                                                                                                                                                                                                                                                | Automatic / uint16           |
|       |                             | 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).                                                                                                                                                                                                                                                                                                                                                                    |                              |
|       | 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 premagnetizing time is set long enough. | 1                            |
|       |                             | 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.                                                                                                                |                              |
|       | 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                            |

| No.   | Name / Range /<br>Selection | Description                                                                                                         |                                                                                                                                                            | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 21.02 | Magnetization time          | Defines the pre-magnetiz  parameter 21.01 Start                                                                     | ation time when<br>mode is set to Const time (in                                                                                                           | 500 ms / uint16              |
|       |                             | DTC motor control mode), or  parameter 21.19 Scalar start mode is set to Const time (in scalar motor control mode). |                                                                                                                                                            |                              |
|       |                             | magnetizes the motor for<br>magnetizing, set this para<br>or higher than, the rotor t                               | the drive automatically pre-<br>the set time. To ensure full<br>meter to the same value as,<br>ime constant. If not known,<br>ue given in the table below: |                              |
|       |                             | Motor rated power                                                                                                   | Constant magnetizing time                                                                                                                                  |                              |
|       |                             | < 1 kW                                                                                                              | ≥ 50 to 100 ms                                                                                                                                             |                              |
|       |                             | 1 to 10 kW                                                                                                          | ≥ 100 to 200 ms                                                                                                                                            |                              |
|       |                             | 10 to 200 kW                                                                                                        | ≥ 200 to 1000 ms                                                                                                                                           |                              |
|       |                             | 200 to 1000 kW                                                                                                      | ≥ 1000 to 2000 ms                                                                                                                                          |                              |
|       |                             | <b>Note:</b> This parameter cannot be changed while the drive is running.                                           |                                                                                                                                                            |                              |
|       | 010000 ms                   | Constant DC magnetizing                                                                                             | time.                                                                                                                                                      | 1 = 1 ms / 1 = 1 ms          |
| 21.03 | Stop mode                   | Selects the way the motor is stopped when a stop command is received.                                               |                                                                                                                                                            | Coast / uint16               |
|       |                             | Additional braking is possi<br>(see parameter 97.05 Flux                                                            | ible by selecting flux braking braking).                                                                                                                   |                              |
|       | Coast                       | Stop by switching off the output semiconductors of the drive.                                                       |                                                                                                                                                            | 0                            |
|       |                             | The motor coasts to a sto                                                                                           | p.                                                                                                                                                         |                              |
|       |                             | WARNING! If a mechanical brake stop the drive by coa                                                                | e is used, ensure it is safe to<br>asting.                                                                                                                 |                              |
|       | Ramp                        | Stop along the active dece<br>er group 23 Speed referer<br>Frequency reference chair                                |                                                                                                                                                            | 1                            |
|       | Torque limit                | Stop according to torque<br>Minimum torque 1 and 30                                                                 |                                                                                                                                                            | 2                            |
|       |                             | This mode is only possible mode.                                                                                    | e in vector motor control                                                                                                                                  |                              |
| 21.04 | Emergency stop mode         | Selects the way the motor gency stop command is re                                                                  | r is stopped when an emer-<br>eceived.                                                                                                                     | Ramp stop (Off1) /<br>uint16 |
|       |                             | The source of the emerge by parameter 21.05 Emerg                                                                   | ncy stop signal is selected<br>gency stop source.                                                                                                          |                              |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                               | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Ramp stop (Off1)            | <ul> <li>With the drive running:</li> <li>1 = Normal operation.</li> <li>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.</li> <li>With the drive stopped:</li> <li>1 = Starting allowed.</li> <li>0 = Starting not allowed.</li> </ul> |                              |
|       | 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<br>(Off3)     | <ul> <li>With the drive running:</li> <li>1 = Normal operation.</li> <li>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.</li> <li>With the drive stopped:</li> <li>1 = Starting allowed.</li> <li>0 = Starting not allowed.</li> </ul>   | 2                            |
| 21.05 | Emergency stop<br>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) /<br>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 /<br>Selection | Description                                                                                                                                                                                                                                | Def / Type<br>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<br>rpm        | Zero speed limit. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                          | 1 = 1 rpm / 100 = 1<br>rpm   |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                        | Def / Type<br>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.                                                                                                                                     | 0 ms / real32                |
|       |                             | Without zero speed delay:                                                                                                                                                                                                                                                                                                                          |                              |
|       |                             | The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter 21.06 Zero speed limit, inverter modulation is stopped and the motor coasts to a standstill.                                                                                                                            |                              |
|       |                             | Speed Speed controller switched off Motor coasts to a stop.                                                                                                                                                                                                                                                                                        |                              |
|       |                             | -21.06                                                                                                                                                                                                                                                                                                                                             |                              |
|       |                             | With zero speed delay:                                                                                                                                                                                                                                                                                                                             |                              |
|       |                             | The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter 21.06 Zero speed limit, the zero speed delay function activates. During the delay the function keeps the speed controller live: the inverter modulates, motor is magnetized and the drive is ready for a quick restart. |                              |
|       |                             | Speed Speed controller remains active Motor is decelerated to true ze speed.                                                                                                                                                                                                                                                                       |                              |
|       |                             |                                                                                                                                                                                                                                                                                                                                                    |                              |
|       |                             | →                                                                                                                                                                                                                                                                                                                                                  |                              |
|       | 030000 ms                   | Zero speed delay.                                                                                                                                                                                                                                                                                                                                  | 1 = 1 ms / 1 = 1 ms          |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                        | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 21.08 | DC current control          | Activates/deactivates the DC hold and post-magnetization functions. See section DC magnetization (page 103).                                                                                                                                                                                                       | 0000h / uint16               |
|       |                             | 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. |                              |
| b0    | DC hold                     | 1 = Enable DC hold. See section DC magnetization (page 103).                                                                                                                                                                                                                                                       |                              |
|       |                             | <b>Note:</b> 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).                                                                                                                                                                                                                                            |                              |
|       |                             | <b>Note:</b> 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.                                                                                      |                              |
| b315  | Reserved                    |                                                                                                                                                                                                                                                                                                                    |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                    | 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<br>rpm   |
| 21.10 | DC current reference        | Defines the DC hold current in percent of the motor<br>nominal current. See parameter 21.08 DC current con-<br>trol, and section DC magnetization (page 103).                                                                                                                                                      | 30.0 percent / real32        |
|       |                             | After 100 s post-magnetization time, the maximum magnetization current is limited to the magnetization current corresponding to the actual flux reference.                                                                                                                                                         |                              |
|       | 0.0 100.0 %                 | DC hold current.                                                                                                                                                                                                                                                                                                   | 1 = 1 % / 10 = 1 %           |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                               | Def / Type<br>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. | 0 s / uint32                 |
|       |                             | See parameter 21.08 DC current control.                                                                                                                                   |                              |
|       | 03000 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.                     | Off / uint32                 |
|       |                             | <ul> <li>Note:</li> <li>The heating function requires that STO is not triggered.</li> <li>The heating function requires that the drive is not faulted.</li> </ul>         |                              |
|       | 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                |
|       | 103000 s                    | Pre-heating time delay.                                                                                                                                                   | 1=1s/1=1s                    |

| No.   | lo. Name / Range / Description Selection |                                                                                                                                                                                                                                                                                                                                                                                                                            | Def / Type<br>FbEq 16b / 32b |
|-------|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       |                                          | 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.                                                                                                                                                                                                                                                                                          | Automatic / uint16           |
|       |                                          | 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).                                                                                                                                         |                              |
|       | 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. | 1                            |
|       |                                          | <b>Note</b> : 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 breakaway torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.                                                                                                                      |                              |
|       | 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.                                                                                                                                                                                                        | 2                            |
|       |                                          | Note: Cannot be used in multimotor systems.                                                                                                                                                                                                                                                                                                                                                                                |                              |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                         | Def / Type<br>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.                                                                                                                                                                                                                                                     | 3                            |
|       |                             | 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.                                                                                                                                                                                                                                                                                                               |                              |
|       |                             | <b>Note:</b> 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 breakaway torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.                                                                               |                              |
|       | 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.                                                                        | 5                            |
|       |                             | 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. |                              |
|       | Flying start+boost          | Flying start with torque boost.                                                                                                                                                                                                                                                                                                                                                     | 6                            |
|       |                             | Flying start is performed first and the motor is magnetized. If the speed is found to be zero, torque boost is applied.                                                                                                                                                                                                                                                             |                              |
| 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                    | Def / Type<br>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.                                                                                                       | 0.00 s / real32              |
|       |                             | Start delay can be used with all start modes.                                                                                                                                                                                                                                                                  |                              |
|       | 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. | Disabled / uint16            |
|       |                             | Can be used for permanent magnet synchronous motors only.                                                                                                                                                                                                                                                      |                              |
|       | 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.                                                    | 50.0 percent / real32        |
|       |                             | Can be used for permanent magnet synchronous motors only.                                                                                                                                                                                                                                                      |                              |
|       | 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.                                                                                                                                                                                                       | 10.0 percent / real32        |
|       |                             | Can be used for permanent magnet synchronous motors only.                                                                                                                                                                                                                                                      |                              |
|       | 2.0 100.0 %                 | Value as a percentage of the nominal motor frequency.                                                                                                                                                                                                                                                          | 1 = 1 % / 10 = 1 %           |
| 21.26 | Torque boost cur-<br>rent   | Defines the maximum supplied current to motor when parameter 21.19 Scalar start mode is set to Torque boost (page 206).                                                                                                                                                                                        | 100.0 percent / real32       |
|       |                             | 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.                                                                                                                                                                                                                                                                 |                              |
|       | 15.0 300.0 %                | Value in percent of the nominal motor current.                                                                                                                                                                                                                                                                 | 1 = 1 % / 10 = 1 %           |

| No.   | Name / Range /<br>Selection         | Description                                                                                                                                                                                                                                                 | Def / Type<br>FbEq 16b / 32b |
|-------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 21.27 | Torque boost time                   | Defines the minimum and maximum torque boost time.                                                                                                                                                                                                          | 20.0 s / real32              |
|       |                                     | 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.                               |                              |
|       | 0.0 60.0 s                          | Nominal motor time.                                                                                                                                                                                                                                         | 1 = 1 s / 10 = 1 s           |
| 21.30 | Speed com-<br>pensated stop<br>mode | Selects the method used to stop the drive.  Speed compensated stop is active only if                                                                                                                                                                        | Off / uint16                 |
|       | mode                                | <ul><li>the operation mode is not torque, and</li><li>parameter 21.03 Stop mode is Ramp.</li></ul>                                                                                                                                                          |                              |
|       | 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. | 1                            |
|       |                                     | If the direction of rotation is reverse, the drive is stopped along a ramp.                                                                                                                                                                                 |                              |
|       | 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. | 2                            |
|       |                                     | If the direction of rotation is forward, the drive is stopped along a ramp.                                                                                                                                                                                 |                              |
|       | 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<br>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<br>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          |
|       | 10100 %                             | 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 /<br>Selection | Description                                             | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------|------------------------------|
|       | 0.00 10.00 kW               | Preheating power.                                       | 100 = 1 kW / 100 = 1<br>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 /<br>Selection    | Description                                                                                                                                                                                                                                                                  | Def / Type<br>FbEq 16b / 32b |
|-------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 22    | Speed reference se-<br>lection | 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).                                                                                                                                    | 0.00 rpm / real32            |
|       |                                | This parameter is read-only.                                                                                                                                                                                                                                                 |                              |
|       | -30000.00<br>30000.00 rpm      | Value of the selected speed reference. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                       | 1 = 1 rpm / 100 = 1<br>rpm   |
| 22.11 | Ext1 speed ref1                | Selects EXT1 speed reference source 1.                                                                                                                                                                                                                                       | Al1 scaled / uint32          |
|       |                                | 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). |                              |
|       |                                | 22.13 ADD Other Other  22.13 Bert SUB O A EXT1 Other  19.11 Other                                                                                                                                                                                                            |                              |
|       |                                | 0 22.18 22.20 Ref1 EXT2 Other SuB O AAI SUB O BB                                                                                                                                                                                            |                              |
|       | Zero                           | None.                                                                                                                                                                                                                                                                        | 0                            |
|       | Al1 scaled                     | Parameter 12.12 Al1 scaled value.                                                                                                                                                                                                                                            | 1                            |
|       | Al2 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 /<br>Selection   | Description                                                                                                                                                                                                                                                                                                                                                                                      | Def / Type<br>FbEq 16b / 32b |
|-------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Motor potentiomet-<br>er      | 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<br>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.  Reference  EXT1 reference  EXT2 reference  Active reference  Inactive reference  EXT1 -> EXT2                                                                                                                                        | 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.  Reference  EXT1 reference  EXT2 reference  Active reference  Inactive 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.                                                                                                                                                                                                                                                                                                                                                           | Zero / uint32                |
|       |                               | For the selections, and a diagram of reference source selection, see parameter 22.11 Ext1 speed ref1.                                                                                                                                                                                                                                                                                            |                              |
| 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                          | Def / Type<br>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                            |
|       | Al1 scaled                  | Parameter 12.12 Al1 scaled value.                                                                                                                                                                                                                                                                    | 1                            |
|       | AI2 scaled                  | Parameter 12.22 Al2 scaled value.                                                                                                                                                                                                                                                                    | 2                            |
|       | EFB ref1                    | Parameter 03.09 EFB reference 1.                                                                                                                                                                                                                                                                     | 8                            |
|       | EFB ref2                    | Parameter 03.10 EFB reference 2.                                                                                                                                                                                                                                                                     | 9                            |
|       | Motor potentiomet-<br>er    | 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.  Reference                                                                                                                                | 18                           |
|       |                             | EXT1 reference  X = X - X - X - X - X - X - X - X - X -                                                                                                                                                                                                                                              |                              |

| No.   | Name / Range /<br>Selection               |                                                                                                                                                                                                                                                                                                                                                                                                  |                |
|-------|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|       | 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.  Reference  EXT1 reference  EXT2 reference  Active reference  Inactive reference | 19             |
|       | Integrated panel                          | EXT1 -> EXT2  See above Control panel (ref saved).                                                                                                                                                                                                                                                                                                                                               | 20             |
|       | (ref saved) 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.                                                                                                                                                                                                                                                                                                                                                           | Zero / uint32  |
|       |                                           | For the selections, and a diagram of reference source selection, see parameter 22.18 Ext2 speed ref1.                                                                                                                                                                                                                                                                                            |                |
| 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.  | o. Name / Range / Description Selection |                                                                                                                                                                                                                                                                                                                                               | Def / Type<br>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 22.2622.32) 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 22.2622.32 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 22.2622.32).                                                                                                                                                                                           |                              |
| b215 | Reserved                                |                                                                                                                                                                                                                                                                                                                                               |                              |
|      | 0000hFFFFh                              |                                                                                                                                                                                                                                                                                                                                               | 1=1/1=1                      |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                    |                                                             |                                    |                               | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|------------------------------------|-------------------------------|------------------------------|
| 22.22 | Constant speed sel1         | When bit 0 of is 0 (Separate speed 1.                                                                                                                                                                          |                                                             |                                    |                               | DI3 / uint32                 |
|       |                             | 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 |                                                             |                                    |                               |                              |
|       |                             | Source<br>defined by<br>par. 22.22                                                                                                                                                                             | Source<br>defined by<br>par. 22.23                          | Source<br>defined by<br>par. 22.24 | Constant<br>speed act-<br>ive |                              |
|       |                             | 0                                                                                                                                                                                                              | 0                                                           | 0                                  | None                          |                              |
|       |                             | 1                                                                                                                                                                                                              | 0                                                           | 0                                  | Constant<br>speed 1           |                              |
|       |                             | 0                                                                                                                                                                                                              | 1                                                           | 0                                  | Constant<br>speed 2           |                              |
|       |                             | 1                                                                                                                                                                                                              | 1                                                           | 0                                  | Constant<br>speed 3           |                              |
|       |                             | 0                                                                                                                                                                                                              | 0                                                           | 1                                  | Constant<br>speed 4           |                              |
|       |                             | 1                                                                                                                                                                                                              | 0                                                           | 1                                  | Constant<br>speed 5           |                              |
|       |                             | 0                                                                                                                                                                                                              | 1                                                           | 1                                  | Constant<br>speed 6           |                              |
|       |                             | 1                                                                                                                                                                                                              | 1                                                           | 1                                  | Constant<br>speed 7           |                              |
|       | Always off                  | 0.                                                                                                                                                                                                             |                                                             |                                    |                               | 0                            |
|       | Always on                   | 1.                                                                                                                                                                                                             |                                                             |                                    |                               | 1                            |
|       | DI1                         | Digital input DI1 (parameter 10.02 DI delayed status, bit 0).                                                                                                                                                  |                                                             |                                    |                               | 2                            |
|       | DI2                         | Digital input I<br>bit 1).                                                                                                                                                                                     | igital input DI2 (parameter 10.02 DI delayed status, it 1). |                                    | 3                             |                              |
|       | DI3                         | Digital input I<br>bit 2).                                                                                                                                                                                     | OI3 (paramete                                               | er 10.02 DI dela                   | ayed status,                  | 4                            |
|       | DI4                         | Digital input I<br>bit 3).                                                                                                                                                                                     | OI4 (paramete                                               | er 10.02 DI dela                   | ayed status,                  | 5                            |
|       | DI5                         | Digital input I<br>bit 4).                                                                                                                                                                                     | DI5 (paramete                                               | er 10.02 DI dela                   | ayed status,                  | 6                            |
|       | Timed function 1            | Bit 0 of paran                                                                                                                                                                                                 | neter 34.01 Ti                                              | med functions                      | s status.                     | 18                           |
|       | Timed function 2            | Bit 1 of param                                                                                                                                                                                                 | neter 34.01 Tir                                             | ned functions                      | status.                       | 19                           |
|       | Timed function 3            | Bit 2 of param                                                                                                                                                                                                 | neter 34.01 Tir                                             | med functions                      | status.                       | 20                           |
|       | Supervision 1               | Bit 0 of paran                                                                                                                                                                                                 | neter 32.01 Su                                              | pervision stat                     | us.                           | 24                           |
|       | Supervision 2               | Bit 1 of param                                                                                                                                                                                                 | neter 32.01 Su                                              | pervision stat                     | us.                           | 25                           |

| No.   | Name / Range /<br>Selection                                                        | Description                                                                                                                                                                                                                                                                  | Def / Type<br>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.                                                                                                                                                     | Always off / uint32                           |
|       |                                                                                    | 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.                                                                                                                                                                                                                 |                                               |
| 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.                                                                                                                                                     | Always off / uint32                           |
|       |                                                                                    | 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.                                                                                                                                                                                                                 |                                               |
| 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.                                                                                                                                                     | Always off / uint32                           |
|       |                                                                                    | For the selections, see parameter 22.22 Constant speed sel1.                                                                                                                                                                                                                 |                                               |
| 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<br>(95.20 b0) rpm /<br>real32  |
|       | -30000.00<br>30000.00 rpm                                                          | Constant speed 1. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                            | 1 = 1 rpm / 100 = 1<br>rpm                    |
| 22.27 | Constant speed 2                                                                   | Defines constant speed 2.                                                                                                                                                                                                                                                    | 600.00; 720.00<br>(95.20 b0) rpm /<br>real32  |
|       | -30000.00<br>30000.00 rpm                                                          | Constant speed 2. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                            | 1 = 1 rpm / 100 = 1<br>rpm                    |
| 22.28 | Constant speed 3                                                                   | Defines constant speed 3.                                                                                                                                                                                                                                                    | 900.00; 1080.00<br>(95.20 b0) rpm /<br>real32 |
|       | -30000.00<br>30000.00 rpm                                                          | Constant speed 3. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                            | 1 = 1 rpm / 100 = 1<br>rpm                    |

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

| No.   | Name / Range /<br>Selection               | Description                                                                                                                                                      | Def / Type<br>FbEq 16b / 32b |
|-------|-------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| b1    | Sign mode                                 | 1 = Signed: The signs of parameters 22.5222.57 are taken into account.                                                                                           |                              |
|       |                                           | 0 = Absolute: Parameters 22.5222.57 are handled as absolute values. Each range is effective in both directions of rotation.                                      |                              |
| b215  | Reserved                                  |                                                                                                                                                                  |                              |
|       | 0000hFFFFh                                |                                                                                                                                                                  | 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<br>30000.00 rpm                 | Low limit for critical speed 1. For scaling, see parameter 46.01 Speed scaling.                                                                                  | 1 = 1 rpm / 100 = 1<br>rpm   |
| 22.53 | Critical speed 1 high                     | Defines the high limit for critical speed range 1.                                                                                                               | 0.00 rpm / real32            |
|       |                                           | <b>Note</b> : This value must be less than or equal to the value of parameter 22.52 Critical speed 1 low.                                                        |                              |
|       | -30000.00<br>30000.00 rpm                 | High limit for critical speed 1. For scaling, see parameter 46.01 Speed scaling.                                                                                 | 1 = 1 rpm / 100 = 1<br>rpm   |
| 22.54 | Critical speed 2 low                      | Defines the low limit for critical speed range 2.                                                                                                                | 0.00 rpm / real32            |
|       |                                           | <b>Note:</b> This value must be less than or equal to the value of parameter 22.55 Critical speed 2 high.                                                        |                              |
|       | -30000.00<br>30000.00 rpm                 | Low limit for critical speed 2. For scaling, see parameter 46.01 Speed scaling.                                                                                  | 1 = 1 rpm / 100 = 1<br>rpm   |
| 22.55 | Critical speed 2 high                     | Defines the high limit for critical speed range 2.                                                                                                               | 0.00 rpm / real32            |
|       |                                           | <b>Note:</b> This value must be greater than or equal to the value of parameter 22.54 Critical speed 2 low.                                                      |                              |
|       | -30000.00<br>30000.00 rpm                 | High limit for critical speed 2. For scaling, see parameter 46.01 Speed scaling.                                                                                 | 1 = 1 rpm / 100 = 1<br>rpm   |
| 22.56 | Critical speed 3 low                      | Defines the low limit for critical speed range 3.                                                                                                                | 0.00 rpm / real32            |
|       |                                           | <b>Note</b> : This value must be less than or equal to the value of parameter 22.57 Critical speed 3 high.                                                       |                              |
|       | -30000.00<br>30000.00 rpm                 | Low limit for critical speed 3. For scaling, see parameter 46.01 Speed scaling.                                                                                  | 1 = 1 rpm / 100 = 1<br>rpm   |
| 22.57 | Critical speed 3<br>high                  | Defines the high limit for critical speed range 3. <b>Note:</b> This value must be greater than or equal to the                                                  | 0.00 rpm / real32            |
|       |                                           | value of parameter 22.56 Critical speed 3 low.                                                                                                                   |                              |
|       | -30000.00<br>30000.00 rpm                 | High limit for critical speed 3. For scaling, see parameter 46.01 Speed scaling.                                                                                 | 1 = 1 rpm / 100 = 1<br>rpm   |
| 22.70 | Motor potentiomet-<br>er 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 /<br>Selection            | Description                                                                                                                                                                                                                                                                                                                                                 | Def / Type<br>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 potentiomet-<br>er 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<br>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.                                | 1                            |
|       |                                        | A stop or a power cycle will reset the counter to parameter 22.72 Motor potentiometer initial value.                                                                                                                                                                                                                                                        |                              |
|       | 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 (re-<br>sume/init to actual)   | As Enabled (init to actual), but the motor potentiometer ref act value is retained over power cycle.                                                                                                                                                                                                                                                        | 4                            |
| 22.72 | Motor potentiomet-<br>er 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<br>32767.00                  | Initial value for motor potentiometer.                                                                                                                                                                                                                                                                                                                      | 1 = 1 / 100 = 1              |

| No.   | Name / Range /<br>Selection        | Description                                                                                                                                                                                                                                                                                                  | Def / Type<br>FbEq 16b / 32b |
|-------|------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 22.73 | Motor potentiomet-<br>er up source | Selects the source of Floating point control (Motor potentiometer) counter up signal.                                                                                                                                                                                                                        | Not used / uint32            |
|       |                                    | 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                           | 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 /<br>Selection          | Description                                                                                                                                                                                                                                                                                                                                                                          | Def / Type<br>FbEq 16b / 32b |
|-------|--------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 22.74 | Motor potentiomet-<br>er down source | Selects the source of Floating point control (Motor potentiometer) counter down signal.                                                                                                                                                                                                                                                                                              | Not used / uint32            |
|       |                                      | 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. |                              |
| 22.75 | Motor potentiomet-<br>er 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 potentiomet-<br>er min value   | Defines the minimum value of the Floating point control (Motor potentiometer) counter.                                                                                                                                                                                                                                                                                               | -50.00 NoUnit /<br>real32    |
|       |                                      | <b>Note:</b> If vector control mode is used, value of this parameter must be changed.                                                                                                                                                                                                                                                                                                |                              |
|       | -32768.00<br>32767.00                | Counter minimum.                                                                                                                                                                                                                                                                                                                                                                     | 1 = 1 / 100 = 1              |
| 22.77 | Motor potentiomet-<br>er max value   | Defines the maximum value of the Floating point control (Motor potentiometer) counter.                                                                                                                                                                                                                                                                                               | 50.00 NoUnit /<br>real32     |
|       |                                      | <b>Note:</b> If vector control mode is used, value of this parameter must be changed.                                                                                                                                                                                                                                                                                                |                              |
|       | -32768.00<br>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 22.7122.74.)                                                                                                                                                                                                                                  | 0 NoUnit / real32            |
|       |                                      | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                                         |                              |
|       | -32768.00<br>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 se                                                                                                                                                        | 0 rpm / real32               |
|       |                                      | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                                         |                              |

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

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                  | Def / Type<br>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 in-<br>put   | 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). | 0 rpm / real32               |
|       |                             | This parameter is read-only.                                                                                                                                                 |                              |
|       | -30000.00<br>30000.00 rpm   | Speed reference before ramping and shaping. For scaling, see parameter 46.01 Speed scaling.                                                                                  | 1 = 1 rpm / 100 = 1<br>rpm   |
| 23.02 | Speed ref ramp<br>output    | Displays the ramped and shaped speed reference in rpm. See the control chain diagram Speed reference ramping and shaping (page 514).                                         | 0 rpm / real32               |
|       |                             | This parameter is read-only.                                                                                                                                                 |                              |
|       | -30000.00<br>30000.00 rpm   | Speed reference after ramping and shaping. For scaling, see parameter 46.01 Speed scaling.                                                                                   | 1 = 1 rpm / 100 = 1<br>rpm   |
| 23.11 | Ramp set selection          | Selects the source that switches between the two sets of acceleration/deceleration ramp times defined by parameters 23.1223.15.                                              | Acc/Dec time 1 / uint32      |
|       |                             | 0 = Acceleration time 1 and deceleration time 1 are active.                                                                                                                  |                              |
|       |                             | 1 = Acceleration time 2 and deceleration time 2 are active.                                                                                                                  |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                               | Def / Type<br>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).                                                                                                                                                          | 20.000 s / real32            |
|       |                             | 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.                                                                                                                                                                                          |                              |
|       | 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<br>the speed to change from the speed defined by para-<br>meter 46.01 Speed scaling (not from parameter 30.12<br>Maximum speed) to zero.                                                                                                                                             | 20.000 s / real32            |
|       |                             | 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). |                              |
|       |                             | <b>Note:</b> 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.                                                                                                                                                       |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 23.23 | Emergency stop<br>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 | 3.000 s / real32             |
|       |                             | <ul> <li>ramp as defined by parameters 23.1123.15.</li> <li>The same parameter value is also used in frequency control mode (ramp parameters 28.7128.75).</li> </ul>                                                                                                                                                                                                                                                                                                                                                      |                              |
|       | 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.                                                                                                                                                                                                                                                                            | Off / uint16                 |
|       |                             | 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.                                                                                                                                                                                                                                                                                             |                              |
|       |                             | Speed reference  Speed reference  23.02 Speed ref ramp output                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                              |
|       |                             | 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                         | Variable slope disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 0                            |
|       | On                          | Variable slope enabled (not available in local control).                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1                            |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                        | Def / Type<br>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.                                                            | 50 ms / real32               |
|       |                             | For the best result, enter the reference update interval into this parameter.                                                                                                      |                              |
|       | 230000 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 / real32             |
|       |                             | 0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps.                                                                                         |                              |
|       |                             | 0.0011000.000 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:                                                                                                                                                                      |                              |
|       |                             | Linear ramp: 23.32 = 0 s  Linear ramp: 23.32 = 0 s  S-curve ramp: 23.32 > 0 s  S-curve ramp: 23.32 > 0 s  Time                                                                     |                              |
|       |                             | Speed S-curve ramp: 23.32 > 0 s                                                                                                                                                    |                              |
|       |                             | 23.32 = 0 s  S-curve ramp: 23.32 > 0 s  Linear ramp: 23.32 = 0 s  Time                                                                                                             |                              |
|       | 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 /<br>Selection | Description                                                   | Def / Type<br>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 /<br>Selection  | Description                                                                                                                                                                                                                                                                                                                                                        | Def / Type<br>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).                                                                                                                                                                                                              | 0.00 rpm / real32            |
|       |                              | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                       |                              |
|       | -30000.00<br>30000.00 rpm    | Speed reference used for speed error calculation. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                                                                                  | 1 = 1 rpm / 100 = 1<br>rpm   |
| 24.02 | Used speed feed-<br>back     | Displays the speed feedback used for speed error calculation. See the control chain diagram Speed error calculation (page 515).                                                                                                                                                                                                                                    | 0.00 rpm / real32            |
|       |                              | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                       |                              |
|       | -30000.00<br>30000.00 rpm    | Speed feedback used for speed error calculation. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                                                                                   | 1 = 1 rpm / 100 = 1<br>rpm   |
| 24.03 | Speed error filtered         | Displays the filtered speed error. See the control chain diagram Speed error calculation (page 515).                                                                                                                                                                                                                                                               | 0.00 rpm / real32            |
|       |                              | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                       |                              |
|       | -30000.00<br>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).                                                                                                                                                                                                                                                  | 0.00 rpm / real32            |
|       |                              | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                       |                              |
|       | -30000.00<br>30000.00 rpm    | Inverted speed error. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                                                                                                              | 1 = 1 rpm / 100 = 1<br>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.                                                                                                                                   | 0.00 rpm / real32            |
|       |                              | See the control chain diagram Speed error calculation (page 515).                                                                                                                                                                                                                                                                                                  |                              |
|       | -10000.00<br>10000.00 rpm    | Speed reference correction. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                                                                                                        | 1 = 1 rpm / 100 = 1<br>rpm   |
| 24.12 | Speed error filter time      | Defines the time constant of the speed error low-pass filter.                                                                                                                                                                                                                                                                                                      | 0 ms / real32                |
|       |                              | 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. |                              |

| No. | Name / Range /<br>Selection | •                                                            | Def / Type<br>FbEq 16b / 32b |
|-----|-----------------------------|--------------------------------------------------------------|------------------------------|
|     | 010000 ms                   | Speed error filtering time constant. 0 = filtering disabled. | 1 = 1 ms / 1 = 1 ms          |

| No.   | Name / Range /<br>Selection    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Def / Type<br>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.                                                                                                                                                                                                                                                                                                                                                                                                    | 0.0 percent / real32         |
|       |                                | See the control chain diagram Speed controller (page 516).                                                                                                                                                                                                                                                                                                                                                                                                                            |                              |
|       |                                | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                              |
|       | -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. $ \frac{Gain = K_p = 1}{T_p \text{ integration time = 0}} $ Controller output = $\frac{K_p}{K_p} = 1$ Controller output = $\frac{K_p}{K_p} = 1$ If gain is set to 1, a 10% change in error value (reference – actual value) causes the speed controller output to | 5.00 NoUnit / real32         |
|       | 0.00 250.00                    | change by 10%, that is, the output value is input × gain.  Proportional gain for speed controller.                                                                                                                                                                                                                                                                                                                                                                                    | 100 = 1 / 100 = 1            |
|       | 0.00 230.00                    | Proportional gain for speed controller.                                                                                                                                                                                                                                                                                                                                                                                                                                               | 100 - 1 / 100 - 1            |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Def / Type<br>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. | 2.50 s / real32              |
|       |                             | Setting the integration time to zero disables the l-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.                                                                                                                                                                                                                                                                                                                                                                                                     |                              |
|       |                             | Controller output                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                              |
|       |                             | K <sub>p</sub> xe                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                              |
|       | 0.00 1000.00 s              | Integration time for speed controller.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 10 = 1 s / 100 = 1 s         |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Def / Type<br>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. | 0.000 s / real32             |
|       |                             | 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.                                                                                                                                                                                                                                                                                                                                                                                                            |                              |
|       |                             | $K_{p} \times T_{D} \times \frac{\Delta e}{T_{s}}$ $K_{p} \times e$ $K_{p} \times e$ $K_{p} \times e$ $T_{l}$ $Time$                                                                                                                                                                                                                                                                                                                                                                                               |                              |
|       |                             | Gain = K <sub>p</sub> = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                              |
|       |                             | T <sub>I</sub> = Integration time > 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                              |
|       |                             | T <sub>D</sub> = Derivation time > 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                              |
|       |                             | $T_s$ = Sample time period = 250 $\mu$ s                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                              |
|       |                             | $\Delta e$ = Error value change between two samples                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                              |
|       | 0.000 10.000 s              | Derivation time for speed controller.                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1000 = 1 s / 1000 = 1<br>s   |
|       |                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
| 25.05 | Derivation filter time      | Defines the derivation filter time constant. See parameter 25.04 Speed derivation time.                                                                                                                                                                                                                                                                                                                                                                                                                            | 8 ms / real32                |

| No.   | Name / Range /<br>Selection   | Description                                                                                                                                                                                                                                                                                                                | Def / Type<br>FbEq 16b / 32b |
|-------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 25.06 | Acc comp deriva-<br>tion 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. | 0.00 s / real32              |
|       |                               | <b>Note</b> : 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:                                                                                                                                                                                                                                                                                              |                              |
|       |                               | %                                                                                                                                                                                                                                                                                                                          |                              |
|       |                               |                                                                                                                                                                                                                                                                                                                            |                              |
|       |                               | <ul> <li>Speed reference</li> </ul>                                                                                                                                                                                                                                                                                        |                              |
|       |                               | Actual speed                                                                                                                                                                                                                                                                                                               |                              |
|       |                               | <u> </u>                                                                                                                                                                                                                                                                                                                   |                              |
|       |                               | Time Acceleration compensation:                                                                                                                                                                                                                                                                                            |                              |
|       |                               | % i                                                                                                                                                                                                                                                                                                                        |                              |
|       |                               | <sup>↑</sup> <b>↑</b>                                                                                                                                                                                                                                                                                                      |                              |
|       |                               |                                                                                                                                                                                                                                                                                                                            |                              |
|       |                               | <u></u>                                                                                                                                                                                                                                                                                                                    |                              |
|       |                               |                                                                                                                                                                                                                                                                                                                            |                              |
|       |                               | <ul> <li>Speed reference</li> </ul>                                                                                                                                                                                                                                                                                        |                              |
|       |                               | Actual speed                                                                                                                                                                                                                                                                                                               |                              |
|       |                               |                                                                                                                                                                                                                                                                                                                            |                              |
|       | 1000                          | Time                                                                                                                                                                                                                                                                                                                       |                              |
|       | 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 /<br>real32     |

| No.   | Name / Range /<br>Selection    | Description                                                                                                                                                                                                                                                                                                                                                                                                          | Def / Type<br>FbEq 16b / 32b |
|-------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | 1.00 250.00                    | Proportional gain upon an emergency stop.                                                                                                                                                                                                                                                                                                                                                                            | 100 = 1 / 100 = 1            |
| 25.30 | Flux adaptation enable         | on motor flux reference (parameter 01.24 Flux actual %).  The proportional gain of the speed controller is multi-                                                                                                                                                                                                                                                                                                    | Enable / uint16              |
|       |                                | plied by a coefficient of 01 between 0100% flux reference respectively.                                                                                                                                                                                                                                                                                                                                              |                              |
|       | 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 ma-<br>chinery as determined by the speed controller autotune<br>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.                                                                                                                                                                                                                                                                                                      | 10.00 percent /<br>real32    |
|       |                                | <b>Note:</b> 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.                                                                                                                                                                                                                                              | 6                            |
|       | 0.00 20.00 %                   | Torque step.                                                                                                                                                                                                                                                                                                                                                                                                         | 100 = 1 % / 100 = 1 %        |
| 25.39 | Autotune speed<br>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. | 10.00 percent /<br>real32    |
|       |                                | <b>Note:</b> The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.                                                                                                                                                                                                                                                                                                      |                              |

| No.   | Name / Range /<br>Selection  | Description                                                                                                                                                                                                                          | Def / Type<br>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            |
|       | 110                          | 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.                                                                                                                                                            | 0.0 percent / real32         |
|       |                              | See the control chain diagram Speed controller (page 516).                                                                                                                                                                           |                              |
|       |                              | This parameter is read-only.                                                                                                                                                                                                         |                              |
|       | -30000.0 30000.0<br>%        | 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.                                                                                                                                                                | 0.0 percent / real32         |
|       |                              | See the control chain diagram Speed controller (page 516).                                                                                                                                                                           |                              |
|       |                              | This parameter is read-only.                                                                                                                                                                                                         |                              |
|       | -30000.0 30000.0<br>%        | 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.                                                                                                                                                              | 0.0 percent / real32         |
|       |                              | See the control chain diagram Speed controller (page 516).                                                                                                                                                                           |                              |
|       |                              | This parameter is read-only.                                                                                                                                                                                                         |                              |
|       | -30000.0 30000.0<br>%        | D-part output of speed controller. For scaling, see parameter 46.03 Torque scaling.                                                                                                                                                  | 10 = 1 % / 10 = 1 %          |
| 25.56 | Torque acc com-<br>pensation | Displays the output of the acceleration compensation function.                                                                                                                                                                       | 0.0 percent / real32         |
|       |                              | See the control chain diagram Speed controller (page 516).                                                                                                                                                                           |                              |
|       |                              | This parameter is read-only.                                                                                                                                                                                                         |                              |
|       | -30000.0 30000.0<br>%        | Output of acceleration compensation function. For scaling, see parameter 46.03 Torque scaling.                                                                                                                                       | 10 = 1 % / 10 = 1 %          |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 28    | Frequency refer-            | Settings for the frequency reference chain.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
|       | ence chain                  | See chapter Control chain diagrams (page 509).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                              |
| 28.01 | Frequency ref ramp          | Displays the used frequency reference before ramping.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0.00 Hz / real32             |
|       | input                       | See the control chain diagrams Frequency reference selection (page 510) and Frequency reference modification (page 511).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |
|       |                             | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              |
|       | -500.00 500.00<br>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).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 0.00 Hz / real32             |
|       |                             | See the control chain diagram Frequency reference selection (page 510).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                              |
|       |                             | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                              |
|       | -500.00 500.00<br>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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Al1 scaled / uint32          |
|       |                             | 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).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |
|       |                             | 28.11 ADD O ADD O Cother Other |                              |
|       |                             | O 28.15 Al Ref1 FB Other Sub O B B                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                              |
|       | Zero                        | None.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0                            |

| No.   | Name / Range /<br>Selection   | Description                                                                                                                                                                                                                                                                                                                                                                                      | Def / Type<br>FbEq 16b / 32b |
|-------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Al1 scaled                    | Parameter 12.12 Al1 scaled value.                                                                                                                                                                                                                                                                                                                                                                | 1                            |
|       | Al2 scaled                    | Parameter 12.22 Al2 scaled value.                                                                                                                                                                                                                                                                                                                                                                | 2                            |
|       | EFB ref1                      | Parameter 03.09 EFB reference 1.                                                                                                                                                                                                                                                                                                                                                                 | 8                            |
|       | EFB ref2                      | Parameter 03.10 EFB reference 2.                                                                                                                                                                                                                                                                                                                                                                 | 9                            |
|       | Motor potentiomet-<br>er      | 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.  Reference    EXT1 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.  Reference  EXT1 reference  EXT2 reference  Active reference  Inactive 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                          | Def / Type<br>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 feri         | 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                            |
|       | Al1 scaled                  | Parameter 12.12 Al1 scaled value.                                                                                                                                                                                                                                                                                    | 1                            |
|       | AI2 scaled                  | Parameter 12.22 Al2 scaled value.                                                                                                                                                                                                                                                                                    | 2                            |
|       | EFB ref1                    | Parameter 03.09 EFB reference 1.                                                                                                                                                                                                                                                                                     | 8                            |
|       | EFB ref2                    | Parameter 03.10 EFB reference 2.                                                                                                                                                                                                                                                                                     | 9                            |
|       | Motor potentiomet-<br>er    | 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.  **Reference**  **EXT1 reference**                                                                                                                        | 18                           |
|       |                             | X - X - X X X EXT2 reference — Active reference Inactive reference                                                                                                                                                                                                                                                   |                              |
|       |                             | EXT1 -> EXT2                                                                                                                                                                                                                                                                                                         |                              |

| No.   | Name / Range /<br>Selection   | Description                                                                                                                                                                                                                                                                                                                                                                                      | Def / Type<br>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.  Reference  EXT1 reference  EXT2 reference  Active reference  Inactive 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 | . ,                           | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                   | Def / Type<br>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 28.2628.32) 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 28.2628.32 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 28.2628.32).                                                                                                                                                                                                 |                              |
| b215 | Reserved                    |                                                                                                                                                                                                                                                                                                                                               |                              |
|      | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                               | 1=1/1=1                      |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                        |                                    |                                    |                                 | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|------------------------------------|---------------------------------|------------------------------|
| 28.22 | Constant frequency sel1     | When bit 0 of parameter 28.21 Constant frequency function is 0 (Separate), selects a source that activates constant frequency 1.                                                                                                                   |                                    |                                    | DI3 / uint32                    |                              |
|       |                             | 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: |                                    |                                    |                                 |                              |
|       |                             | Source<br>defined by<br>par. 28.22                                                                                                                                                                                                                 | Source<br>defined by<br>par. 28.23 | Source<br>defined by<br>par. 28.24 | Constant<br>frequency<br>active |                              |
|       |                             | 0                                                                                                                                                                                                                                                  | 0                                  | 0                                  | None                            |                              |
|       |                             | 1                                                                                                                                                                                                                                                  | 0                                  | 0                                  | Constant<br>frequency 1         |                              |
|       |                             | 0                                                                                                                                                                                                                                                  | 1                                  | 0                                  | Constant<br>frequency 2         |                              |
|       |                             | 1                                                                                                                                                                                                                                                  | 1                                  | 0                                  | Constant<br>frequency 3         |                              |
|       |                             | 0                                                                                                                                                                                                                                                  | 0                                  | 1                                  | Constant<br>frequency 4         |                              |
|       |                             | 1                                                                                                                                                                                                                                                  | 0                                  | 1                                  | Constant<br>frequency 5         |                              |
|       |                             | 0                                                                                                                                                                                                                                                  | 1                                  | 1                                  | Constant<br>frequency 6         |                              |
|       |                             | 1                                                                                                                                                                                                                                                  | 1                                  | 1                                  | Constant<br>frequency 7         |                              |
|       | 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 I<br>bit 1).                                                                                                                                                                                                                         | OI2 (paramete                      | r 10.02 DI dela                    | ayed status,                    | 3                            |
|       | DI3                         | Digital input I<br>bit 2).                                                                                                                                                                                                                         | OI3 (paramete                      | r 10.02 DI dela                    | ayed status,                    | 4                            |
|       | DI4                         | Digital input I<br>bit 3).                                                                                                                                                                                                                         | OI4 (paramete                      | er 10.02 DI del                    | ayed status,                    | 5                            |
|       | DI5                         | Digital input I<br>bit 4).                                                                                                                                                                                                                         | OI5 (paramete                      | er 10.02 DI del                    | ayed status,                    | 6                            |
|       | Timed function 1            | Bit 0 of paran                                                                                                                                                                                                                                     | neter 34.01 Ti                     | med functions                      | s status.                       | 18                           |
|       | Timed function 2            | Bit 1 of param                                                                                                                                                                                                                                     | neter 34.01 Tir                    | ned functions                      | status.                         | 19                           |
|       | Timed function 3            | Bit 2 of param                                                                                                                                                                                                                                     | neter 34.01 Tir                    | med functions                      | status.                         | 20                           |
|       | Supervision 1               | Bit 0 of paran                                                                                                                                                                                                                                     | neter 32.01 Su                     | pervision stat                     | tus.                            | 24                           |
|       | Supervision 2               | Bit 1 of param                                                                                                                                                                                                                                     | neter 32.01 Su                     | pervision stat                     | us.                             | 25                           |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                       | Def / Type<br>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.                                                                                                                                                                  | Always off / uint32                    |
|       |                             | 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.                                                                                                                                                                                                                                  |                                        |
| 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.                                                                                                                                                                  | Always off / uint32                    |
|       |                             | 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.                                                                                                                                                                                                                                  |                                        |
| 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.                                                                                                                                                                  | Always off / uint32                    |
|       |                             | For the selections, see parameter 28.22 Constant frequency sel1.                                                                                                                                                                                                                                  |                                        |
| 28.26 | Constant frequency          | Defines constant frequency 1 (the frequency the motor will turn when constant frequency 1 is selected).                                                                                                                                                                                           | 5.00; 6.00 (95.20 b0)<br>Hz / real32   |
|       | -500.00 500.00<br>Hz        | Constant frequency 1. For scaling, see parameter 46.02 Frequency scaling.                                                                                                                                                                                                                         | 10 = 1 Hz / 100 = 1 Hz                 |
| 28.27 | Constant frequency<br>2     | Defines constant frequency 2.                                                                                                                                                                                                                                                                     | 10.00; 12.00 (95.20<br>b0) Hz / real32 |
|       | -500.00 500.00<br>Hz        | Constant frequency 2. For scaling, see parameter 46.02 Frequency scaling.                                                                                                                                                                                                                         | 10 = 1 Hz / 100 = 1 Hz                 |
| 28.28 | Constant frequency          | Defines constant frequency 3.                                                                                                                                                                                                                                                                     | 15.00; 18.00 (95.20<br>b0) Hz / real32 |
|       | -500.00 500.00<br>Hz        | Constant frequency 3. For scaling, see parameter 46.02 Frequency scaling.                                                                                                                                                                                                                         | 10 = 1 Hz / 100 = 1 Hz                 |
| 28.29 | Constant frequency<br>4     | Defines constant frequency 4.                                                                                                                                                                                                                                                                     | 20.00; 24.00 (95.20<br>b0) Hz / real32 |
|       | -500.00 500.00<br>Hz        | Constant frequency 4. For scaling, see parameter 46.02 Frequency scaling.                                                                                                                                                                                                                         | 10 = 1 Hz / 100 = 1 Hz                 |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                        | Def / Type<br>FbEq 16b / 32b                 |
|-------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| 28.30 | Constant frequency<br>5     | Defines constant frequency 5.                                                                                                                      | 25.00; 30.00 Hz<br>(95.20 b0) Hz /<br>real32 |
|       | -500.00 500.00<br>Hz        | Constant frequency 5. For scaling, see parameter 46.02 Frequency scaling.                                                                          | 10 = 1 Hz / 100 = 1 Hz                       |
| 28.31 | Constant frequency<br>6     | Defines constant frequency 6.                                                                                                                      | 40.00; 48.00 (95.20<br>b0) Hz / real32       |
|       | -500.00 500.00<br>Hz        | Constant frequency 6. For scaling, see parameter 46.02 Frequency scaling.                                                                          | 10 = 1 Hz / 100 = 1 Hz                       |
| 28.32 | Constant frequency<br>7     | Defines constant frequency 7.                                                                                                                      | 50.00; 60.00 (95.20<br>b0) Hz / real32       |
|       | -500.00 500.00<br>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                                                           | 0.00 Hz / real32                             |
|       |                             | <ul> <li>parameter 12.03 Al supervision function</li> <li>parameter 49.05 Communication loss action.</li> </ul>                                    |                                              |
|       | -500.00 500.00<br>Hz        | Safe frequency reference. For scaling, see parameter 46.02 Frequency scaling.                                                                      | 10 = 1 Hz / 100 = 1 Hz                       |
| 28.46 | Constant frequency<br>sel5  | When bit 0 of parameter 28.21 Constant frequency function is 0 (Separate), selects a source that activates constant frequency 4.                   | Always off / uint32                          |
|       |                             | For the selections, see parameter 28.22 Constant frequency sel1.                                                                                   |                                              |
| 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.                   | Always off / uint32                          |
|       |                             | For the selections, see parameter 28.22 Constant frequency sel1.                                                                                   |                                              |
| 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. | 0000h / uint16                               |
|       |                             | See also section Critical speeds/frequencies (page 75).                                                                                            |                                              |
| b0    | Crit freq                   | 1 = Enable: Critical frequencies enabled.                                                                                                          |                                              |
|       |                             | 0 = Disable: Critical frequencies disabled.                                                                                                        |                                              |
| b1    | Sign mode                   | 1 = According to par: The signs of parameters 28.5228.57 are taken into account.                                                                   |                                              |
|       |                             | 0 = Absolute: Parameters 28.5228.57 are handled as absolute values. Each range is effective in both directions of rotation.                        |                                              |
| b215  | Reserved                    |                                                                                                                                                    |                                              |
|       | 0000hFFFFh                  |                                                                                                                                                    | 1=1/1=1                                      |

| No.   | Name / Range /<br>Selection | Description                                                                                                              | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 28.52 | Critical frequency 1        | Defines the low limit for critical frequency 1.                                                                          | 0.00 Hz / real32             |
|       | low                         | <b>Note:</b> This value must be less than or equal to the value of parameter 28.53 Critical frequency 1 high.            |                              |
|       | -500.00 500.00<br>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.                                                                         | 0.00 Hz / real32             |
|       | g                           | <b>Note:</b> This value must be greater than or equal to the value of parameter 28.52 Critical frequency 1 low.          |                              |
|       | -500.00 500.00<br>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        | Defines the low limit for critical frequency 2.                                                                          | 0.00 Hz / real32             |
|       |                             | <b>Note:</b> This value must be less than or equal to the value of parameter 28.55 Critical frequency 2 high.            |                              |
|       | -500.00 500.00<br>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.                                                                         | 0.00 Hz / real32             |
|       | 9                           | <b>Note:</b> This value must be greater than or equal to the value of parameter 28.54 Critical frequency 2 low.          |                              |
|       | -500.00 500.00<br>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        | Defines the low limit for critical frequency 3.                                                                          | 0.00 Hz / real32             |
|       |                             | <b>Note:</b> This value must be less than or equal to the value of parameter 28.57 Critical frequency 3 high.            |                              |
|       | -500.00 500.00<br>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        | Defines the high limit for critical frequency 3.                                                                         | 0.00 Hz / real32             |
|       | ingii                       | <b>Note:</b> This value must be greater than or equal to the value of parameter 28.56 Critical frequency 3 low.          |                              |
|       | -500.00 500.00<br>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 28.7228.75. | Acc/Dec time 1 / uint32      |
|       |                             | 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              | 0.                                                                                                                       | 0                            |
|       | Acc/Dec time 2              | 1.                                                                                                                       | 1                            |
|       | DI1                         | Digital input DI1 (parameter 10.02 DI delayed status, bit 0).                                                            | 2                            |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                           | Def / Type<br>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. | 30.000 s / real32            |
|       |                             | 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.                                                                                                                                                      |                              |
|       | 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                                           | 30.000 s / real32            |
|       |                             | too short, ensure that DC overvoltage control (parameter 30.30 Overvoltage control) is on.                                                                                                                                                                                                            |                              |
|       |                             | <b>Note</b> : 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.                                                                                                                  |                              |
|       | 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 /<br>Selection | Description                                                   | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------|------------------------------|
| 28.76 | Freq ramp in zero source    | Selects a source that forces the frequency reference to zero. | Inactive / uint32            |
|       |                             | 0 = Force frequency reference to zero.                        |                              |
|       |                             | 1 = Normal operation.                                         |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                                        | Def / Type<br>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 / real32             |
|       |                             | 0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps.                                                                                         |                              |
|       |                             | 0.0011000.000 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:                                                                                                                                                                      |                              |
|       |                             | Linear ramp: 28.82 = 0 s  Shape time  Shape time  28.82 > 0 s  S-curve ramp: 28.82 > 0 s  Time                                                                                     |                              |
|       |                             | Deceleration:                                                                                                                                                                      |                              |
|       |                             | Speed  S-curve ramp: 28.82 > 0 s  Linear ramp: 28.82 > 0 s  Linear ramp: 28.82 > 0 s  Time                                                                                         |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                                 | Def / Type<br>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). | 0.00 Hz / real32             |
|       |                             | See the control chain diagram Frequency reference selection (page 510).                                                                                                     |                              |
|       |                             | This parameter is read-only.                                                                                                                                                |                              |
|       | -500.00 500.00<br>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.                                                                   | 0.00 Hz / real32             |
|       |                             | See the control chain diagram Frequency reference selection (page 510).                                                                                                     |                              |
|       |                             | This parameter is read-only.                                                                                                                                                |                              |
|       | -500.00 500.00<br>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.                                                                | 0.00 Hz / real32             |
|       |                             | See the control chain diagram Frequency reference modification (page 511).                                                                                                  |                              |
|       |                             | This parameter is read-only.                                                                                                                                                |                              |
|       | -500.00 500.00<br>Hz        | Frequency reference before ramping and limiting. For scaling, see parameter 46.02 Frequency scaling.                                                                        | 10 = 1 Hz / 100 = 1 Hz       |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                            | Def / Type<br>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<br>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. |                                 |
| b16   | Reserved                    |                                                                                                                                                                                        |                                 |
| b7    | Max speed ref lim           | 1 = Speed reference is being limited by parameter 30.12<br>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.                                                                                                         |                                 |
| b1115 | Reserved                    |                                                                                                                                                                                        |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                                                        | 1 = 1 / 1 = 1                   |
| 30.02 | Torque limit status         | Displays the torque controller limitation status word.  This parameter is read-only.                                                                                                   | 0000 0000 0000<br>0000 / uint16 |
|       |                             | *Only one out of bits 03, and one out of bits 911 can be on simultaneously. The bit typically indicates the limit that is exceeded first.                                              |                                 |
| 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 811) 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Def / Type<br>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<br>Maximum current.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                |
| b11   | Thermal IGBT                | *1 = Output current is being limited by a calculated thermal current value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                |
| b12   | IGBT overtemperat-<br>ure   | *1 = Output current is being limited because of estimated IGBT temperature.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                |
| b13   | IGBT overload               | *1 = Output current is being limited because of IGBT junction to case temperature.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                |
| b1415 | Reserved                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1=1/1=1                                        |
| 30.11 | Minimum speed               | Defines together with parameter 30.12 Maximum speed the allowed speed range. See the figure below.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 0.00 rpm / real32                              |
|       |                             | 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.  Speed 30.11 value = Request 3 |                                                |
|       | -30000.00<br>30000.00 rpm   | Minimum allowed speed. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1 = 1 rpm / 100 = 1<br>rpm                     |
| 30.12 | Maximum speed               | Defines together with parameter 30.11 Minimum speed the allowed speed range. See parameter 30.11 Minimum speed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1500.00; 1800.00<br>(95.20 b0) rpm /<br>real32 |
|       |                             | <b>Note:</b> This parameter does not affect the speed acceleration and deceleration ramp times. See parameter 46.01 Speed scaling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | -30000.00<br>30000.00 rpm   | Maximum speed. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1 = 1 rpm / 100 = 1<br>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.  Prequency  30.13 value > 0  30.14 Frequency range allowed  30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed 30.13 value > 0  30.14 Frequency range allowed | 0.00 Hz / real32             |
|       | -500.00 500.00<br>Hz        | Minimum frequency. For scaling, see parameter 46.02 Frequency scaling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 10 = 1 Hz / 100 = 1 Hz       |
| 30.14 | Maximum fre-<br>quency      | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                              |
|       | -500.00 500.00<br>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 de-<br>pendant A | Maximum motor current.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 = 1 A / 100 = 1 A          |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                   | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 30.18 | Torq lim sel                | Selects a source that switches between two different predefined minimum torque limit sets.                                                                                                                                                    | Torque limit set 1 / uint32  |
|       |                             | 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). |                              |
|       |                             | 30.21  Al1  Al2  PID  30.23  Other  30.19  User-defined minimum torque limit                                                                                                                                                                  |                              |
|       |                             | 30.22  Al1  Al2  PID  30.24  Other  30.20  User-defined minimum torque limit                                                                                                                                                                  |                              |
|       |                             | <b>Note:</b> In addition to the user-defined limits, torque may be limited for other reasons (such as power limitation)                                                                                                                       |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                | Def / Type<br>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).                                                                                                                                                                                                                                                                                                                         | -300.0 percent /<br>real32   |
|       |                             | See diagram at parameter 30.18 Torq lim sel.                                                                                                                                                                                                                                                                                                                                                               |                              |
|       |                             | The limit is effective when                                                                                                                                                                                                                                                                                                                                                                                |                              |
|       |                             | <ul> <li>the source selected by parameter 30.18 Torq lim sel is 0, or</li> <li>parameter 30.18 Torq lim sel is set to Torque limit set 1.</li> </ul>                                                                                                                                                                                                                                                       |                              |
|       |                             | 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. |                              |
|       | -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).                                                                                                                                                                                                                                                                                                                         | 300.0 percent /<br>real32    |
|       |                             | See diagram at parameter 30.18 Torq lim sel.                                                                                                                                                                                                                                                                                                                                                               |                              |
|       |                             | The limit is effective when                                                                                                                                                                                                                                                                                                                                                                                |                              |
|       |                             | <ul> <li>the source selected by parameter 30.18 Torq lim sel<br/>is 0, or</li> </ul>                                                                                                                                                                                                                                                                                                                       |                              |
|       |                             | <ul> <li>parameter 30.18 Torq lim sel is set to Torque limit set 1.</li> </ul>                                                                                                                                                                                                                                                                                                                             |                              |
|       | 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         |                                                                                                                                                                                                                                                                                                                                                                                                            | Minimum torque 2 / uint32    |
|       |                             | the source selected by parameter 30.18 Torq lim sel is 1, or     parameter 30.18 Torq lim sel is set to Torque limit.                                                                                                                                                                                                                                                                                      |                              |
|       |                             | <ul> <li>parameter 30.18 Torq lim sel is set to Torque limit<br/>set 2.</li> <li>See diagram at parameter 30.18 Torq lim sel.</li> </ul>                                                                                                                                                                                                                                                                   |                              |
|       |                             |                                                                                                                                                                                                                                                                                                                                                                                                            |                              |
|       |                             | <b>Note:</b> Any positive values received from the selected source are inverted.                                                                                                                                                                                                                                                                                                                           |                              |
|       | Zero                        | None.                                                                                                                                                                                                                                                                                                                                                                                                      | 0                            |
|       | Al1 scaled                  | Parameter 12.12 Al1 scaled value.                                                                                                                                                                                                                                                                                                                                                                          | 1                            |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                  | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | AI2 scaled                  | Parameter 12.22 Al2 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                                                                                                                                                         | Maximum torque 2 / uint32    |
|       |                             | <ul> <li>parameter 30.18 Torq lim sel is set to Torque limit<br/>set 2.</li> </ul>                                                                                                                                                                                                                                           |                              |
|       |                             | See diagram at parameter 30.18 Torq lim sel.                                                                                                                                                                                                                                                                                 |                              |
|       |                             | <b>Note:</b> Any negative values received from the selected source are inverted.                                                                                                                                                                                                                                             |                              |
|       | Zero                        | None.                                                                                                                                                                                                                                                                                                                        | 0                            |
|       | Al1 scaled                  | Parameter 12.12 Al1 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                                                                                                                                                                                                                                     | -300.0 percent /<br>real32   |
|       |                             | <ul> <li>the source selected by parameter 30.18 Torq lim sel is 1, or</li> <li>parameter 30.18 Torq lim sel is set to Torque limit set 2, and</li> <li>parameter 30.21 Min torque 2 source is set to Minimum torque 2.</li> <li>See diagram at parameter 30.18 Torq lim sel.</li> </ul>                                      |                              |
|       | -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                                                                                                                                                                                                                                     | 300.0 percent /<br>real32    |
|       |                             | <ul> <li>The limit is effective when</li> <li>the source selected by parameter 30.18 Torq lim sel is 1, or</li> <li>parameter 30.18 Torq lim sel is set to Torque limit set 2, and</li> <li>parameter 30.22 Max torque 2 source is set to Maximum torque 2.</li> <li>See diagram at parameter 30.18 Torq lim sel.</li> </ul> |                              |
|       | 0.0 1600.0 %                | Maximum torque limit 2. For scaling, see parameter 46.03 Torque scaling.                                                                                                                                                                                                                                                     | 10 = 1 % / 10 = 1 %          |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 30.26 | Power motoring<br>limit     | Defines the maximum allowed power fed by the inverter to the motor in percent of nominal motor power.                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 300.00 percent /<br>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                                                                                                                                                                                   | -300.00 percent / real32     |
|       |                             | parameter 30.19 Minimum torque 1 or 30.27 Power generating limit to 0%, as the drive is then not able to stop correctly.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                              |
|       | -600.00 0.00 %              | Maximum generating power.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 1 = 1 % / 100 = 1 %          |
| 30.30 | Overvoltage control         | 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.                                                                                                                                                                                                                                                                                                                                      | Enable / uint16              |
|       |                             | <b>Note:</b> If the drive is equipped with a brake chopper and resistor, or a regenerative supply unit, the controller must be disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                  |                              |
|       | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Enable / uint16              |
|       |                             | The limitation should only be disabled if required by the application.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
|       | Disable                     | Thermal current limitation disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0                            |
|       | Enable                      | Thermal current limitation enabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 1                            |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                 | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 30.36 | Speed limit selection       | Selects a source that switches between two different predefined adjustable speed limit sets.                                                                                                                                                                                                                | Not selected / uint32        |
|       |                             | 0 = minimum speed limit defined by parameter 30.11<br>Minimum speed and maximum speed limit defined by<br>parameter 30.12 Maximum speed are active.                                                                                                                                                         |                              |
|       |                             | 1 = minimum speed limit selected by parameter 30.37<br>Min speed source defined by parameter 30.38 Max<br>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). |                              |
|       |                             | Minimum speed Other  30.31  User-defined minimum speed limit                                                                                                                                                                                                                                                |                              |
|       |                             | Maximum speed Other 30.12  Output  Other                                                                                |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                 | Def / Type<br>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. |                              |
|       | Zero                        | None.                                                                                                                                                                                                                                                                       | 0                            |
|       | Al1 scaled                  | Parameter 12.12 Al1 scaled value.                                                                                                                                                                                                                                           | 1                            |
|       | AI2 scaled                  | Parameter 12.22 Al2 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.           |                              |
|       | Zero                        | None.                                                                                                                                                                                                                                                                       | 0                            |
|       | Al1 scaled                  | Parameter 12.12 Al1 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<br>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<br>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 /<br>Selection  | Description                                                                                                                                         | Def / Type<br>FbEq 16b / 32b    |
|-------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 30.41 | Limit word 1 event selection | Enables/disables if a warning is generated.                                                                                                         | 0000 0000 0000<br>0000 / uint16 |
| b0    | Torq lim                     | 0 = Disabled; 1 = Enabled. See parameter 30.01 Limit word 1 for more information.                                                                   |                                 |
| b12   | 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.                                                                   |                                 |
| b1115 | Reserved                     |                                                                                                                                                     |                                 |
|       | 0000hFFFFh                   |                                                                                                                                                     | 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 /<br>Selection | Description                                                                              | Def / Type<br>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-<br>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. |                              |
| b1415 | Reserved                    |                                                                                          |                              |
|       | 0000hFFFFh                  |                                                                                          | 1=1/1=1                      |

| No.   | Name / Range /<br>Selection | Description                                                                                 | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------|------------------------------|
| 31    | Fault functions             | Configuration of external events; selection of behavior of the drive upon fault situations. |                              |
| 31.01 | External event 1            | Defines the source of external event 1.                                                     | Inactive (true) /            |
|       | source                      | See also parameter 31.02 External event 1 type.                                             | uint32                       |
|       |                             | 0 = Trigger event.                                                                          |                              |
|       |                             | 1 = Normal operation.                                                                       |                              |
|       | 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.     | Inactive (true) /<br>uint32  |
|       |                             | For the selections, see parameter 31.01 External event 1 source.                            |                              |
| 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.     | Inactive (true) /<br>uint32  |
|       |                             | For the selections, see parameter 31.01 External event 1 source.                            |                              |
| 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Def / Type<br>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.                                                                                                                                                                                                                                                                                                                                                                        | Inactive (true) /<br>uint32  |
|       |                             | For the selections, see parameter 31.01 External event 1 source.                                                                                                                                                                                                                                                                                                                                                                                               |                              |
| 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.                                                                                                                                                                                                                                                                                                                                                                        | Inactive (true) /<br>uint32  |
|       |                             | For the selections, see parameter 31.01 External event 1 source.                                                                                                                                                                                                                                                                                                                                                                                               |                              |
| 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                                                                                                                                                                                                                                                                                                | Not used / uint32            |
|       |                             | 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                    | 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 /<br>Selection  | Description                                                                                                                                                                       | Def / Type<br>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          | meter 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.                                   | 000Ch / uint16               |
|       |                              | <b>Note:</b> 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:                                                                                                                |                              |
| b0    | Overcurrent                  | Overcurrent.                                                                                                                                                                      |                              |
| b1    | Overvoltage                  | Overvoltage.                                                                                                                                                                      |                              |
| b2    | Undervoltage                 | Undervoltage.                                                                                                                                                                     |                              |
| b3    | Al supervision fault         | Al supervision fault.                                                                                                                                                             |                              |
| b4    | Reserved                     |                                                                                                                                                                                   |                              |
| b5    | Overfrequency /<br>Overspeed | Overfrequency/overspeed.                                                                                                                                                          |                              |
| b6    | Earth fault                  | Earth fault.                                                                                                                                                                      |                              |
| b7    | Short circuit                | Short circuit.                                                                                                                                                                    |                              |
| b89   | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                           | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| b15   | External fault 5            | External fault 5 (from source selected by parameter 31.09 External event 5 source).                                                                                                                                                                                                                                                                                                   |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                                                                       | 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                   |
|       | 0000FFFFh                   | 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.                                                                                                                                                                                                                                   | 5 NoUnit / uint32            |
|       |                             | 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.                                                                                                                                                                                                                                                                                              |                              |
|       | 05                          | 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,                                                                                                                                                     | 30.0 s / real32              |
|       |                             | 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.                                       |                              |
|       | 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<br>before attempting an automatic reset. See parameter<br>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.                                                                                                                                                                                                                                                                                                                     | Fault / uint16               |
|       |                             | In scalar motor control mode:                                                                                                                                                                                                                                                                                                                                                         |                              |
|       |                             | <ul> <li>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.</li> <li>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.</li> </ul> |                              |
|       | No action                   | No action taken.                                                                                                                                                                                                                                                                                                                                                                      | 0                            |
|       | Fault                       | The drive trips on fault 3381 Output phase loss.                                                                                                                                                                                                                                                                                                                                      | 1                            |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Def / Type<br>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.                                                                                                                                                                                                                                                                                                                                                                       | Fault/Fault / uint16         |
|       |                             | 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. |                              |
|       |                             | 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 <i>The Safe torque off function</i> in the Hardware manual of the drive.                                                                                                                                                         |                              |

| No. | Name / Range /<br>Selection | Desci | riptio | n                                  |                                           | Def / Type<br>FbEq 16b / 32b |
|-----|-----------------------------|-------|--------|------------------------------------|-------------------------------------------|------------------------------|
|     | Fault/Fault                 | Inp   | uts    | L                                  |                                           | 0                            |
|     |                             | IN1   | IN2    | indication (runn                   | ing or stopped)                           |                              |
|     |                             | 0     | 0      | Fault 5091 Sa                      | afe torque off                            |                              |
|     |                             | 0     | 1      | Faults 5091 Safe                   | torque off off and                        |                              |
|     |                             |       |        | FA81 Safe t                        | corque off 1                              |                              |
|     |                             | 1     | 0      |                                    | e torque off and<br>corque off 2          |                              |
|     |                             | 1     | 1      | (Normal o                          | pperation)                                |                              |
|     | Fault/Warning               | Inp   | uts    | Indic                              | ation                                     | 1                            |
|     |                             | IN1   | IN2    | Running                            | Stopped                                   |                              |
|     |                             | 0     | 0      | Fault 5091 Safe<br>torque off      | Warning A5A0 Safe<br>torque off           |                              |
|     |                             | 0     | 1      | Faults 5091 Safe<br>torque off and | Warning A5A0 Safe torque off and fault    |                              |
|     |                             |       |        | FA81 Safe torque off<br>1          | FA81 Safe torque off                      |                              |
|     |                             | 1     | 0      | Faults 5091 Safe<br>torque off and | Warning A5A0 Safe<br>torque off and fault |                              |
|     |                             |       |        | FA82 Safe torque off<br>2          | FA82 Safe torque off<br>2                 |                              |
|     |                             | 1     | 1      | (Normal c                          | peration)                                 |                              |
|     | Fault/Event                 | Inp   | uts    | Indic                              | ation                                     | 2                            |
|     |                             | IN1   | IN2    | Running                            | Stopped                                   |                              |
|     |                             | 0     | 0      | Fault 5091 Safe<br>torque off      | Event B5A0 STO event                      |                              |
|     |                             | 0     | 1      | Faults 5091 Safe<br>torque off and | Event B5A0 STO<br>event and fault FA81    |                              |
|     |                             |       |        | FA81 Safe torque off               | Safe torque off 1                         |                              |
|     |                             | 1     | 0      | Faults 5091 Safe<br>torque off and | Event B5A0 STO<br>event and fault FA82    |                              |
|     |                             |       |        | FA82 Safe torque off<br>2          | Safe torque off 2                         |                              |
|     |                             | 1     | 1      | (Normal o                          | peration)                                 |                              |

| No.   | Name / Range /<br>Selection | Description                |                                                                          |                                                                                                                    | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|----------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Warning/Warning             | Inp                        | uts                                                                      | to disease of constitution and the                                                                                 | 3                            |
|       |                             | IN1                        | IN2                                                                      | Indication (running or stopped)                                                                                    |                              |
|       |                             | 0                          | 0                                                                        | Warning A5A0 Safe torque off                                                                                       |                              |
|       |                             | 0                          | 1                                                                        | Warning A5A0 Safe torque off and fault<br>FA81 Safe torque off 1                                                   |                              |
|       |                             | 1                          | 0                                                                        | Warning A5A0 Safe torque off and fault<br>FA82 Safe torque off 2                                                   |                              |
|       |                             | 1                          | 1                                                                        | (Normal operation)                                                                                                 |                              |
|       | Event/Event                 | Inp                        | uts                                                                      |                                                                                                                    | 4                            |
|       |                             | IN1                        | IN2                                                                      | Indication (running or stopped)                                                                                    |                              |
|       |                             | 0                          | 0                                                                        | Event B5A0 STO event                                                                                               |                              |
|       |                             | 0                          | 1                                                                        | Event B5A0 STO event and fault FA81 Safe torque off 1                                                              |                              |
|       |                             | 1                          | 0                                                                        | Event B5A0 STO event and fault FA82 Safe torque off 2                                                              |                              |
|       |                             | 1                          | 1                                                                        | (Normal operation)                                                                                                 |                              |
|       | No indication/No            | Inputs IN1 IN2             |                                                                          | 5                                                                                                                  |                              |
|       | indication                  |                            | IN2                                                                      | Indication (running or stopped)                                                                                    |                              |
|       |                             | 0                          | 0                                                                        | None                                                                                                               |                              |
|       |                             | 0                          | 1                                                                        | Fault FA81 Safe torque off 1                                                                                       |                              |
|       |                             | 1                          | 0                                                                        | Fault FA82 Safe torque off 2                                                                                       |                              |
|       |                             | 1                          | 1                                                                        | (Normal operation)                                                                                                 |                              |
| 31.23 | Wiring or earth fault       | and n                      | notor                                                                    | w the drive reacts to incorrect input power cable connection (ie. input power cable is to drive motor connection). | Fault / uint16               |
|       | No action                   | No ac                      | tion t                                                                   | taken.                                                                                                             | 0                            |
|       | Fault                       | The d                      | lrive t                                                                  | rips on fault 3181 Wiring or earth fault.                                                                          | 1                            |
| 31.24 | Stall function              |                            |                                                                          | w the drive reacts to a motor stall condition.                                                                     | No action / uint16           |
|       |                             | • Th 31 • th m is lir • th | ne dri<br>25 St<br>e out<br>eter 3<br>belov<br>nit, an<br>e con<br>me se | ditions above have been true longer than the t by parameter 31.28 Stall time.                                      |                              |
|       | No action                   | None                       | (stall                                                                   | supervision disabled).                                                                                             | 0                            |

| No.   | Name / Range /<br>Selection | Description                                                                                                         | Def / Type<br>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 /<br>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<br>(95.20 b0) rpm /<br>real32 |
|       | 0.00 10000.00<br>rpm        | Stall speed limit. For scaling, see parameter 46.01 Speed scaling.                                                  | 1 = 1 rpm / 100 = 1<br>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<br>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                                |
|       | 03600 s                     | Stall time.                                                                                                         | 1 = 1 s / 1 = 1 s                            |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Def / Type<br>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          |
|       |                             | Overspeed trip level  (30.12)  Time  (30.11)  Overspeed trip level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                              |
|       |                             | Overspeed trip level  (31.30)  (30.12)  (30.11)  (31.30)  Overspeed trip level  Time  Overspeed trip level  (30.11)  (30.11)  (30.11)  (30.12)  (30.12)                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                              |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | 0.00 10000.00<br>rpm        | Overspeed trip margin. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1 = 1 rpm / 100 = 1<br>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            |
|       |                             | Overfrequency trip level  31.31  ABS (30.14)  ABS (30.14)  31.13  Time  31.13  Overfrequency trip level                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                              |
|       | 0.00 10000.00 Hz            | Overfrequency trip margin.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1 = 1 Hz / 100 = 1 Hz        |

| No.   | Name / Range /<br>Selection         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Def / Type<br>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.                                                                                                                                                                                                                                                                                                                                    | 0 percent / real32              |
|       |                                     | The supervision is based on either                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                 |
|       |                                     | <ul> <li>observing the time within which the motor stops, or</li> <li>comparing the actual and expected deceleration rates.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                 |
|       |                                     | 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 23.1123.15 (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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                 |
|       | 0300 %                              | Maximum deviation from expected deceleration rate.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1 = 1 % / 1 = 1 %               |
| 31.33 | Emergency ramp<br>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.                                                                                                                                                                                                                              | 0 s / real32                    |
|       |                                     | 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.                                                                                                                                                                                                                                                                                      |                                 |
|       | 0100 s                              | Maximum ramp-down time, or supervision activation delay.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1=1s/1=1s                       |
| 31.40 | Disable warning<br>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<br>0000 / uint16 |
| b0    | Reserved                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                 |
| b1    | DC link under-<br>voltage           | 1 = Warning A3A2 DC link undervoltage is suppressed.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                 |
| h2 4  | Reserved                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                 |

| No.   | Name / Range /<br>Selection      | Description                                                                                    | Def / Type<br>FbEq 16b / 32b |
|-------|----------------------------------|------------------------------------------------------------------------------------------------|------------------------------|
| b5    | Emergency stop<br>(off2)         | 1 = Warning AFE1 Emergency stop (off2) is suppressed.                                          |                              |
| b6    | Emergency stop<br>(off1 or off3) | 1 = Warning AFE2 Emergency stop (off1 or off3) is suppressed.                                  |                              |
| b715  | Reserved                         |                                                                                                |                              |
|       | 0000hFFFFh                       |                                                                                                | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                             | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 32    | Supervision                 | Configuration of signal supervision functions 13.                                                                                                                                                                                                                                                                                                                       |                              |
|       |                             | 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.                                                                                                                                                                                                                                                                                                                                         | 0000 0000 0000               |
|       |                             | Indicates whether the values monitored by the signal supervision functions are within or outside their respective limits.                                                                                                                                                                                                                                               | 0000 / uint16                |
|       |                             | <b>Note:</b> This word is independent of the drive actions defined by parameters 32.06, 32.16, 32.26, 32.36, 32.46 and 32.56.                                                                                                                                                                                                                                           |                              |
| 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.                                                                                                                                                                                                                                                                                                           |                              |
| b615  | Reserved                    |                                                                                                                                                                                                                                                                                                                                                                         |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                                                         | 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 /<br>Selection | Description                                                                                                                                                                                                             | Def / Type<br>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.                                   | 8                            |
|       |                             | Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.                                                                                                                  |                              |
|       | 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.                                 | 9                            |
|       |                             | Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.                                                                                                                  |                              |
| 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.                                                                                    | No action / uint16           |
|       |                             | <b>Note:</b> This parameter does not affect the status indicated by parameter 32.01 Supervision status.                                                                                                                 |                              |
|       | 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 A8BO 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                            |
|       | Al1                         | Parameter 12.11 Al1 actual value.                                                                                                                                                                                       | 9                            |
|       | Al2                         | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                             | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Freq ref used               | Parameter 28.02 Frequency ref ramp output.                                                                                                                                                                                                                                                                                                                              | 22                           |
|       | Inverter temperat-<br>ure   | Parameter 05.11 Inverter temperature.                                                                                                                                                                                                                                                                                                                                   | 23                           |
|       | Process PID output          | Parameter 40.01 Process PID output actual.                                                                                                                                                                                                                                                                                                                              | 24                           |
|       | Process PID feed-<br>back   | Parameter 40.02 Process PID feedback actual.                                                                                                                                                                                                                                                                                                                            | 25                           |
|       | Process PID set-<br>point   | Parameter 40.03 Process PID setpoint actual.                                                                                                                                                                                                                                                                                                                            | 26                           |
|       | Process PID devi-<br>ation  | 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<br>s   |
| 32.09 | Supervision 1 low           | Defines the lower limit for signal supervision 1.                                                                                                                                                                                                                                                                                                                       | 0.00 NoUnit / real32         |
|       | -21474836.00<br>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<br>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).                                                                                                                                                                        | 0.00 null / real32           |
|       |                             | 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 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 /<br>Selection | Description                                                                                                                                                                                                             | Def / Type<br>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.                                   | 8                            |
|       |                             | Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.                                                                                                                  |                              |
|       | 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.                                 | 9                            |
|       |                             | Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.                                                                                                                  |                              |
| 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.                                                                                    | No action / uint16           |
|       |                             | <b>Note:</b> This parameter does not affect the status indicated by parameter 32.01 Supervision status.                                                                                                                 |                              |
|       | 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.                                                                                                                                                    | Current / uint32             |
|       |                             | For the available selections, see parameter 32.07 Supervision 1 signal.                                                                                                                                                 |                              |
| 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<br>s   |
| 32.19 | Supervision 2 low           | Defines the lower limit for signal supervision 2.                                                                                                                                                                       | 0.00 NoUnit / real32         |
|       | -21474836.00<br>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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                             | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | -21474836.00<br>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).                                                                                                                                                                        | 0.00 null / real32           |
|       |                             | 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 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.                                                                                                                                                                                                                                               | 4                            |
|       |                             | Action is deactivated whenever absolute value of signal is below absolute value of 'Supervision High' limit - 0.5 * hysteresis.                                                                                                                                                                                                                                         |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                           | Def / Type<br>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.                                                                                                                                                                                                                 | 8                            |
|       |                             | Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.                                                                                                                                                                                                                                                                                                |                              |
|       | 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.                                                                                                                                                                                                               | 9                            |
|       |                             | Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.                                                                                                                                                                                                                                                                                                |                              |
| 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.                                                                                                                                                                                                                                                                  | No action / uint16           |
|       |                             | <b>Note:</b> This parameter does not affect the status indicated by parameter 32.01 Supervision status.                                                                                                                                                                                                                                                                                               |                              |
|       | 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.                                                                                                                                                                                                                                                                                                                                  | Torque / uint32              |
|       |                             | For the available selections, see parameter 32.07 Supervision 1 signal.                                                                                                                                                                                                                                                                                                                               |                              |
| 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<br>s   |
| 32.29 | Supervision 3 low           | Defines the lower limit for signal supervision 3.                                                                                                                                                                                                                                                                                                                                                     | 0.00 NoUnit / real32         |

| No.   | Name / Range /<br>Selection |                                                                                                                                                                                                                                                                                                                                                                         |                      |  |  |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--|--|
|       | -21474836.00<br>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<br>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).                                                                                                                                                                        | 0.00 null / real32   |  |  |
|       |                             | 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 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.                                                                                                                                                                                                                                                | 3                    |  |  |
|       |                             | Action is deactivated whenever absolute value of signal is above absolute value of 'Supervision Low' limit + 0.5 * hysteresis.                                                                                                                                                                                                                                          |                      |  |  |
|       | Abs high                    | Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis.                                                                                                                                                                                                                                               | 4                    |  |  |
|       |                             | Action is deactivated whenever absolute value of signal is below absolute value of 'Supervision High' limit - 0.5 * hysteresis.                                                                                                                                                                                                                                         |                      |  |  |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                           | Def / Type<br>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.                                                                                                                                                                                                                 | 8                            |
|       |                             | Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.                                                                                                                                                                                                                                                                                                |                              |
|       | 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.                                                                                                                                                                                                               | 9                            |
|       |                             | Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.                                                                                                                                                                                                                                                                                                |                              |
| 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.                                                                                                                                                                                                                                                                  | No action / uint16           |
|       |                             | <b>Note:</b> This parameter does not affect the status indicated by parameter 32.01 Supervision status.                                                                                                                                                                                                                                                                                               |                              |
|       | 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.                                                                                                                                                                                                                                                                                                                                  | Zero / uint32                |
|       |                             | For the available selections, see parameter 32.07 Supervision 1 signal.                                                                                                                                                                                                                                                                                                                               |                              |
| 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<br>s   |
| 32.39 | Supervision 4 low           | Defines the lower limit for signal supervision 4.                                                                                                                                                                                                                                                                                                                                                     | 0.00 NoUnit / real32         |

| No.   | Name / Range /<br>Selection | Def / Type<br>FbEq 16b / 32b                                                                                                                                                                                                                                                                                                                                            |                      |  |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------|--|
|       | -21474836.00<br>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<br>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).                                                                                                                                                                        | 0.00 null / real32   |  |
|       |                             | 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 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.                                                                                                                                                                                                                                                | 3                    |  |
|       |                             | Action is deactivated whenever absolute value of signal is above absolute value of 'Supervision Low' limit + 0.5 * hysteresis.                                                                                                                                                                                                                                          |                      |  |
|       | Abs high                    | Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis.                                                                                                                                                                                                                                               | 4                    |  |
|       |                             | Action is deactivated whenever absolute value of signal is below absolute value of 'Supervision High' limit - 0.5 * hysteresis.                                                                                                                                                                                                                                         |                      |  |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                           | Def / Type<br>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                                                                                                                                                          | 8                            |
|       |                             | than 'Supervision low' limit + 0.5 * hysteresis.                                                                                                                                                                                                                                                                                                                                                      |                              |
|       | 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.                                                                                                                                                                                                               | 9                            |
|       |                             | Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.                                                                                                                                                                                                                                                                                                |                              |
| 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.                                                                                                                                                                                                                                                                  | No action / uint16           |
|       |                             | <b>Note:</b> This parameter does not affect the status indicated by parameter 32.01 Supervision status.                                                                                                                                                                                                                                                                                               |                              |
|       | 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.                                                                                                                                                                                                                                                                                                                                  | Zero / uint32                |
|       |                             | For the available selections, see parameter 32.07 Supervision 1 signal.                                                                                                                                                                                                                                                                                                                               |                              |
| 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<br>s   |
| 32.49 | Supervision 5 low           | Defines the lower limit for signal supervision 5.                                                                                                                                                                                                                                                                                                                                                     | 0.00 NoUnit / real32         |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                             | Def / Type<br>FbEq 16b / 32b |  |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--|
|       | -21474836.00<br>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<br>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).                                                                                                                                                                        | 0.00 null / real32           |  |
|       |                             | 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 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.                                                                                                                                                                                                                                                | 3                            |  |
|       |                             | Action is deactivated whenever absolute value of signal is above absolute value of 'Supervision Low' limit + 0.5 * hysteresis.                                                                                                                                                                                                                                          |                              |  |
|       | Abs high                    | Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis.                                                                                                                                                                                                                                               | 4                            |  |
|       |                             | Action is deactivated whenever absolute value of signal is below absolute value of 'Supervision High' limit - 0.5 * hysteresis.                                                                                                                                                                                                                                         |                              |  |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                           | Def / Type<br>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.                                                                                                                                                                                                                 | 8                            |
|       |                             | Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.                                                                                                                                                                                                                                                                                                |                              |
|       | 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.                                                                                                                                                                                                               | 9                            |
|       |                             | Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.                                                                                                                                                                                                                                                                                                |                              |
| 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.                                                                                                                                                                                                                                                                  | No action / uint16           |
|       |                             | <b>Note:</b> This parameter does not affect the status indicated by parameter 32.01 Supervision status.                                                                                                                                                                                                                                                                                               |                              |
|       | 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.                                                                                                                                                                                                                                                                                                                                  | Zero / uint32                |
|       |                             | For the available selections, see parameter 32.07 Supervision 1 signal.                                                                                                                                                                                                                                                                                                                               |                              |
| 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<br>s   |
| 32.59 | Supervision 6 low           | Defines the lower limit for signal supervision 6.                                                                                                                                                                                                                                                                                                                                                     | 0.00 NoUnit / real32         |

## 284 Parameters

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                             | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | -21474836.00<br>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<br>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).                        | 0.00 null / real32           |
|       |                             | 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 100000.00              | Hysteresis.                                                                                                                                                                                                             | - / 100 = 1                  |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                    | Def / Type<br>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<br>0000 / uint16 |
| h0    | Timed function 1            | 1 = Active.                                                                                                                                                    |                                 |
|       |                             |                                                                                                                                                                |                                 |
|       | Timed function 2            | 1 = Active.                                                                                                                                                    |                                 |
|       | Timed function 3            | 1 = Active.                                                                                                                                                    |                                 |
| b315  | Reserved                    |                                                                                                                                                                |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                                | 1/1                             |
| 34.02 | Timer status                | Status of timers 112.                                                                                                                                          | 0000 0000 0000<br>0000 / uint16 |
|       |                             | This parameter is read-only.                                                                                                                                   | 0000 / uiiit16                  |
| 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.                                                                                                                                                    |                                 |
| b1215 | Reserved                    |                                                                                                                                                                |                                 |
|       | 0000hFFFFh                  |                                                                                                                                                                | 1/1                             |
| 34.04 | Season/exception day status | Status of seasons 14, 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. | 0000 0000 0000<br>0000 / uint16 |
|       |                             | This parameter is read-only.                                                                                                                                   |                                 |
| b0    | Season 1                    | 1 = Active.                                                                                                                                                    |                                 |
| b1    | Season 2                    | 1 = Active.                                                                                                                                                    |                                 |
| b2    | Season 3                    | 1 = Active.                                                                                                                                                    |                                 |
| b3    | Season 4                    | 1 = Active.                                                                                                                                                    |                                 |
| b49   | Reserved                    |                                                                                                                                                                |                                 |

## 286 Parameters

| No.   | Name / Range /<br>Selection | Description                                                   | Def / Type<br>FbEq 16b / 32b |  |
|-------|-----------------------------|---------------------------------------------------------------|------------------------------|--|
| b10   | Exception workday           | 1 = Active.                                                   |                              |  |
| b11   | Exception holiday           | 1 = Active.                                                   |                              |  |
| b1215 | Reserved                    |                                                               |                              |  |
|       | 0000hFFFFh                  |                                                               | 1/1                          |  |
| 34.10 | Timed functions enable      | Selects the source for the timed functions enable signal.     | Disabled / uint32            |  |
|       |                             | 0 = Disabled.                                                 |                              |  |
|       |                             | 1 = Enabled.                                                  |                              |  |
|       | 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 /<br>Selection              | -                                                                                                                                                                              |                                                                                                         |                                                                                                         |                                                                                                 |                                                                                                                      |                                                                                                                              |                                                                                                                |                                                                                                       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| 34.11 | Timer 1 configura-                       | Det                                                                                                                                                                            | fine                                                                                                    | s w                                                                                                     | hen                                                                                             | tir                                                                                                                  | ner                                                                                                                          | 1 is                                                                                                           | ac                                                                                                    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|       | tion                                     | Bits of parameter 34.11 Timer 1 configuration                                                                                                                                  |                                                                                                         |                                                                                                         |                                                                                                 |                                                                                                                      |                                                                                                                              |                                                                                                                |                                                                                                       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|       | 2) E E E E E E E E E E E E E E E E E E E | defisees<br>Seas<br>Not<br>Example<br>Holi<br>Example<br>Holi<br>Example<br>Holi<br>Example<br>Holi<br>Example<br>Holi<br>Holi<br>Holi<br>Holi<br>Holi<br>Holi<br>Holi<br>Holi | mpl<br>ned<br>son<br>epti<br>hav<br>mpl<br>hav<br>mpl<br>day<br>mpl<br>ddit<br>kda<br>mpl<br>med<br>son | e 2:<br>I by<br>e a:<br>I by<br>Sea<br>on (e a:<br>I by<br>ring<br>e 5:<br>I by<br>ring<br>e 6:<br>I by | dayny e Tin oth sorr day ny e Tin oth sorr day ny e Tin oth ega Tir oth ega Tir oth reg Tir oth | set<br>effe<br>mer<br>is set<br>effe<br>mer<br>ner<br>e T<br>garc<br>mer per set | ting<br>ct c<br>is a<br>par<br>car<br>cting<br>ct c<br>is a<br>par<br>ime<br>ess<br>is a<br>par<br>on1<br>ime<br>ime<br>is a | gs (gon t<br>ctivament be<br>gs (gon t<br>ctivament be<br>gs (gon t<br>ctivament be<br>and<br>er is<br>s where | ye determined the control of the con | uriirs fi<br>ame<br>Fim<br>uriirs fi<br>nfig<br>ame<br>Fim<br>uriirs o<br>easc<br>cive<br>is t<br>urii<br>s ev | eterent eteren | the in Moreon Mo | time to the time t | es of of ses of of ses of east | f the day<br>Fri and<br>ion day<br>son.<br>f the day<br>and every |                              |                |
| b∩    | Monday                                   |                                                                                                                                                                                | Γhe<br>Mo                                                                                               |                                                                                                         |                                                                                                 |                                                                                                                      |                                                                                                                              |                                                                                                                |                                                                                                       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|       | Tuesday                                  | -                                                                                                                                                                              | Tue                                                                                                     |                                                                                                         |                                                                                                 |                                                                                                                      |                                                                                                                              |                                                                                                                |                                                                                                       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| b2    | 2 Wednesday                              | 1 =                                                                                                                                                                            | We                                                                                                      | dne                                                                                                     | sda                                                                                             | ay is                                                                                                                | s ar                                                                                                                         | ac                                                                                                             | tive                                                                                                  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| b3    | Thursday                                 | 1 =                                                                                                                                                                            | Thu                                                                                                     | ırsc                                                                                                    | lay                                                                                             | is a                                                                                                                 | n a                                                                                                                          | ctiv                                                                                                           | e s                                                                                                   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| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                            | Def / Type<br>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 010 in the timer configuration) and the start time and duration of the timer (see parameters 34.12 and 34.13).  Exception day settings, parameters 34.7034.90, 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 010 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 34.7034.90. 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 010 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 34.7034.90 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 010 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 34.7034.90 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. |                              |
| b1415 | Reserved                    |                                                                                                                                                                                                                                                                        |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                        | 1/1                          |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                           | Def / Type<br>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.                                                                                                                                                                                                                                                     | 00:00:00 / uint32               |
|       |                             | 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.                                                                                     |                                 |
|       | 00:00:0023:59:59            | 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.                                                                                                                                                                                                                                                         | 00 00:00 / uint16               |
|       |                             | 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 00:0007 00:00            | Timer duration.                                                                                                                                                                                                                                                                                                                       | 1 = 1                           |
| 34.14 | Timer 2 configura-<br>tion  | See parameter 34.11 Timer 1 configuration.                                                                                                                                                                                                                                                                                            | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                       | 1/1                             |
| 34.15 | Timer 2 start time          | See parameter 34.12 Timer 1 start time.                                                                                                                                                                                                                                                                                               | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                                                                                                                                                                                                                                                                                                                       | 1 = 1                           |
| 34.16 | Timer 2 duration            | See parameter 34.13 Timer 1 duration.                                                                                                                                                                                                                                                                                                 | 00 00:00 / uint16               |
|       | 00 00:0007 00:00            |                                                                                                                                                                                                                                                                                                                                       | 1 = 1                           |
| 34.17 | Timer 3 configura-<br>tion  | See parameter 34.11 Timer 1 configuration.                                                                                                                                                                                                                                                                                            | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                       | 1/1                             |
| 34.18 | Timer 3 start time          | See parameter 34.12 Timer 1 start time.                                                                                                                                                                                                                                                                                               | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                                                                                                                                                                                                                                                                                                                       | 1 = 1                           |
| 34.19 | Timer 3 duration            | See parameter 34.13 Timer 1 duration.                                                                                                                                                                                                                                                                                                 | 00 00:00 / uint16               |
|       | 00 00:0007 00:00            |                                                                                                                                                                                                                                                                                                                                       | 1 = 1                           |
| 34.20 | Timer 4 configura-<br>tion  | See parameter 34.11 Timer 1 configuration.                                                                                                                                                                                                                                                                                            | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                       | 1/1                             |
| 34.21 | Timer 4 start time          | See parameter 34.12 Timer 1 start time.                                                                                                                                                                                                                                                                                               | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                                                                                                                                                                                                                                                                                                                       | 1 = 1                           |
| 34.22 | Timer 4 duration            | See parameter 34.13 Timer 1 duration.                                                                                                                                                                                                                                                                                                 | 00 00:00 / uint16               |
|       | 00 00:0007 00:00            |                                                                                                                                                                                                                                                                                                                                       | 1 = 1                           |
| 34.23 | Timer 5 configura-<br>tion  | See parameter 34.11 Timer 1 configuration.                                                                                                                                                                                                                                                                                            | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                                                       | 1/1                             |

| No.   | Name / Range /<br>Selection | Description                                | Def / Type<br>FbEq 16b / 32b    |
|-------|-----------------------------|--------------------------------------------|---------------------------------|
| 34.24 | Timer 5 start time          | See parameter 34.12 Timer 1 start time.    | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                            | 1 = 1                           |
| 34.25 | Timer 5 duration            | See parameter 34.13 Timer 1 duration.      | 00 00:00 / uint16               |
|       | 00 00:0007 00:00            |                                            | 1 = 1                           |
| 34.26 | Timer 6 configura-<br>tion  | See parameter 34.11 Timer 1 configuration. | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                            | 1/1                             |
| 34.27 | Timer 6 start time          | See parameter 34.12 Timer 1 start time.    | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                            | 1 = 1                           |
| 34.28 | Timer 6 duration            | See parameter 34.13 Timer 1 duration.      | 00 00:00 / uint16               |
|       | 00 00:0007 00:00            |                                            | 1 = 1                           |
| 34.29 | Timer 7 configura-<br>tion  | See parameter 34.11 Timer 1 configuration. | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                            | 1/1                             |
| 34.30 | Timer 7 start time          | See parameter 34.12 Timer 1 start time.    | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                            | 1 = 1                           |
| 34.31 | Timer 7 duration            | See parameter 34.13 Timer 1 duration.      | 00 00:00 / uint16               |
|       | 00 00:0007 00:00            |                                            | 1 = 1                           |
| 34.32 | Timer 8 configura-<br>tion  | See parameter 34.11 Timer 1 configuration. | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                            | 1/1                             |
| 34.33 | Timer 8 start time          | See parameter 34.12 Timer 1 start time.    | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                            | 1 = 1                           |
| 34.34 | Timer 8 duration            | See parameter 34.13 Timer 1 duration.      | 00 00:00 / uint16               |
|       | 00 00:0007 00:00            |                                            | 1 = 1                           |
| 34.35 | Timer 9 configura-<br>tion  | See parameter 34.11 Timer 1 configuration. | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                            | 1/1                             |
| 34.36 | Timer 9 start time          | See parameter 34.12 Timer 1 start time.    | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                            | 1 = 1                           |
| 34.37 | Timer 9 duration            | See parameter 34.13 Timer 1 duration.      | 00 00:00 / uint16               |
|       | 00 00:0007 00:00            |                                            | 1 = 1                           |
| 34.38 | Timer 10 configura-<br>tion | See parameter 34.11 Timer 1 configuration. | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                            | 1/1                             |
| 34.39 | Timer 10 start time         | See parameter 34.12 Timer 1 start time.    | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                            | 1 = 1                           |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                  | Def / Type<br>FbEq 16b / 32b    |
|-------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 34.40 | Timer 10 duration           | See parameter 34.13 Timer 1 duration.                                                                                                                                                                                                                                                                        | 00 00:00 / uint16               |
|       | 00 00:0007 00:00            |                                                                                                                                                                                                                                                                                                              | 1 = 1                           |
| 34.41 | Timer 11 configura-<br>tion | See parameter 34.11 Timer 1 configuration.                                                                                                                                                                                                                                                                   | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                              | 1/1                             |
| 34.42 | Timer 11 start time         | See parameter 34.12 Timer 1 start time.                                                                                                                                                                                                                                                                      | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                                                                                                                                                                                                                                                                                              | 1 = 1                           |
| 34.43 | Timer 11 duration           | See parameter 34.13 Timer 1 duration.                                                                                                                                                                                                                                                                        | 00 00:00 / uint16               |
|       | 00 00:0007 00:00            |                                                                                                                                                                                                                                                                                                              | 1 = 1                           |
| 34.44 | Timer 12 configura-<br>tion | See parameter 34.11 Timer 1 configuration.                                                                                                                                                                                                                                                                   | 0000 0111 1000<br>0000 / uint16 |
|       | 0000hFFFFh                  |                                                                                                                                                                                                                                                                                                              | 1/1                             |
| 34.45 | Timer 12 start time         | See parameter 34.12 Timer 1 start time.                                                                                                                                                                                                                                                                      | 00:00:00 / uint32               |
|       | 00:00:0023:59:59            |                                                                                                                                                                                                                                                                                                              | 1 = 1                           |
| 34.46 | Timer 12 duration           | See parameter 34.13 Timer 1 duration.                                                                                                                                                                                                                                                                        | 00 00:00 / uint16               |
|       | 00 00:0007 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.                                                                                                                                                                                     | 01.01 / uint16                  |
|       |                             | 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 (14) 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. |                                 |
|       | 01.0112.31                  | Season start date.                                                                                                                                                                                                                                                                                           | 1 = 1                           |
| 34.61 | Season 2 start date         | Defines the start date of season 2.                                                                                                                                                                                                                                                                          | 01.01 / uint16                  |
|       |                             | See parameter 34.60 Season 1 start date.                                                                                                                                                                                                                                                                     |                                 |
|       | 01.0112.31                  |                                                                                                                                                                                                                                                                                                              | 1 = 1                           |
| 34.62 | Season 3 start date         | Defines the start date of season 3.                                                                                                                                                                                                                                                                          | 01.01 / uint16                  |
|       |                             | See parameter 34.60 Season 1 start date.                                                                                                                                                                                                                                                                     |                                 |
|       | 01.0112.31                  |                                                                                                                                                                                                                                                                                                              | 1 = 1                           |
| 34.63 | Season 4 start date         | Defines the start date of season 4.                                                                                                                                                                                                                                                                          | 01.01 / uint16                  |
|       |                             | See parameter 34.60 Season 1 start date.                                                                                                                                                                                                                                                                     |                                 |
|       | 01.0112.31                  |                                                                                                                                                                                                                                                                                                              | 1 = 1                           |

| No.   | Name / Range /<br>Selection | Description                                                                                                                          | Def / Type<br>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.                | 3 NoUnit / uint16               |
|       |                             | Exceptions 13 are periods (duration can be defined) and exceptions 416 are days (duration is always 24 hours).                       |                                 |
|       |                             | <b>Example:</b> If the value is 4, exceptions 14 are active, and exceptions 516 are not active.                                      |                                 |
|       | 016                         | Number of active exception periods or days.                                                                                          | 1 = 1 / 1 = 1                   |
| 34.71 | Exception types             | Defines the types of exceptions 116 as workday or holiday.                                                                           | 0000 0000 0000<br>0000 / uint16 |
|       |                             | Exceptions 13 are periods (duration can be defined) and exceptions 416 are days (duration is always 24 hours).                       |                                 |
| 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.                                                                                                            |                                 |
|       | 0000hFFFFh                  |                                                                                                                                      | 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. | 01.01 / uint16                  |
|       |                             | 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.                   |                                 |
|       | 01.0131.12                  | Start date of exception period 1.                                                                                                    | 1 = 1                           |

| Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                | Def / Type<br>FbEq 16b / 32b                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Exception 1 length          | Defines the length of the exception period in days.                                                                                                                                                                                                                                                                                                        | 0 days / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|                             | Exception period is handled the same as a number of consecutive exception days.                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 060 days                    | Length of exception period 1.                                                                                                                                                                                                                                                                                                                              | 1 = 1 days / 1 = 1 days                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Exception 2 start           | See parameter 34.72 Exception 1 start.                                                                                                                                                                                                                                                                                                                     | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception 2 length          | See parameter 34.73 Exception 1 length.                                                                                                                                                                                                                                                                                                                    | 0 days / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| days                        |                                                                                                                                                                                                                                                                                                                                                            | 1=1days/1=1days                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Exception 3 start           | See parameter 34.72 Exception 1 start.                                                                                                                                                                                                                                                                                                                     | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception 3 length          | See parameter 34.73 Exception 1 length.                                                                                                                                                                                                                                                                                                                    | 0 days / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| days                        |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1 days / 1 = 1 days                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Exception day 4             | Defines the date of exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 01.0112.31                  | Start date of exception day 4.                                                                                                                                                                                                                                                                                                                             | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|                             | The timer started on an exception day is always stopped at 23:59:59 even if it has duration left.                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| Exception day 5             | See parameter 34.78 Exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception day 6             | See parameter 34.78 Exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception day 7             | See parameter 34.78 Exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception day 8             | See parameter 34.78 Exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception day 9             | See parameter 34.78 Exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception day 10            | See parameter 34.78 Exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception day 11            | See parameter 34.78 Exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception day 12            | See parameter 34.78 Exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception day 13            | See parameter 34.78 Exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| -                           |                                                                                                                                                                                                                                                                                                                                                            | 1 = 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| Exception day 14            | See parameter 34.78 Exception day 4.                                                                                                                                                                                                                                                                                                                       | 01.01 / uint16                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                             | Selection  Exception 1 length  060 days  Exception 2 start  -  Exception 2 length days  Exception 3 start  -  Exception 3 length days  Exception day 4  01.0112.31  Exception day 5  -  Exception day 6  -  Exception day 7  -  Exception day 9  -  Exception day 9  -  Exception day 10  -  Exception day 11  -  Exception day 12  -  Exception day 13  - | Exception 1 length 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.  060 days Length of exception period 1. Exception 2 start See parameter 34.72 Exception 1 start.  Exception 2 length See parameter 34.73 Exception 1 length.  days Exception 3 start See parameter 34.73 Exception 1 length.  days Exception 3 length See parameter 34.73 Exception 1 length.  days Exception day 4 Defines the 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.  Exception day 5 See parameter 34.78 Exception day 4.  Exception day 6 See parameter 34.78 Exception day 4.  Exception day 7 See parameter 34.78 Exception day 4.  Exception day 9 See parameter 34.78 Exception day 4.  Exception day 10 See parameter 34.78 Exception day 4.  Exception day 11 See parameter 34.78 Exception day 4.  Exception day 12 See parameter 34.78 Exception day 4.  Exception day 13 See parameter 34.78 Exception day 4. |

| No.    | Name / Range /<br>Selection | Description                                                                                                                           | Def / Type<br>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.                                                                               | 0000 0000 0000<br>0000 / uint16 |
|        |                             | 0 = Not connected.                                                                                                                    |                                 |
|        |                             | 1 = Connected.                                                                                                                        |                                 |
|        |                             | See parameter 34.01 Timed functions status.                                                                                           |                                 |
| 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.                                                                                                             |                                 |
| b1215  | Reserved                    |                                                                                                                                       |                                 |
|        | 0000hFFFFh                  |                                                                                                                                       | 1/1                             |
| 34.101 | Timed function 2            | Defines which timers are connected to combined timer 2.                                                                               | 0000 0000 0000<br>0000 / uint16 |
|        |                             | See parameter 34.01 Timed functions status.                                                                                           |                                 |
|        | 0000hFFFFh                  |                                                                                                                                       | 1/1                             |
| 34.102 | Timed function 3            | Defines which timers are connected to combined timer 3.                                                                               | 0000 0000 0000<br>0000 / uint16 |
|        |                             | See parameter 34.01 Timed functions status.                                                                                           |                                 |
|        | 0000hFFFFh                  |                                                                                                                                       | 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<br>0000 / uint16 |
| b0     | Timed function 1            | 0 = Inactive. 1 = Active.                                                                                                             |                                 |
| b1     | Timed function 2            | 0 = Inactive. 1 = Active.                                                                                                             |                                 |

| No.    | Name / Range /<br>Selection       | Description                                                                                                                                                                                                                           | Def / Type<br>FbEq 16b / 32b |
|--------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| b2     | Timed function 3                  | 0 = Inactive. 1 = Active.                                                                                                                                                                                                             |                              |
| b315   | Reserved                          |                                                                                                                                                                                                                                       |                              |
|        | 0000hFFFFh                        |                                                                                                                                                                                                                                       | 1/1                          |
| 34.111 | Boost time activa-<br>tion 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.                                                                                                                       | 00 00:00 / uint16            |
|        |                                   | <b>Example:</b> 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 00:0007 00:00                  | Extra time duration.                                                                                                                                                                                                                  | 1 = 1                        |

| No.   | Name / Range /<br>Selection             | Description                                                                                                                                                                                                                                    | Def / Type<br>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 35.5035.55). The unit is selected by parameter 96.16 Unit selection.                                                                | 0 / 0 celsius / real32              |
|       |                                         | This parameter is read-only.                                                                                                                                                                                                                   |                                     |
|       | -60 / -761000 /<br>1832C                | Estimated motor temperature.                                                                                                                                                                                                                   | 1 = 1 °C / 1 = 1 °C                 |
| 35.02 | Measured temperat-<br>ure 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.                                                                                  | 0 / 0 / 0 celsius /<br>real32       |
|       |                                         | This parameter is read-only.                                                                                                                                                                                                                   |                                     |
|       | -60 / -76 / 0 5000<br>/ 9032 / [35.12]C | Measured temperature 1.                                                                                                                                                                                                                        | 1 = 1 °C / 1 = 1 °C                 |
| 35.05 | Motor overload<br>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.                                                                                                                                                                                                                          | 10 = 1 % / 10 = 1 %                 |
|       |                                         | 0.0% No motor overloading.                                                                                                                                                                                                                     |                                     |
|       |                                         | 88.0% Motor overloaded to warning level.                                                                                                                                                                                                       |                                     |
|       |                                         | 100.0% Motor overloaded to fault level.                                                                                                                                                                                                        |                                     |
| 35.11 | Temperature 1 source                    | Selects the source from which measured temperature 1 is read.                                                                                                                                                                                  | Estimated temperat-<br>ure / uint32 |
|       |                                         | Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list. |                                     |
|       | Disabled                                | None. Temperature monitoring function 1 is disabled.                                                                                                                                                                                           | 0                                   |
|       | Estimated temperat-<br>ure              | Estimated motor temperature (see parameter 35.01 Motor estimated temperature).                                                                                                                                                                 | 1                                   |
|       |                                         | 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.                                                                  |                                     |

| No. | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Def / Type<br>FbEq 16b / 32b |
|-----|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|     | KTY84 analog I/O            | KTY84 sensor connected to the analog input selected by parameter 35.14 Temperature 1 Al source and an analog output. The analog input can be from the standard I/O or from an extension module.                                                                                                                                                                                                                                                                                 | 2                            |
|     |                             | 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.                                                                                                                                                                                                                                 |                              |
|     | 1 x Pt100 analog I/O        | Pt100 sensor connected to a standard analog input selected by parameter 35.14 Temperature 1 Al source and an analog output.                                                                                                                                                                                                                                                                                                                                                     | 5                            |
|     |                             | <ul> <li>The following settings are required:</li> <li>Set the hardware jumper or switch related to the analog input to U (voltage). Any change must be validated by a control unit reboot.</li> <li>Set the appropriate analog input unit selection parameter in parameter group 12 Standard AI (page 173) to V (volt).</li> <li>In parameter group 13 Standard AO (page 179), set the source selection parameter of the analog output to Temp sensor 1 excitation.</li> </ul> |                              |
|     |                             | 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 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 /<br>Selection | Description                                                                                                                                                                                                                                                                         | Def / Type     |
|-----|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|
|     | Sciection                   |                                                                                                                                                                                                                                                                                     | FbEq 16b / 32b |
|     | PTC analog I/O              | PTC sensor connected to analog input selected by parameter 35.14 Temperature 1 Al source and an analog output.                                                                                                                                                                      | 20             |
|     |                             | The required settings are the same as with selection KTY84 analog I/O.                                                                                                                                                                                                              |                |
|     |                             | <b>Note:</b> 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.                                                    |                |
|     | Direct temperature          | The temperature is taken from the source selected by parameter 35.14 Temperature 1 Al 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 Al source and an analog output.                                                                                                                                                                | 12             |
|     |                             | The following settings are required:                                                                                                                                                                                                                                                |                |
|     |                             | <ul> <li>Set the appropriate analog input unit selection parameter in parameter group 12 Standard Al (page 173) to V (volt).</li> <li>In parameter group 13 Standard AO (page 179), set the source selection parameter of the analog output to Temp sensor 1 excitation.</li> </ul> |                |
|     |                             | 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.                                     |                |
|     | 1 x Pt1000 analog<br>I/O    | Pt1000 sensor connected to a standard analog input selected by parameter 35.14 Temperature 1 Al source and an analog output.                                                                                                                                                        | 13             |
|     |                             | The following settings are required:                                                                                                                                                                                                                                                |                |
|     |                             | <ul> <li>Set the appropriate analog input unit selection parameter in parameter group 12 Standard AI (page 173) to V (volt).</li> <li>In parameter group 13 Standard AO (page 179), set the source selection parameter of the analog output to Temp sensor 1 excitation.</li> </ul> |                |
|     |                             | 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 x Pt1000 analog<br>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<br>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 /<br>Selection      | Description                                                                                                                                                                                                                                                                         | Def / Type<br>FbEq 16b / 32b       |
|-------|----------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|       | Ni1000                           | Ni1000 sensor connected to the analog input selected<br>by parameter 35.14 Temperature 1 Al source and an<br>analog output.                                                                                                                                                         | 16                                 |
|       |                                  | The following settings are required:                                                                                                                                                                                                                                                |                                    |
|       |                                  | <ul> <li>Set the appropriate analog input unit selection parameter in parameter group 12 Standard AI (page 173) to V (volt).</li> <li>In parameter group 13 Standard AO (page 179), set the source selection parameter of the analog output to Temp sensor 1 excitation.</li> </ul> |                                    |
|       |                                  | 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.                                     |                                    |
|       | 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.                                                                                                                | 130 / 266 celsius /<br>real32      |
|       |                                  | The unit is selected by parameter 96.16 Unit selection.                                                                                                                                                                                                                             |                                    |
|       | -60 / -765000 /<br>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.                                                                                                                  | 110 / 230 °C or °F /<br>real32     |
|       |                                  | The unit is selected by parameter 96.16 Unit selection.                                                                                                                                                                                                                             |                                    |
|       | -60 / -765000 /<br>9032 °C or °F | Warning limit for temperature monitoring function 1.                                                                                                                                                                                                                                | 1 = 1 °C or °F / 1 = 1<br>°C or °F |
| 35.14 | Temperature 1 Al source          | Specifies the analog input when the setting of parameter 35.11 Temperature 1 source requires measurement through an analog input.                                                                                                                                                   | Not selected / uint32              |
|       |                                  | <b>Note:</b> If parameter 35.11 Temperature 1 source is set to Direct temperature, use selection Other here, and point to parameter 12.12 Al1 scaled value.                                                                                                                         |                                    |
|       | Not selected                     | None.                                                                                                                                                                                                                                                                               | 0                                  |
|       | Al1 actual value                 | Analog input Al1 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 /<br>Selection    | Description                                                                                                                                                                                                                                                                                               | Def / Type<br>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.                                                                                                                                                              | 20 / 68 °C or °F /<br>real32       |
|       |                                | The motor thermal protection model estimates the motor temperature on the basis of parameters 35.5035.55. 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.                                                                                                                                                                                               |                                    |
|       | -60 / -76100 / 212<br>°C or °F | Ambient temperature.                                                                                                                                                                                                                                                                                      | 1 = 1 °C or °F / 1 = 1<br>°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.                                                                                                                                                                                                        | 110 percent / uint16               |
|       |                                | 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.  |                                    |
|       |                                | $I = Motor current$ $I_N = Nominal motor current$                                                                                                                                                                                                                                                         |                                    |
|       |                                | 35.51<br>35.52<br>50                                                                                                                                                                                                                                                                                      |                                    |
|       |                                | 35.53 Drive output frequency                                                                                                                                                                                                                                                                              |                                    |
|       | 50150 %                        | 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. | 70 percent / uint16                |
|       |                                | See parameter 35.51 Motor load curve.                                                                                                                                                                                                                                                                     |                                    |

| No.   | Name / Range /<br>Selection    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Def / Type<br>FbEq 16b / 32b       |
|-------|--------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
|       | 25150 %                        | 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.  **Temperature**  **Motor nominal temperature**  **Indeed Time**  **Ambient temperature**  **Time**  **Time** | 80 / 176 °C or °F /<br>real32      |
|       | 0 / 0300 / 572 °C<br>or °F     | Temperature rise.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1 = 1 °C or °F / 1 = 1<br>°C or °F |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                        | Def / Type<br>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.                                                                                | 256 s / uint16               |
|       |                             | 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. |                              |
|       |                             | Motor current                                                                                                                                                                                                                                                                      |                              |
|       |                             | 100%-                                                                                                                                                                                                                                                                              |                              |
|       |                             | Time                                                                                                                                                                                                                                                                               |                              |
|       |                             | Temperature rise                                                                                                                                                                                                                                                                   |                              |
|       |                             | 100%                                                                                                                                                                                                                                                                               |                              |
|       | 10010000 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.                                                                                                                                                                                  | Warning and fault / uint16   |
|       | No action                   | See section Motor overload protection (page 112).  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%.                                                                                                                  | 2                            |
|       |                             | 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%.                                                                                                                      |                              |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                           | Def / Type<br>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. | Class 20 / uint16            |
|       |                             | See section Motor overload protection (page 112).                                                                                                                                                     |                              |
|       | 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                            |

## 304 Parameters

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                        | Def / Type<br>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.                                                                                                                                                                                                       | Output power /<br>uint32     |
|       |                             | 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 36.1036.15.                                                                                                                                                           |                              |
|       |                             | 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. |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                     | Def / Type<br>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.                                                            | Motor torque / uint32        |
|       |                             | The results are displayed by parameters 36.4036.49. 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.                                                                                                      |                              |
| 36.07 | AL2 signal scaling          | Defines the signal value that corresponds to 100% amplitude.                                                                                                    | 100.00 NoUnit /<br>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<br>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                   |
|       | 00:00:0023:59:59            | 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<br>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 /<br>Selection | Description                                                                                                                                                                                                            | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | -30000.00<br>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            |
|       | 00:00:0023:59:59            | 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 /<br>Selection | Description                                                                        | Def / Type<br>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            |
|       | 00:00:0023:59:59            | Last reset time of amplitude logger 2.                                             | 1 = 1                        |

| No.   | Name / Range /<br>Selection     | Description                                                                                                                                                                                                        | Def / Type<br>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.) | 0000 0000 0000<br>0000 / uint16 |
|       |                                 | This parameter is read-only.                                                                                                                                                                                       |                                 |
| 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.                                                                                                                                       |                                 |
| b415  | Reserved                        |                                                                                                                                                                                                                    |                                 |
|       | 0000hFFFFh                      |                                                                                                                                                                                                                    | 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.                                    | 3                               |
|       |                                 | 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.                                                     |                                 |
| 37.04 | ULC underload actions           | Selects how the drive reacts if the absolute value of<br>the monitored signal stays continuously above the<br>overload curve for longer than the value of parameter<br>37.42 ULC underload timer.                  | Disabled / uint16               |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                        | Def / Type<br>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.                                          | 3                            |
|       |                             | 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.                                                                  |                              |
| 37.11 | ULC speed table point 1     | Defines the first of the five speed points on the X-axis of the user load curve.                                                                                                                                                   | 150.0 rpm / real32           |
|       |                             | 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. |                              |
|       | -30000.0 30000.0 rpm        | Speed.                                                                                                                                                                                                                             | 1 = 1 rpm / 10 = 1<br>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<br>rpm    |
| 37.13 | ULC speed table             | Defines the third speed point.                                                                                                                                                                                                     | 1290.0 rpm / real32          |
|       | point 3                     | See parameter 37.11 ULC speed table point 1.                                                                                                                                                                                       |                              |
|       | -30000.0 30000.0 rpm        | Speed.                                                                                                                                                                                                                             | 1 = 1 rpm / 10 = 1<br>rpm    |
| 37.14 | ULC speed table             | Defines the fourth speed point.                                                                                                                                                                                                    | 1500.0 rpm / real32          |
|       | point 4                     | See parameter 37.11 ULC speed table point 1.                                                                                                                                                                                       |                              |
|       | -30000.0 30000.0 rpm        | Speed.                                                                                                                                                                                                                             | 1 = 1 rpm / 10 = 1<br>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<br>rpm    |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                         | Def / Type<br>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.                                                                                                                                                                                                                                                | 5.0 Hz / real32              |
|       |                             | 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.                                                                                                  |                              |
|       | -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 |                             | Defines the third frequency point.                                                                                                                                                                                                                                                                                                  | 43.0 Hz / real32             |
|       | point 3                     | See parameter 37.16 ULC frequency table point 1.                                                                                                                                                                                                                                                                                    | ,                            |
|       | -500.0 500.0 Hz             | Frequency.                                                                                                                                                                                                                                                                                                                          | 1 = 1 Hz / 10 = 1 Hz         |
| 37.19 | ULC frequency table point 4 | Defines the fourth frequency point.                                                                                                                                                                                                                                                                                                 | 50.0 Hz / real32             |
|       |                             | See parameter 37.16 ULC frequency table point 1.                                                                                                                                                                                                                                                                                    |                              |
|       | -500.0 500.0 Hz             | Frequency.                                                                                                                                                                                                                                                                                                                          | 1 = 1 Hz / 10 = 1 Hz         |
| 37.20 | ULC frequency table point 5 | Defines the fifth frequency point.                                                                                                                                                                                                                                                                                                  | 60.0 Hz / real32             |
|       |                             | See parameter 37.16 ULC frequency table point 1.                                                                                                                                                                                                                                                                                    |                              |
|       | -500.0 500.0 Hz             | Frequency.                                                                                                                                                                                                                                                                                                                          | 1 = 1 Hz / 10 = 1 Hz         |
| 37.21 | ULC underload<br>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 137.15 ULC speed table point 5 or 37.15 ULC speed table point 537.20 ULC frequency table point 5) define the underload (lower) curve.  Each point of the underload curve must have a lower | 10.0 percent / real32        |
|       |                             | value than the corresponding overload point.                                                                                                                                                                                                                                                                                        |                              |
|       | -1600.0 1600.0 %            | Underload point.                                                                                                                                                                                                                                                                                                                    | 1 = 1 % / 10 = 1 %           |
| 37.22 | ULC underload               | Defines the second underload point.                                                                                                                                                                                                                                                                                                 | 15.0 percent / real32        |
|       | point 2                     | See parameter 37.21 ULC underload point 1.                                                                                                                                                                                                                                                                                          |                              |
|       | -1600.0 1600.0 %            | Underload point.                                                                                                                                                                                                                                                                                                                    | 1 = 1 % / 10 = 1 %           |
| 37.23 | ULC underload               | Defines the third underload point.                                                                                                                                                                                                                                                                                                  | 25.0 percent / real32        |
|       | point 3                     | See parameter 37.21 ULC underload point 1.                                                                                                                                                                                                                                                                                          |                              |
|       | -1600.0 1600.0 %            | Underload point.                                                                                                                                                                                                                                                                                                                    | 1 = 1 % / 10 = 1 %           |
| 37.24 | ULC underload               | Defines the fourth underload point.                                                                                                                                                                                                                                                                                                 | 30.0 percent / real32        |
|       | point 4                     | See parameter 37.21 ULC underload point 1.                                                                                                                                                                                                                                                                                          |                              |
|       | -1600.0 1600.0 %            | Underload point.                                                                                                                                                                                                                                                                                                                    | 1 = 1 % / 10 = 1 %           |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                    | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 37.25 | ULC underload               | Defines the fifth underload point.                                                                                                                                                                                                                                             | 30.0 percent / real32        |
|       | point 5                     | See parameter 37.21 ULC underload point 1.                                                                                                                                                                                                                                     |                              |
|       | -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 137.15 ULC speed table point 5 or 37.15 ULC speed table point 537.20 ULC frequency table point 5) define the overload (higher) curve. | 300.0 percent / real32       |
|       |                             | Each point of the overload curve must have a higher value than the corresponding underload point.                                                                                                                                                                              |                              |
|       | -1600.0 1600.0 %            | Overload point.                                                                                                                                                                                                                                                                | 1 = 1 % / 10 = 1 %           |
| 37.32 |                             | Defines the second overload point.                                                                                                                                                                                                                                             | 300.0 percent /              |
|       | 2                           | See parameter 37.31 ULC overload point 1.                                                                                                                                                                                                                                      | real32                       |
|       | -1600.0 1600.0 %            | Overload point.                                                                                                                                                                                                                                                                | 1 = 1 % / 10 = 1 %           |
| 37.33 | ULC overload point 3        | Defines the third overload point.                                                                                                                                                                                                                                              | 300.0 percent /              |
|       |                             | See parameter 37.31 ULC overload point 1.                                                                                                                                                                                                                                      | real32                       |
|       | -1600.0 1600.0 %            | Overload point.                                                                                                                                                                                                                                                                | 1 = 1 % / 10 = 1 %           |
| 37.34 | ULC overload point 4        | Defines the fourth overload point.                                                                                                                                                                                                                                             | 300.0 percent /              |
|       |                             | See parameter 37.31 ULC overload point 1.                                                                                                                                                                                                                                      | real32                       |
|       | -1600.0 1600.0 %            | Overload point.                                                                                                                                                                                                                                                                | 1 = 1 % / 10 = 1 %           |
| 37.35 |                             | Defines the fifth overload point.                                                                                                                                                                                                                                              | 300.0 percent /              |
|       | 5                           | See parameter 37.31 ULC overload point 1.                                                                                                                                                                                                                                      | 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<br>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 /<br>Selection            | Description                                                                                                                                                                                                                                                                                                                                                        | Def / Type<br>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 40.0740.50 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<br>the control chain diagram Process PID control-<br>ler (page 518).                                                                                                                                                                                                                                        | 0.00 percent / real32                      |
|       |                                        | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                       |                                            |
|       | -200000.00<br>200000.00 %              | Process PID controller output.                                                                                                                                                                                                                                                                                                                                     | 1 = 1 % / 100 = 1 %                        |
| 40.02 | Process PID feed-<br>back actual       | Displays the value of process feedback after source selection, mathematical function (parameter 40.10 Set 1 feedback function), and filtering.                                                                                                                                                                                                                     | 0.00 Set 1 units / real32                  |
|       |                                        | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                       |                                            |
|       | -200000.00<br>200000.00 Set 1<br>units | Process feedback.                                                                                                                                                                                                                                                                                                                                                  | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |
| 40.03 | Process PID set-<br>point actual       | Displays the value of process PID setpoint after source selection, mathematical function (parameter 40.18 Set 1 setpoint function), limitation and ramping.                                                                                                                                                                                                        | 0.00 Set 1 units /<br>real32               |
|       |                                        | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                       |                                            |
|       | -200000.00<br>200000.00 Set 1<br>units | Setpoint for process PID controller.                                                                                                                                                                                                                                                                                                                               | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |
| 40.04 | Process PID devi-<br>ation 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).                                                                                                                                | 0.00 Set 1 units /<br>real32               |
|       |                                        | This parameter is read-only.                                                                                                                                                                                                                                                                                                                                       |                                            |
|       | -200000.00<br>200000.00 Set 1<br>units | PID deviation.                                                                                                                                                                                                                                                                                                                                                     | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |
| 40.06 | Process PID status<br>word             | Displays status information on process PID control.  This parameter is read-only.                                                                                                                                                                                                                                                                                  | 0000 0000 0000<br>0000 / uint16            |
| bΩ    | PID active                             | 1 = Process PID control active.                                                                                                                                                                                                                                                                                                                                    |                                            |
|       |                                        |                                                                                                                                                                                                                                                                                                                                                                    |                                            |
| DI    | Setpoint frozen                        | 1 = Process PID setpoint frozen.                                                                                                                                                                                                                                                                                                                                   |                                            |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                            | Def / Type<br>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 40.1640.23).                                                                                                              |                              |
| b1315 | Reserved                    |                                                                                                                                                                        |                              |
|       | 0000hFFFFh                  |                                                                                                                                                                        | 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 run-<br>ning  | 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                            |
|       | Al1 scaled                  | Parameter 12.12 Al1 scaled value.                                                                                                                                      | 1                            |
|       | AI2 scaled                  | Parameter 12.22 AI2 scaled value.                                                                                                                                      | 2                            |
|       | Freq in scaled              | Parameter 11.39 Freq in 1 scaled value.                                                                                                                                | 3                            |
|       | Al1 percent                 | Parameter 12.101 Al1 percent value.                                                                                                                                    | 8                            |
|       | Al2 percent                 | Parameter 12.102 AI2 percent value.                                                                                                                                    | 9                            |
|       | Feedback data<br>storage    | Parameter 40.91 Feedback data storage.                                                                                                                                 | 10                           |
|       | Other [bit]                 | Source selection (see Terms and abbreviations (page 137)).                                                                                                             | -                            |

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| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                       | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 40.09 | Set 1 feedback 2<br>source  | Selects the second source of process feedback. The second source is used only if the setpoint function requires two inputs.                                                       | Not selected / uint32        |
|       |                             | For the selections, see parameter 40.08 Set 1 feedback 1 source.                                                                                                                  |                              |
| 40.10 | Set 1 feedback<br>function  | Defines how process feedback is calculated from the two feedback sources selected by parameters 40.08 Set 1 feedback 1 source and 40.09 Set 1 feedback 2 source.                  | In1 / uint16                 |
|       |                             | 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                         | 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(ln1+ln2)               | Square root of (source 1 + source 2).                                                                                                                                             | 10                           |
|       | sqrt(ln1)+sqrt(ln2)         | 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         |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                   |                                                                                   | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|------------------------------|
| 40.14 | Set 1 setpoint scaling      | Defines, together with para<br>scaling, a general scaling for<br>control chain.                                                               |                                                                                   | 0.00 NoUnit / real32         |
|       |                             | If the parameter is set to z scaling is activated, where calculated according to sel tual setpoint scale is show point scaling actual.        | suitable setpoint scale is ected setpoint source. Ac-                             |                              |
|       |                             | The scaling can be utilized process setpoint is input ir PID controller is used as an In this case, this parameter parameter 40.15 to the non | n Hz, and the output of the rpm value in speed control. r might be set to 50, and |                              |
|       |                             | In effect, the output of the when deviation (setpoint - $[40.32] = 1$ .                                                                       |                                                                                   |                              |
|       |                             |                                                                                                                                               | on the ratio between 40.14 e values 50 and 1500 would as 1 and 30.                |                              |
|       | -200000.00<br>200000.00     | Scaling.                                                                                                                                      |                                                                                   | 1 = 1 / 100 = 1              |
| 40.15 | Set 1 output scaling        | See parameter 40.14 Set 1                                                                                                                     | 0.00 NoUnit / real32                                                              |                              |
|       |                             | If the parameter is set to zero, scaling is automatic, and according to column Scaling:                                                       |                                                                                   |                              |
|       |                             | Operation mode                                                                                                                                | Scaling                                                                           |                              |
|       |                             | (see par. 19.01)                                                                                                                              |                                                                                   |                              |
|       |                             | Speed control                                                                                                                                 | 40.01 Process PID output<br>actual                                                |                              |
|       |                             | Frequency control                                                                                                                             | 40.02 Process PID feed-<br>back actual                                            |                              |
|       | -200000.00<br>200000.00     | Process PID controller outp                                                                                                                   | out base.                                                                         | 1 = 1 / 100 = 1              |
| 40.16 | Set 1 setpoint 1 source     | Selects the primary source<br>See chapter Control chain                                                                                       | of process PID setpoint.<br>diagrams (page 509).                                  | Internal setpoint / uint32   |
|       | Not selected                | None.                                                                                                                                         |                                                                                   | 0                            |
|       | Internal setpoint           | Internal setpoint. See para setpoint sel1.                                                                                                    | meter 40.19 Set 1 internal                                                        | 2                            |
|       | Al1 scaled                  | Parameter 12.12 Al1 scaled                                                                                                                    | value.                                                                            | 3                            |
|       | AI2 scaled                  | Parameter 12.22 AI2 scaled                                                                                                                    | value.                                                                            | 4                            |
|       | Motor potentiomet-<br>er    | 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 s                                                                                                                   | caled value.                                                                      | 10                           |
|       | Al1 percent                 | Parameter 12.101 Al1 perce                                                                                                                    | nt value.                                                                         | 11                           |
|       | Al2 percent                 | Parameter 12.102 Al2 perce                                                                                                                    | nt value.                                                                         | 12                           |

| No.   | Name / Range /<br>Selection   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Def / Type<br>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.  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  **Reference**  **EXT1 reference**  **EXT2 reference**  **EXT2 reference**  **LTT2 reference**  **LTT1 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 set-<br>point     | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Not selected / uint32        |
|       |                               | For the selections, see parameter 40.16 Set 1 setpoint 1 source.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                              |
| 40.18 | Set 1 setpoint function       | Selects a function between the setpoint sources selected by parameters 40.16 Set 1 setpoint 1 source and 40.17 Set 1 setpoint 2 source.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | In1 / uint16                 |
|       |                               | The result of the function (for any selection) is multiplied by parameter 40.89 Set 1 setpoint multiplier.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                              |
|       | In1                           | Source 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 0                            |

| No.   | Name / Range /<br>Selection       | Description                 |                                                               |                   | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------------|-----------------------------|---------------------------------------------------------------|-------------------|------------------------------|
|       | ln1+ln2                           | Sum of sources 1 a          | and 2.                                                        |                   | 1                            |
|       | In1-In2                           | Source 2 subtracte          | ed from source 1.                                             |                   | 2                            |
|       | ln1*ln2                           | Source 1 multiplied         | d by source 2.                                                |                   | 3                            |
|       | ln1/ln2                           | Source 1 divided b          | y source 2.                                                   |                   | 4                            |
|       | MIN(ln1,ln2)                      | Smaller of the two          | sources.                                                      |                   | 5                            |
|       | MAX(In1,In2)                      | Greater of the two          | sources.                                                      |                   | 6                            |
|       | AVE(ln1,ln2)                      | Average of the two          | o sources.                                                    |                   | 7                            |
|       | sqrt(In1)                         | Square root of sou          | ırce 1.                                                       |                   | 8                            |
|       | sqrt(In1-In2)                     | Square root of (so          | urce 1 - source 2).                                           |                   | 9                            |
|       | sqrt(ln1+ln2)                     | Square root of (so          | urce 1 + source 2).                                           |                   | 10                           |
|       | sqrt(ln1)+sqrt(ln2)               | Square root of sou          | ırce 1 + square roc                                           | ot of source 2.   | 11                           |
| 40.19 | Set 1 internal set-<br>point sel1 |                             | nternal setpoint o<br>eters 40.2140.24<br>40.16 Set 1 setpoin | ut of the presets |                              |
|       |                                   | Source defined              | Source defined                                                | Setpoint preset   |                              |
|       |                                   | by par. 40.19               | by par. 40.20                                                 | active            |                              |
|       |                                   | 0                           | 0                                                             | 0 (par. 40.24)    |                              |
|       |                                   | 1                           | 0                                                             | 1 (par. 40.21)    |                              |
|       |                                   | 0                           | 1                                                             | 2 (par. 40.22)    |                              |
|       |                                   | 1                           | 1                                                             | 3 (par. 40.23)    |                              |
|       | Not selected                      | 0.                          |                                                               |                   | 0                            |
|       | Selected                          | 1.                          |                                                               |                   | 1                            |
|       | DI1                               | Digital input DI1 (pbit 0). | parameter 10.02 D                                             | I delayed status, | 2                            |
|       | DI2                               | Digital input DI2 (pbit 1). | oarameter 10.02 D                                             | I delayed status, | 3                            |
|       | DI3                               | Digital input DI3 (pbit 2). | oarameter 10.02 D                                             | I delayed status, | 4                            |
|       | DI4                               | Digital input DI4 (pbit 3). | parameter 10.02 D                                             | I delayed status, | 5                            |
|       | DI5                               | Digital input DI5 (pbit 4). | parameter 10.02 D                                             | I delayed status, | 6                            |
|       | Timed function 1                  | Bit 0 of parameter          | 34.01 Timed func                                              | tions status.     | 18                           |
|       | Timed function 2                  | Bit 1 of parameter          | 34.01 Timed func                                              | tions status.     | 19                           |
|       | Timed function 3                  | Bit 2 of parameter          | 34.01 Timed func                                              | tions status.     | 20                           |
|       | Supervision 1                     | Bit 0 of parameter          | 32.01 Supervision                                             | status.           | 21                           |
|       | Supervision 2                     | Bit 1 of parameter          | 32.01 Supervision                                             | status.           | 22                           |

| No.   | Name / Range /<br>Selection            | Description                                                                                                                                                                                                                    | Def / Type<br>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-<br>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 40.2140.23. 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-<br>point 1         | Internal process setpoint 1. See parameter 40.19 Set 1 internal setpoint sel1.                                                                                                                                                 | 0.00 Set 1 units /<br>real32               |
|       | -200000.00<br>200000.00 Set 1<br>units | Internal process setpoint 1.                                                                                                                                                                                                   | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |
| 40.22 | Set 1 internal set-<br>point 2         | Internal process setpoint 2. See parameter 40.19 Set 1 internal setpoint sel1.                                                                                                                                                 | - / real32                                 |
|       | -200000.00<br>200000.00 Set 1<br>units | Internal process setpoint 2.                                                                                                                                                                                                   | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |
| 40.23 | Set 1 internal set-<br>point 3         | Internal process setpoint 3. See parameter 40.19 Set 1 internal setpoint sel1.                                                                                                                                                 | - / real32                                 |
|       | -200000.00<br>200000.00 Set 1<br>units | Internal process setpoint 3.                                                                                                                                                                                                   | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |
| 40.24 | Set 1 internal set-<br>point 0         | Internal process setpoint 0. See parameter 40.19 Set 1 internal setpoint sel1.                                                                                                                                                 | - / real32                                 |

| No.   | Name / Range /<br>Selection            | Description                                                                                                                                                                                                                                                                                                                                                                  | Def / Type<br>FbEq 16b / 32b               |
|-------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
|       | -200000.00<br>200000.00 Set 1<br>units | Internal process setpoint 0.                                                                                                                                                                                                                                                                                                                                                 | 1 = 1 Set 1 units / 100<br>= 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<br>200000.00 Set 1<br>units | Minimum limit for process PID controller setpoint.                                                                                                                                                                                                                                                                                                                           | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |
| 40.27 | Set 1 setpoint max                     | Defines a maximum limit for the process PID controller setpoint.                                                                                                                                                                                                                                                                                                             | 200000.00 Set 1<br>units / real32          |
|       | -200000.00<br>200000.00 Set 1<br>units | Maximum limit for process PID controller setpoint.                                                                                                                                                                                                                                                                                                                           | 1 = 1 Set 1 units / 100<br>= 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 de-<br>crease 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<br>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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                               | Def / Type<br>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 -                                                                                                                                                                                                                                                                                                                                      | Not inverted (Ref -<br>Fbk) / uint32 |
|       |                             | Feedback).  1 = Deviation inverted (Deviation = Feedback - Setpoint).                                                                                                                                                                                                                                                                                                                                                                     |                                      |
|       |                             | See also section Sleep and boost functions for process PID control (page 82).                                                                                                                                                                                                                                                                                                                                                             |                                      |
|       | Not inverted (Ref -<br>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.  Error/Controller output  GXI  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 /<br>Selection       | Description                                                                                                                                                                                                                   | Def / Type<br>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: | 0.000 s / real32             |
|       |                                   | PID DERIV TIME × $(E_K - E_{K-1})/T_S$ , in which                                                                                                                                                                             |                              |
|       |                                   | T <sub>S</sub> = 2 ms sample time                                                                                                                                                                                             |                              |
|       |                                   | E = Error = Process reference - process feedback.                                                                                                                                                                             |                              |
|       | 0.000 10.000 s                    | Derivation time.                                                                                                                                                                                                              | 1000 = 1 s / 1000 = 1<br>s   |
| 40.35 | Set 1 derivation fil-<br>ter time | Defines the time constant of the 1-pole filter used to smooth the derivative component of the process PID controller.                                                                                                         | 0.0 s / real32               |
|       |                                   | Unfiltered signal  Filtered signal  Time  O = I × (1 - e <sup>-t/T</sup> )  I = filter input (step)  O = filter output  t = time  T = filter time constant                                                                    |                              |
|       | 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<br>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 /<br>real32   |
|       | -200000.00<br>200000.00 %         | Maximum limit for process PID controller output.                                                                                                                                                                              | 1 = 1 % / 100 = 1 %          |

| No.   | Name / Range /<br>Selection   | Description                                                                                                                                                                                                                                                                                                                                                                                                          | Def / Type<br>FbEq 16b / 32b |
|-------|-------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 40.38 | Set 1 output freeze<br>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.                                                                                                               | Not selected / uint32        |
|       |                               | 1 = Process PID controller output frozen.                                                                                                                                                                                                                                                                                                                                                                            |                              |
|       |                               | See also parameter 40.30 Set 1 setpoint freeze enable.                                                                                                                                                                                                                                                                                                                                                               |                              |
|       | 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.  40.39 Set 1  deadband range Setpoint  Feedback  A0.40 Set 1 deadband delay  Time | 0.00 Set 1 units / real32    |

| No.   | Name / Range /<br>Selection            | Description                                                                                                                                                                                                                                                                              | Def / Type<br>FbEq 16b / 32b               |
|-------|----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
|       | 0.00 200000.00<br>Set 1 units          | Deadband range.                                                                                                                                                                                                                                                                          | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |
| 40.40 | Set 1 deadband<br>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.                                                                                                                                                                                       | 0.0 percent / real32                       |
|       |                                        | 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 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.                                                                                                                                                                                        | 60.0 s / real32                            |
|       |                                        | 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.                                                                                                                                                  |                                            |
|       | 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<br>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.                                                                                                                                   | 0.00 Set 1 units / real32                  |
|       |                                        | If active, sleep boost is aborted when the drive wakes up.                                                                                                                                                                                                                               |                                            |
|       | 0.00 200000.00<br>Set 1 units          | Sleep boost step.                                                                                                                                                                                                                                                                        | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |
| 40.47 | Set 1 wake-up devi-<br>ation           | Defines the wake-up level as deviation between process setpoint and feedback.                                                                                                                                                                                                            | - / real32                                 |
|       |                                        | 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.                                                                                                                                                                                                                                      |                                            |
|       | -200000.00<br>200000.00 Set 1<br>units | Wake-up level (as deviation between process setpoint and feedback).                                                                                                                                                                                                                      | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |

| No.   | Name / Range /<br>Selection  | Description                                                                                                                                                                                                                           | Def / Type<br>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.                                                                                                             | 0.50 s / real32              |
|       |                              | The delay timer starts when the deviation exceeds the wake-up level (parameter $40.47~\rm Set~1$ wake-up deviation), and resets if the deviation falls below the wake-up level.                                                       |                              |
|       | 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). | Not selected / uint32        |
|       |                              | 1 = Tracking mode enabled.                                                                                                                                                                                                            |                              |
|       | 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                            |
|       | Al1 scaled                   | Parameter 12.12 Al1 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 40.0740.50) or set 2 (parameter group 41 Process PID set 2 (page 331)) is used.                                                                    | PID set 1 / uint32           |

| No.   | Name / Range /<br>Selection | Description                                                                                                                              | Def / Type<br>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.                                                                              | On / uint32                  |
|       |                             | See also parameter 40.07 Process PID operation mode.                                                                                     |                              |
|       |                             | 0 = Process PID control disabled.                                                                                                        |                              |
|       |                             | 1 = Process PID control enabled.                                                                                                         |                              |
|       | Off                         | 0.                                                                                                                                       | 0                            |
|       | On                          | 1.                                                                                                                                       | 1                            |

| No.   | Name / Range /<br>Selection            | Description                                                                                                                               | Def / Type<br>FbEq 16b / 32b               |
|-------|----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
|       | Follow Ext1/Ext2<br>selection          | Process PID control is disabled when external control location EXT1 is active, and enabled when external control location EXT2 is active. | 2                                          |
|       |                                        | See also parameter 19.11 Ext1/Ext2 selection.                                                                                             |                                            |
|       | 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<br>200000.00                | Scaling.                                                                                                                                  | 1 = 1 / 100 = 1                            |
| 40.62 | PID internal set-                      | Displays the value of the internal setpoint.                                                                                              | - / real32                                 |
|       | point actual                           | See the control chain diagram Process PID setpoint and feedback source selection (page 517).                                              |                                            |
|       |                                        | This parameter is read-only.                                                                                                              |                                            |
|       | -200000.00<br>200000.00 Set 1<br>units | Process PID internal setpoint.                                                                                                            | 1 = 1 Set 1 units / 100<br>= 1 Set 1 units |

| No.   | Name / Range /<br>Selection                | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Def / Type<br>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 40.7140.76. The compensated setpoint curve will be a mixture of a straight line between the points and a squared line between the points.  y  x2, y2  x2, y2  x2 = 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<br>21474836.00 Set 1<br>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                            |
|       | Al1 scaled                                 | Parameter 12.12 Al1 scaled value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 3                            |
|       | Al2 scaled                                 | Parameter 12.22 AI2 scaled value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 4                            |
|       | Motor potentiomet-<br>er                   | 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                           |
|       | Al1 percent                                | Parameter 12.101 Al1 percent value.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 11                           |

| No.   | Name / Range /<br>Selection            | Description                                                                                                                                                     | Def / Type<br>FbEq 16b / 32b               |
|-------|----------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|
|       | Al2 percent                            | Parameter 12.102 Al2 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<br>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<br>200000.00 Set 1<br>units | Compensated setpoint value.                                                                                                                                     | 1 = 1 Set 1 units / 100<br>= 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<br>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<br>200000.00 Set 1<br>units | Compensated setpoint value.                                                                                                                                     | 1 = 1 Set 1 units / 100<br>= 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                         |
|       | 0100 %                                 | 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                                         |
|       | inH₂O                                  | Inch of water.                                                                                                                                                  | 58                                         |
|       | °C                                     | Degree Celsius.                                                                                                                                                 | 150                                        |
|       | °F                                     | Degree Fahrenheit.                                                                                                                                              | 151                                        |

| No.   | Name / Range /<br>Selection    | Description                                                                                                                      | Def / Type<br>FbEq 16b / 32b |
|-------|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | mbar                           | Millibar.                                                                                                                        | 44                           |
|       | m³/h                           | Cubic meter per hour.                                                                                                            | 78                           |
|       | dm³/h                          | Cubic decimeter per hour.                                                                                                        | 21                           |
|       | l/s                            | Liter per second.                                                                                                                | 79                           |
|       | l/min                          | Liter per minute.                                                                                                                | 37                           |
|       | l/h                            | Liter per hour.                                                                                                                  | 38                           |
|       | m³/s                           | Cubic meter per second.                                                                                                          | 88                           |
|       | m³/min                         | Cubic meter per minute.                                                                                                          | 40                           |
|       | km³/h                          | Cubic kilometer per minute.                                                                                                      | 131                          |
|       | gal/s                          | Gallon per second.                                                                                                               | 47                           |
|       | ft³/s                          | Cubic feet per second.                                                                                                           | 50                           |
|       | ft³/min                        | Cubic feet per minute.                                                                                                           | 51                           |
|       | ft³/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<br>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<br>max source | Selects the source for set 1 PID output maximum.                                                                                 | Set1 output max /<br>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 multi-<br>plier | 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<br>200000.00        | Multiplier.                                                                                                                      | 1 = 1 / 100 = 1              |

| No.   | Name / Range /<br>Selection    | Description                                                                                                                                                                                                                                                                        | Def / Type<br>FbEq 16b / 32b |
|-------|--------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 40.90 | Set 1 feedback mul-<br>tiplier | 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<br>200000.00        | Multiplier.                                                                                                                                                                                                                                                                        | 1 = 1 / 100 = 1              |
| 40.91 | Feedback data<br>storage       | Storage parameter for receiving a process feedback value, for example, through the embedded fieldbus interface.                                                                                                                                                                    | 0.00 NoUnit / real32         |
|       |                                | The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (parameters 58.10158.114) 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. |                              |
|       | -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.                                                                                                                                                                    | 0.00 NoUnit / real32         |
|       |                                | The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (parameters 58.10158.114) 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. |                              |
|       | -327.68 327.67                 | Storage parameter for process setpoint.                                                                                                                                                                                                                                            | 100 = 1 / 100 = 1            |
| 40.96 | Process PID output<br>%        | 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 feed-<br>back %    | 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 set-<br>point %    | 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 devi-<br>ation %   | 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 /<br>Selection       | Description                                                                                                                                                | Def / Type<br>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 40.0140.06, 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<br>source        | See parameter 40.08 Set 1 feedback 1 source.                                                                                                               | Al2 percent / uint32                                  |
| 41.09 | Set 2 feedback 2<br>source        | See parameter 40.09 Set 1 feedback 2 source.                                                                                                               | Not selected / uint32                                 |
| 41.10 | Set 2 feedback<br>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=1s/1=1s                                             |
| 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 /<br>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 set-<br>point sel1 | See parameter 40.19 Set 1 internal setpoint sel1.                                                                                                          | Not selected / uint32                                 |
| 41.20 | Set 2 internal set-<br>point sel2 | See parameter 40.20 Set 1 internal setpoint sel2.                                                                                                          | Not selected / uint32                                 |
| 41.21 | Set 2 internal set-<br>point 1    | See parameter 40.21 Set 1 internal setpoint 1.                                                                                                             | 0.00 PID_Custom-<br>Unit / real32                     |
|       | PID_CustomUnit                    |                                                                                                                                                            | 1 = 1 PID_Custom-<br>Unit / 1 = 1 PID_Cus-<br>tomUnit |
| 41.22 | Set 2 internal set-<br>point 2    | See parameter 40.22 Set 1 internal setpoint 2.                                                                                                             | 0.00 PID_Custom-<br>Unit / real32                     |
|       | PID_CustomUnit                    |                                                                                                                                                            | 1 = 1 PID_Custom-<br>Unit / 1 = 1 PID_Cus-<br>tomUnit |
| 41.23 | Set 2 internal set-<br>point 3    | See parameter 40.23 Set 1 internal setpoint 3.                                                                                                             | 0.00 PID_Custom-<br>Unit / real32                     |

| No.   | Name / Range /<br>Selection       | Description                                       | Def / Type<br>FbEq 16b / 32b                          |
|-------|-----------------------------------|---------------------------------------------------|-------------------------------------------------------|
|       | PID_CustomUnit                    |                                                   | 1 = 1 PID_Custom-<br>Unit / 1 = 1 PID_Cus-<br>tomUnit |
| 41.24 | Set 2 internal set-<br>point 0    | See parameter 40.24 Set 1 internal setpoint 0.    | 0.00 PID_Custom-<br>Unit / real32                     |
|       | PID_CustomUnit                    |                                                   | 1 = 1 PID_Custom-<br>Unit / 1 = 1 PID_Cus-<br>tomUnit |
| 41.26 | Set 2 setpoint min                | See parameter 40.26 Set 1 setpoint min.           | 0.00 Set 1 units /<br>real32                          |
|       | Set 1 units                       |                                                   | 1 = 1 Set 1 units / 1 =<br>1 Set 1 units              |
| 41.27 | Set 2 setpoint max                | See parameter 40.27 Set 1 setpoint max.           | 200000.00 Set 1<br>units / real32                     |
|       | Set 1 units                       |                                                   | 1 = 1 Set 1 units / 1 =<br>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 de-<br>crease time | See parameter 40.29 Set 1 setpoint decrease time. | 0.0 s / real32                                        |
|       | S                                 |                                                   | 1=1s/1=1s                                             |
| 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 -<br>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 fil-<br>ter 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 /<br>real32                            |
|       | %                                 |                                                   | 1 = 1 % / 1 = 1 %                                     |

| No.   | Name / Range /<br>Selection     | Description                                          | Def / Type<br>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 /<br>real32                          |
|       | Set 1 units                     |                                                      | 1 = 1 Set 1 units / 1 =<br>1 Set 1 units              |
| 41.40 | Set 2 deadband<br>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=1s/1=1s                                             |
| 41.45 | Set 2 sleep boost time          | See parameter 40.45 Set 1 sleep boost time.          | 0.0 s / real32                                        |
|       | S                               |                                                      | 1=1s/1=1s                                             |
| 41.46 | Set 2 sleep boost step          | See parameter 40.46 Set 1 sleep boost step.          | 0.00 Set 1 units /<br>real32                          |
|       | Set 1 units                     |                                                      | 1 = 1 Set 1 units / 1 =<br>1 Set 1 units              |
| 41.47 | Set 2 wake-up devi-<br>ation    | See parameter 40.47 Set 1 wake-up deviation.         | - / real32                                            |
|       | PID_CustomUnit                  |                                                      | 1 = 1 PID_Custom-<br>Unit / 1 = 1 PID_Cus-<br>tomUnit |
| 41.48 | Set 2 wake-up delay             | See parameter 40.48 Set 1 wake-up delay.             | 0.50 s / real32                                       |
|       | s                               |                                                      | 1=1s/1=1s                                             |
| 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 pre-<br>vention  | 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 /<br>Selection      | Description                                                                                                                          | Def / Type<br>FbEq 16b / 32b                          |
|-------|----------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------|
| 41.73 | Set 2 compensated output 1       | See parameter 40.73 Set 1 compensated output 1.                                                                                      | 0.00 PID_Custom-<br>Unit / real32                     |
|       | PID_CustomUnit                   |                                                                                                                                      | 1 = 1 PID_Custom-<br>Unit / 1 = 1 PID_Cus-<br>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-<br>Unit / real32                     |
|       | PID_CustomUnit                   |                                                                                                                                      | 1 = 1 PID_Custom-<br>Unit / 1 = 1 PID_Cus-<br>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<br>min source   | Selects the source for set 2 PID output minimum.                                                                                     | Set2 output min /<br>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<br>max source   | Selects the source for set 2 PID output maximum.                                                                                     | Set2 output max /<br>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-<br>plier   | See parameter 40.89 Set 1 setpoint multiplier.                                                                                       | 1.00 null / real32                                    |
|       |                                  |                                                                                                                                      | 1 = 1 / 1 = 1                                         |
| 41.90 | Set 2 feedback mul-<br>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 /<br>Selection      | Description                                                                                                                                                                                                                                                                                                                                      | Def / Type<br>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<br>temperature  | Displays the estimated temperature of the brake resistor, or how close the brake resistor is to being too hot.                                                                                                                                                                                                                                   | - / real32                   |
|       |                                  | 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.                                                                                                                                                                                                                                                                                                                     |                              |
|       | 0.0 120.0 %                      | Estimated brake resistor temperature.                                                                                                                                                                                                                                                                                                            | 1 = 1 % / 100 = 1 %          |
| 43.06 | Brake chopper<br>function        | Enables brake chopper control and selects the brake resistor overload protection method (calculation or measurement).                                                                                                                                                                                                                            | Disabled / uint16            |
|       |                                  | 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                         | Brake chopper control disabled.                                                                                                                                                                                                                                                                                                                  | 0                            |
|       | Enabled with<br>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 43.0843.12. See the resistor data sheet.                                                                                                                       | 1                            |
|       | Enabled without<br>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.                                                                         | 2                            |
|       |                                  | For more information, see chapter <i>Resistor braking</i> in the Hardware manual of the drive.                                                                                                                                                                                                                                                   |                              |

| No.   | Name / Range /<br>Selection  | Description                                                                                                                                                                                                                                                                                                                                                                                             | Def / Type<br>FbEq 16b / 32b   |
|-------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
|       | Overvoltage peak protection  | Brake chopper control enabled in an overvoltage condition.                                                                                                                                                                                                                                                                                                                                              | 3                              |
|       |                              | This setting is intended for situations where                                                                                                                                                                                                                                                                                                                                                           |                                |
|       |                              | <ul> <li>the braking chopper is not needed for runtime operation, ie, to dissipate the inertial energy of the motor,</li> <li>the motor is able to store a considerable amount magnetic energy in its windings, and</li> <li>the motor might, deliberately or inadvertently, be stopped by coasting.</li> </ul>                                                                                         |                                |
|       |                              | 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.                                                                                                                                                                                                                                    |                                |
| 43.07 | Brake chopper run enable     | Selects the source for quick brake chopper on/off control.                                                                                                                                                                                                                                                                                                                                              | On / uint32                    |
|       |                              | 0 = Brake chopper IGBT pulses are cut off.                                                                                                                                                                                                                                                                                                                                                              |                                |
|       |                              | 1 = Normal brake chopper IGBT modulation allowed.                                                                                                                                                                                                                                                                                                                                                       |                                |
|       | Off                          | 0.                                                                                                                                                                                                                                                                                                                                                                                                      | 0                              |
|       | On                           | 1.                                                                                                                                                                                                                                                                                                                                                                                                      | 1                              |
|       | Other [bit]                  | See Terms and abbreviations (page 137).                                                                                                                                                                                                                                                                                                                                                                 | -                              |
| 43.08 | Brake resistor<br>thermal tc | Defines the thermal time constant for the brake resistor thermal model.                                                                                                                                                                                                                                                                                                                                 | 0 s / real32                   |
|       | 010000 s                     | Brake resistor thermal time constant, ie, the rated time to achieve 63% temperature.                                                                                                                                                                                                                                                                                                                    | 1=1s/1=1s                      |
| 43.09 | Brake resistor Pmax<br>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 =<br>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<br>= 1 Ohm |

| No.   | Name / Range /<br>Selection     | Description                                                                                                                                                                                                                                                                                                                                                              | Def / Type<br>FbEq 16b / 32b |
|-------|---------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 43.11 | Brake resistor fault<br>limit   | Selects the fault limit for the brake resistor protection based on the thermal model. See parameter 43.06 Brake chopper function.                                                                                                                                                                                                                                        | 105 percent / real32         |
|       |                                 | 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.                                                                                                                                                                                                                    |                              |
|       | 0150 %                          | Brake resistor temperature fault limit.                                                                                                                                                                                                                                                                                                                                  | 100 = 1 % / 100 = 1 %        |
| 43.12 | Brake resistor<br>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          |
|       | 0150 %                          | Brake resistor temperature warning limit.                                                                                                                                                                                                                                                                                                                                | 100 = 1 % / 100 = 1 %        |
|       | 0150 70                         | brake resistor temperature warning limit.                                                                                                                                                                                                                                                                                                                                | 100 = 1 % / 100 = 1 %        |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                              | Def / Type<br>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.                                                                                                                                                           | 0 GWh / uint16               |
|       |                             | This parameter is read-only (see parameter 45.21 Energy calculations reset).                                                                                                                                                                                                                             |                              |
|       | 065535 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.                                                                                                                                                           | 0 MWh / uint16               |
|       |                             | 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).                                                                                                                                                                                                                             |                              |
|       | 0999 MWh                    | Energy savings in MWh.                                                                                                                                                                                                                                                                                   | 1 = 1 MWh / 1 = 1<br>MWh     |
| 45.03 | Saved kW hours              | Energy saved in kWh compared to direct-on-line motor connection.                                                                                                                                                                                                                                         | 0.0 kWh / uint16             |
|       |                             | If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat, but the calculation still records savings made by controlling the speed. If the chopper is disabled, then regenerated energy from the motor is also recorded here. |                              |
|       |                             | When this parameter rolls over, parameter 45.02 Saved MW hours is incremented.                                                                                                                                                                                                                           |                              |
|       |                             | This parameter is read-only (see parameter 45.21 Energy calculations reset).                                                                                                                                                                                                                             |                              |
|       | 0.0 999.9 kWh               | Energy savings in kWh.                                                                                                                                                                                                                                                                                   | 10 = 1 kWh / 10 = 1<br>kWh   |
| 45.04 | Saved energy                | Energy saved in kWh compared to direct-on-line motor connection.                                                                                                                                                                                                                                         | 0.0 kWh / real32             |
|       |                             | If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat.                                                                                                                                                                    |                              |
|       |                             | This parameter is read-only (see parameter 45.21 Energy calculations reset).                                                                                                                                                                                                                             |                              |
|       | 0.0 214748368.0<br>kWh      | Energy savings in kWh.                                                                                                                                                                                                                                                                                   | - / 10 = 1 kWh               |
| 45.05 | Saved money x1000           | Monetary savings in thousands compared to direct-<br>on-line motor connection. This parameter is incremen-<br>ted when parameter 45.06 Saved money rolls over.                                                                                                                                           | 0 unit x 1000 /<br>uint32    |
|       |                             | This parameter is read-only (see parameter 45.21 Energy calculations reset).                                                                                                                                                                                                                             |                              |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                     | Def / Type<br>FbEq 16b / 32b                   |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|
|       | 04294967295 unit<br>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).                                       | 0.00 unit / uint32                             |
|       |                             | When this parameter rolls over, parameter $45.05\mathrm{Saved}$ money x1000 is incremented.                                                                                                                                                     |                                                |
|       |                             | This parameter is read-only (see parameter 45.21 Energy calculations reset).                                                                                                                                                                    |                                                |
|       | 0.00 999.99 unit            | Monetary savings.                                                                                                                                                                                                                               | 1 = 1 unit / 100 = 1<br>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).                                       | 0.00 unit / real32                             |
|       |                             | This parameter is read-only (see parameter 45.21 Energy calculations reset).                                                                                                                                                                    |                                                |
|       | 0.00 21474830.00<br>unit    | Monetary savings.                                                                                                                                                                                                                               | 1 = 1 unit / 100 = 1<br>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.                                                                     | 0 metric kiloton /<br>uint16                   |
|       |                             | This parameter is read-only (see parameter 45.21 Energy calculations reset).                                                                                                                                                                    |                                                |
|       | 065535 metric<br>kiloton    | Reduction in CO2 emissions in metric kilotons.                                                                                                                                                                                                  | 1 = 1 metric kiloton /<br>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). | 0.0 metric ton /<br>uint16                     |
|       |                             | When this parameter rolls over, parameter 45.08 CO2 reduction in kilotons is incremented.                                                                                                                                                       |                                                |
|       |                             | This parameter is read-only (see parameter 45.21 Energy calculations reset).                                                                                                                                                                    |                                                |
|       | 0.0 999.9 metric<br>ton     | Reduction in CO2 emissions in metric tons.                                                                                                                                                                                                      | 1 = 1 metric ton / 10<br>= 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). | 0.0 metric ton /<br>real32                     |
|       |                             | This parameter is read-only (see parameter 45.21 Energy calculations reset).                                                                                                                                                                    |                                                |

| No.   | Name / Range /<br>Selection   | Description                                                                                                                                                                                                                                                                                                                                                                                                             | Def / Type<br>FbEq 16b / 32b |
|-------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | 0.0 214748304.0<br>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 120% 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).                                                                                                                                                                                                                                                                                                                                                                      | 0.200 EUR / uint32           |
|       |                               | See parameter 45.12 Energy tariff 1.                                                                                                                                                                                                                                                                                                                                                                                    |                              |
|       | 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 /<br>uint16     |

| No.   | Name / Range /<br>Selection         | Description                                                                                                                                                                                                                                                                                           | Def / Type<br>FbEq 16b / 32b   |
|-------|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|
|       | tn_MWh                              | Factor for conversion of saved energy into CO2 emissions.                                                                                                                                                                                                                                             | 1 = 1 tn_MWh / 1 = 1<br>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.                                                                                                                                  | 0.00 kW / real32               |
|       |                                     | <b>Note:</b> 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 name-plate power. |                                |
|       | 0.00<br>10000000.00 kW              | Motor power.                                                                                                                                                                                                                                                                                          | 1 = 1 kW / 1 = 1 kW            |
| 45.21 | Energy calculations reset           | Resets the savings counter parameters 45.0145.10.                                                                                                                                                                                                                                                     | 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<br>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                     |
|       | 00:00:0023:59:59                    | Time.                                                                                                                                                                                                                                                                                                 | 1 = 1                          |
| 45.26 | Hourly total energy (resettable)    | Total energy consumption during the last hour, that is, the most recent 60 minutes.                                                                                                                                                                                                                   | - / real32                     |
|       |                                     | You can reset the value by setting it to zero.                                                                                                                                                                                                                                                        |                                |
|       | -3000.00 3000.00<br>kWh             | Total energy.                                                                                                                                                                                                                                                                                         | 10 = 1 kWh / 1 = 1<br>kWh      |
| 45.27 | Daily peak power value (resettable) | Value of the peak power since midnight of the present day.                                                                                                                                                                                                                                            | - / real32                     |
|       |                                     | You can reset the value by setting it to zero.                                                                                                                                                                                                                                                        |                                |
|       | -3000.00 3000.00<br>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                     |
|       | 00:00:0023:59:59                    | Time.                                                                                                                                                                                                                                                                                                 | 1 = 1                          |

| No.   | Name / Range /<br>Selection                   | Description                                                                                                                                                              | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 45.29 | Daily total energy<br>(resettable)            | Total energy consumption since midnight of the present day.                                                                                                              | - / real32                   |
|       |                                               | You can reset the value by setting it to zero.                                                                                                                           |                              |
|       | -30000.00<br>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<br>30000.00 kWh                     | Total energy.                                                                                                                                                            | 1 = 1 kWh / 1 = 1 kWh        |
| 45.31 | Monthly peak<br>power value (reset-<br>table) | 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<br>kW                        | , ,                                                                                                                                                                      | 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                   |
|       | 00:00:0023:59:59                              | Time.                                                                                                                                                                    | 1 = 1                        |
| 45.34 | Monthly total energy (resettable)             | Total energy consumption from the beginning of the present month.                                                                                                        | - / real32                   |
|       |                                               | You can reset the value by setting it to zero.                                                                                                                           |                              |
|       | -1000000.00<br>1000000.00 kWh                 | Total energy.                                                                                                                                                            | 1 = 100 kWh / 1 = 1<br>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<br>1000000.00 kWh                 |                                                                                                                                                                          | 1 = 100 kWh / 1 = 1<br>kWh   |
| 45.36 | Lifetime peak power value                     | Value of the peak power over the drive lifetime.                                                                                                                         | - / real32                   |
|       | -3000.00 3000.00<br>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                   |
|       | 00:00:0023:59:59                              | Time.                                                                                                                                                                    | 1 = 1                        |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                               | Def / Type<br>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).                  | 1500.00; 1800.00<br>(95.20 b0) rpm /<br>real32 |
|       |                             | Also defines the 16-bit scaling of speed-related parameters. The value of this parameter corresponds to 20000, for example, in fieldbus communication.                                                                                                                                                                                                    |                                                |
|       | 0.10 30000.00<br>rpm        | Acceleration/deceleration terminal/initial speed.                                                                                                                                                                                                                                                                                                         | 1 = 1 rpm / 100 = 1<br>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). | 50.00; 60.00 (95.20<br>b0) Hz / real32         |
|       |                             | Also defines the 16-bit scaling of frequency-related parameters. The value of this parameter corresponds to 20000, for example, in fieldbus communication.                                                                                                                                                                                                |                                                |
|       | 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 /<br>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.                                                                                                                                                                                                                 | 1000.0 NoUnit /<br>real32                      |
|       |                             | The unit is selected by parameter 96.16 Unit selection.                                                                                                                                                                                                                                                                                                   |                                                |
|       |                             | For 32-bit scaling see parameter 46.43 Power decimals.                                                                                                                                                                                                                                                                                                    |                                                |
|       | 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.                                                                                                                                                                                                               | 10000 A / real32                               |
|       |                             | For 32-bit scaling see parameter 46.44 Current decimals.                                                                                                                                                                                                                                                                                                  |                                                |
|       | 030000 A                    | Current corresponding to 10000 on fieldbus.                                                                                                                                                                                                                                                                                                               | 1 = 1 A / 1 = 1 A                              |

## 344 Parameters

| No.   | Name / Range /<br>Selection  | Description                                                                                                                                                                                                                                                                                                                                        | Def / Type<br>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 02000 would correspond to a speed of 500[46.01] rpm.  Note: This parameter is effective only with the ABB                                                                     | 0.00 rpm / real32            |
|       |                              | Drives communication profile.                                                                                                                                                                                                                                                                                                                      |                              |
|       | 0.00 30000.00<br>rpm         | Speed corresponding to minimum fieldbus reference.                                                                                                                                                                                                                                                                                                 | 1 = 1 rpm / 100 = 1<br>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 020000 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              |
|       | 220000 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              |
|       | 220000 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              |
|       | 220000 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              |
|       | 220000 ms                    | Output power signal filter time.                                                                                                                                                                                                                                                                                                                   | 1 = 1 ms / 1 = 1 ms          |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                             | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 46.21 | At speed hysteresis         | Defines the "at setpoint" limits for speed control of the drive.                                                                                                                                                                                                                                                                                                                        | 50.00 rpm / real32           |
|       |                             | 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.                                                                                     |                              |
|       |                             | 24.02 (rpm)                                                                                                                                                                                                                                                                                                                                                                             |                              |
|       |                             | 22.87 + 46.21 (rpm)                                                                                                                                                                                                                                                                                                                                                                     |                              |
|       |                             | Drive at setpoint (06.11 bit 8 = 1) 22.87 (rpm)                                                                                                                                                                                                                                                                                                                                         |                              |
|       |                             | 22.87 - 46.21 (rpm)                                                                                                                                                                                                                                                                                                                                                                     |                              |
|       |                             |                                                                                                                                                                                                                                                                                                                                                                                         |                              |
|       | 0.00 30000.00<br>rpm        | Limit for "at setpoint" indication in speed control. For scaling, see parameter 46.01 Speed scaling.                                                                                                                                                                                                                                                                                    | 1 = 1 rpm / 100 = 1<br>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 parameter 46.22 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             |
|       |                             | 01.06 (Hz)                                                                                                                                                                                                                                                                                                                                                                              |                              |
|       |                             | 28.96 + 46.22 (Hz)                                                                                                                                                                                                                                                                                                                                                                      |                              |
|       |                             | Drive at setpoint (06.11 bit 8 = 1) 28.96 (Hz)                                                                                                                                                                                                                                                                                                                                          |                              |
|       |                             | —— 28.96 - 46.22 (Hz)                                                                                                                                                                                                                                                                                                                                                                   |                              |
|       |                             | 0.000                                                                                                                                                                                                                                                                                                                                                                                   |                              |
|       |                             | <i>0</i> rpm                                                                                                                                                                                                                                                                                                                                                                            |                              |

## 346 Parameters

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                           | Def / Type<br>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.                   | 1500.00; 1800.00<br>(95.20 b0) rpm /<br>real32 |
|       |                             | This is also indicated by bit 10 in parameter 06.11 Main status word.                                                                                                                 |                                                |
|       | 0.00 30000.00<br>rpm        | "Above limit" indication trigger level for speed control. For scaling, see parameter 46.01 Speed scaling.                                                                             | 1 = 1 rpm / 100 = 1<br>rpm                     |
| 46.32 | Above frequency<br>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.           | 50.00; 60.00 (90.20<br>b0) Hz / real32         |
|       |                             | This is also indicated by bit 10 in parameter 06.11 Main status word.                                                                                                                 |                                                |
|       | 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<br>kWh       | "kWh pulse" on trigger level.                                                                                                                                                         | 1 = 1 kWh / 1000 = 1<br>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.     | 2 NoUnit / uint16                              |
|       |                             | 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.                                                                                                                                |                                                |
|       | 03                          | 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. | 1 NoUnit / uint16                              |
|       |                             | 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.                                                                                                                                |                                                |
|       | 03                          | Number of decimals.                                                                                                                                                                   | 1=1/1=1                                        |

| No.   | Name / Range /<br>Selection | Description                                                                                                     | Def / Type<br>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<br>real32    | Data storage parameter 1.                                                                                       | 0.000 NoUnit /<br>real32     |
|       | -2147483.000<br>2147483.000 | 32-bit data.                                                                                                    | - / 1000 = 1                 |
| 47.02 | Data storage 2<br>real32    | Data storage parameter 2.                                                                                       | 0.000 NoUnit /<br>real32     |
|       | -2147483.000<br>2147483.000 | 32-bit data.                                                                                                    | - / 1000 = 1                 |
| 47.03 | Data storage 3 real32       | Data storage parameter 3.                                                                                       | 0.000 NoUnit /<br>real32     |
|       | -2147483.000<br>2147483.000 | 32-bit data.                                                                                                    | - / 1000 = 1                 |
| 47.04 | Data storage 4<br>real32    | Data storage parameter 4.                                                                                       | 0.000 NoUnit /<br>real32     |
|       | -2147483.000<br>2147483.000 | 32-bit data.                                                                                                    | -/1000 = 1                   |
| 47.11 | Data storage 1 int32        | Data storage parameter 9.                                                                                       | 0 NoUnit / int32             |
|       | -21474836482147483647       | 32-bit data.                                                                                                    | -/1=1                        |
| 47.12 | Data storage 2 int32        | Data storage parameter 10.                                                                                      | 0 NoUnit / int32             |
|       | -21474836482147483647       | 32-bit data.                                                                                                    | -/1=1                        |
| 47.13 | Data storage 3 int32        | Data storage parameter 11.                                                                                      | 0 NoUnit / int32             |
|       | -21474836482147483647       | 32-bit data.                                                                                                    | -/1=1                        |
| 47.14 | Data storage 4 int32        | Data storage parameter 12.                                                                                      | 0 NoUnit / int32             |
|       | -21474836482147483647       | 32-bit data.                                                                                                    | -/1=1                        |
| 47.21 | Data storage 1 int16        | Data storage parameter 17.                                                                                      | 0 NoUnit / int16             |
|       | -3276832767                 | 16-bit data.                                                                                                    | 1 = 1 / -                    |
| 47.22 | Data storage 2 int16        | Data storage parameter 18.                                                                                      | 0 NoUnit / int16             |
|       | -3276832767                 | 16-bit data.                                                                                                    | 1 = 1 / -                    |
| 47.23 | Data storage 3 int16        | Data storage parameter 19.                                                                                      | 0 NoUnit / int16             |
|       | -3276832767                 | 16-bit data.                                                                                                    | 1 = 1 / -                    |
| 47.24 | Data storage 4 int16        | Data storage parameter 20.                                                                                      | 0 NoUnit / int16             |
|       | -3276832767                 | 16-bit data.                                                                                                    | 1 = 1 / -                    |

| No.   | Name / Range /<br>Selection   | Description                                                                                                                                                                                                                                                                                               | Def / Type<br>FbEq 16b / 32b |
|-------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 49    | Panel port commu-<br>nication | 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            |
|       | 132                           | 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 49.0149.05. <b>Note:</b> 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 /<br>Selection | Description                                                             | Def / Type<br>FbEq 16b / 32b |
|-----|-----------------------------|-------------------------------------------------------------------------|------------------------------|
|     | Configure                   | Refresh parameters 49.0149.05. The value reverts automatically to Done. | 1                            |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                      | Def / Type<br>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.                                                                                                                                                                                                                               | 0000h / uint16               |
|       |                             | This parameter is read-only.                                                                                                                                                                                                                                                                                                                     |                              |
|       | 0000hFFFFh                  | Protocol ID and revision.                                                                                                                                                                                                                                                                                                                        | 1 = 1                        |
| 58.03 | Node address                | Defines the node address of the drive on the fieldbus link.                                                                                                                                                                                                                                                                                      | 0 NoUnit / uint16            |
|       |                             | Values 1247 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).                                                                                                                                                                              |                              |
|       | 0255                        | Node address (values 1247 are allowed).                                                                                                                                                                                                                                                                                                          | 1 = 1 / 1 = 1                |
| 58.04 | Baud rate                   | Selects the transfer rate of the fieldbus link.                                                                                                                                                                                                                                                                                                  | 19.2 kbps / uint16           |
|       |                             | 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).                                                                                                                                                                              |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                    | Def / Type<br>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 58.0158.05, 58.1458.17, 58.25, 58.2858.34) and takes changed EFB configuration settings in use. Reverts automatically to Enabled.                                                                                                                                                               | 1                               |
|       | Silent mode                 | Activates silent mode (no messages are transmitted).                                                                                                                                                                                                                                                                           | 2                               |
|       |                             | Silent mode can be terminated by activating the Refresh settings selection of this parameter.                                                                                                                                                                                                                                  |                                 |
| 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<br>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.                                                                                                                                                                                                                                                         |                                 |

| b8 No er b10 Co b11 CV b12 Re b13 Pr b14 Re b15 In: 00 58.08 Re 58.09 Tr     | No bus activity No packets Noise or addressing Perror Comm loss CW/Ref loss Reserved Protocol 1 Reserved Internal error | 1 = 0 bytes received during last 5 seconds.  1 = 0 packets (addressed to any device) detected during last 5 seconds.  1 = Errors detected (interference, or another device with the same address on line).  1 = 0 packets addressed to the drive received within timeout (58.16 Communication loss time).  1 = No control word or references received within timeout (58.16 Communication loss time).  1 = Duplicate ID detected on the network. Used for BACnet.  1 = Internal error occurred. Contact your local ABB representative. |                   |
|------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| b9 No er er b10 Co b11 CV b12 Re b13 Pr b14 Re b15 In oc 58.08 Re c 58.09 Tr | Noise or addressing error Comm loss CW/Ref loss Reserved Protocol 1 Reserved Internal error                             | ing last 5 seconds.  1 = Errors detected (interference, or another device with the same address on line).  1 = 0 packets addressed to the drive received within timeout (58.16 Communication loss time).  1 = No control word or references received within timeout (58.16 Communication loss time).  1 = Duplicate ID detected on the network. Used for BACnet.  1 = Internal error occurred. Contact your local ABB                                                                                                                  |                   |
| b10 Cc b11 CV b12 Re b13 Pr b14 Re b15 Inf  00 58.08 Re  0                   | Comm loss CW/Ref loss Reserved Protocol 1 Reserved                                                                      | with the same address on line).  1 = 0 packets addressed to the drive received within timeout (58.16 Communication loss time).  1 = No control word or references received within timeout (58.16 Communication loss time).  1 = Duplicate ID detected on the network. Used for BACnet.  1 = Internal error occurred. Contact your local ABB                                                                                                                                                                                            |                   |
| b11 CV b12 Re b13 Pr b14 Re b15 Inf  00 58.08 Re  0                          | Reserved Protocol 1 Reserved Internal error                                                                             | timeout (58.16 Communication loss time).  1 = No control word or references received within timeout (58.16 Communication loss time).  1 = Duplicate ID detected on the network. Used for BACnet.  1 = Internal error occurred. Contact your local ABB                                                                                                                                                                                                                                                                                  |                   |
| b12 Re b13 Pr b14 Re b15 Int  00 58.08 Re  0                                 | Reserved Protocol 1 Reserved Internal error                                                                             | timeout (58.16 Communication loss time).  1 = Duplicate ID detected on the network. Used for BACnet.  1 = Internal error occurred. Contact your local ABB                                                                                                                                                                                                                                                                                                                                                                              |                   |
| b13 Pr b14 Re b15 In  00 58.08 Re  0                                         | Protocol 1<br>Reserved<br>Internal error                                                                                | BACnet.  1 = Internal error occurred. Contact your local ABB                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                   |
| b14 Re b15 In: 00 58.08 Re 0                                                 | Reserved<br>nternal error                                                                                               | BACnet.  1 = Internal error occurred. Contact your local ABB                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                   |
| b15 In:  00 58.08 Re  0 58.09 Tr                                             | nternal error                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |
| 000<br>58.08 Re<br>0<br>58.09 Tr                                             |                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |
| 58.08 Re                                                                     | 0000hFFFFh                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                   |
| 0<br>58.09 Tr                                                                |                                                                                                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 1/1               |
| 58.09 Tr                                                                     | Received packets                                                                                                        | Displays a count of valid packets addressed to the drive. During normal operation, this number increases constantly.                                                                                                                                                                                                                                                                                                                                                                                                                   | 0 NoUnit / uint32 |
| 58.09 Tr                                                                     |                                                                                                                         | Can be reset from the control panel by pressing the Reset softkey for 3 seconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |
|                                                                              | 4294967295                                                                                                              | Number of received packets addressed to the drive.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | -/1=1             |
|                                                                              | ransmitted pack-<br>ets                                                                                                 | Displays a count of valid packets transmitted by the drive. During normal operation, this number increases constantly.                                                                                                                                                                                                                                                                                                                                                                                                                 | 0 NoUnit / uint32 |
|                                                                              |                                                                                                                         | Can be reset from the control panel by pressing the Reset softkey for 3 seconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |
| 0                                                                            | 4294967295                                                                                                              | Number of transmitted packets.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | -/1=1             |
| 58.10 All                                                                    | All packets                                                                                                             | Displays a count of valid packets addressed to any device on the bus. During normal operation, this number increases constantly.                                                                                                                                                                                                                                                                                                                                                                                                       | 0 NoUnit / uint32 |
|                                                                              |                                                                                                                         | Can be reset from the control panel by pressing the Reset softkey for 3 seconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |
| 0.                                                                           | 4294967295                                                                                                              | Number of all received packets.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | -/1=1             |
| 58.11 UA                                                                     | JART errors                                                                                                             | Displays a count of character errors received by the drive. An increasing count indicates a configuration problem on the bus.                                                                                                                                                                                                                                                                                                                                                                                                          | 0 NoUnit / uint32 |
|                                                                              |                                                                                                                         | Can be reset from the control panel by pressing the Reset softkey for 3 seconds.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                   |
| 0.                                                                           |                                                                                                                         | Number of UART errors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -/1=1             |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                           | Def / Type<br>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.                                                                                                                                            | 0 NoUnit / uint32            |
|       |                             | Can be reset from the control panel by pressing the Reset softkey for 3 seconds.                                                                                                                                                                                      |                              |
|       | 04294967295                 | 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            |
|       | 04294967295                 | Counter.                                                                                                                                                                                                                                                              | -/1=1                        |
| 58.14 | Communication loss action   | Selects how the drive reacts to an EFB communication break.                                                                                                                                                                                                           | No action / uint16           |
|       |                             | Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).                                                                                                   |                              |
|       |                             | See also parameters 58.15 Communication loss mode and 58.16 Communication loss time.                                                                                                                                                                                  |                              |
|       | No action                   | No action 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                                                                                           | 1                            |
|       |                             | control in the currently active control location is expected from the EFB or reference is coming from the EFB, and the communication is lost.                                                                                                                         |                              |
|       | 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.      | 2                            |
|       |                             | WARNING!  Make sure that it is safe to continue operation in case of a communication break.                                                                                                                                                                           |                              |
|       | Speed ref safe              | Drive generates an ATCE 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. | 3                            |
|       |                             | WARNING! Make sure that it is safe to continue operation in case of a communication break.                                                                                                                                                                            |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                               | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Warning                     | Drive generates an A7CE EFB comm loss warning. This occurs even though no control is expected from the EFB.                                                               | 5                            |
|       |                             | WARNING!  Make sure that it is safe to continue operation in case of a communication break.                                                                               |                              |
| 58.15 | Communication loss mode     | Defines which message types reset the timeout counter for detecting an EFB communication loss.                                                                            | Any message /<br>uint16      |
|       |                             | 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                 | 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. | 30.0 s / uint16              |
|       |                             | 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.                                                                                                                         |                              |
|       |                             | <b>Note</b> : There is a 30-second boot-up delay immediately after power-up.                                                                                              |                              |
|       | 0.0 6000.0 s                | EFB communication timeout.                                                                                                                                                | 1 = 1 s / 10 = 1 s           |
| 58.17 | Transmit delay              | Modbus RTU, N2 only: Defines a minimum response delay in addition to any fixed delay imposed by the protocol.                                                             | 0 ms / uint16                |
|       |                             | 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).       |                              |
|       | 065535 ms                   | Minimum response delay.                                                                                                                                                   | 1 = 1 ms / 1 = 1 ms          |
| 58.18 | EFB control word            | Modbus RTU, BACnet MS/TP only: Displays the raw (unmodified) control word sent by the Modbus controller to the drive. For debugging purposes.                             | 0.0.0.0 / uint32             |
|       |                             | This parameter is read-only.                                                                                                                                              |                              |
|       | 0.0.0.0FF.FF.FF             | Control word sent by Modbus controller to the drive.                                                                                                                      | 1 = 1                        |

| No.   | Name / Range /<br>Selection | Description                                                                                                    |                                | Def / Type<br>FbEq 16b / 32b   |
|-------|-----------------------------|----------------------------------------------------------------------------------------------------------------|--------------------------------|--------------------------------|
| 58.19 | EFB status word             | Modbus RTU, BACnet MS/T<br>(unmodified) status word f                                                          | 0.0.0.0 / uint32               |                                |
|       |                             | This parameter is read-only                                                                                    |                                |                                |
|       | 0.0.0.0FF.FF.FF             | Status word sent by the driv                                                                                   | ve to the Modbus controller.   | 1 = 1                          |
| 58.25 | Control profile             | Modbus RTU only: Defines to used by the Modbus protocol                                                        | ABB Drives / uint16            |                                |
|       |                             | Changes to this parameter t<br>unit is rebooted or the new<br>parameter 58.06 Communi-<br>settings).           |                                |                                |
|       |                             | <b>Note:</b> If you want to use the set parameter 96.79 Legacy (supported in firmware revi                     | control profile accordingly    |                                |
|       | ABB Drives                  | ABB Drives control profile (v                                                                                  | vith a 16-bit control word).   | 0                              |
|       | DCU Profile                 | DCU control profile (with a                                                                                    | 16 or 32-bit control word).    | 5                              |
| 58.26 | EFB ref1 type               | Modbus RTU only: Selects t erence 1 received through t terface.                                                | Speed or frequency<br>/ uint16 |                                |
|       |                             | The scaled reference is disp<br>EFB reference 1.                                                               |                                |                                |
|       | Speed or frequency          | Type and scaling is chosen automatically according to the currently active operation mode as follows.          |                                | 0                              |
|       |                             | Operation mode                                                                                                 | Reference 1 type               |                                |
|       |                             | (see par. 19.01)                                                                                               |                                |                                |
|       |                             | Speed control                                                                                                  | Speed                          |                                |
|       |                             | Frequency control                                                                                              | Frequency                      |                                |
|       | Transparent                 | No scaling is applied.                                                                                         | <u> </u>                       | 1                              |
|       | General                     | Generic reference without a 100.                                                                               | a specific unit. Scaling: 1 =  | 2                              |
|       | Torque                      | Torque reference. The scalir 46.03 Torque scaling.                                                             | ng is defined by parameter     | 3                              |
|       | Speed                       | Speed reference. The scalin<br>46.01 Speed scaling.                                                            | g is defined by parameter      | 4                              |
|       | Frequency                   | Frequency reference. The semeter 46.02 Frequency scal                                                          | 5                              |                                |
| 58.27 | EFB ref2 type               | Modbus RTU only: Selects the type and scaling of reference 2 received through the embedded fieldbus interface. |                                | Speed or frequency<br>/ uint16 |
|       |                             | The scaled reference is disp<br>EFB reference 2.                                                               | played by parameter 03.10      |                                |
| 58.28 | EFB act1 type               | Modbus RTU only: Selects t                                                                                     | he type of actual value 1.     | Speed or frequency<br>/ uint16 |

| No.   | Name / Range /<br>Selection        | Description                                                                                                 | Def / Type<br>FbEq 16b / 32b     |                       |
|-------|------------------------------------|-------------------------------------------------------------------------------------------------------------|----------------------------------|-----------------------|
|       | Speed or frequency                 | Type and scaling is chosen a the currently active operati                                                   | 0                                |                       |
|       |                                    | Operation mode                                                                                              | Actual 1 type                    |                       |
|       |                                    | (see par. 19.01)                                                                                            |                                  |                       |
|       |                                    | Speed control                                                                                               | Speed                            |                       |
|       |                                    | Frequency control                                                                                           | Frequency                        |                       |
|       | Transparent                        | No scaling is applied.                                                                                      |                                  | 1                     |
|       | General                            | Generic reference without a 100.                                                                            | a specific unit. Scaling: 1 =    | 2                     |
|       | Torque                             | Scaling is defined by param                                                                                 | eter 46.03 Torque scaling.       | 3                     |
|       | Speed                              | Scaling is defined by param                                                                                 | neter 46.01 Speed scaling.       | 4                     |
|       | Frequency                          | Scaling is defined by param scaling.                                                                        | neter 46.02 Frequency            | 5                     |
| 58.29 | EFB act2 type                      | Modbus RTU only: Selects t                                                                                  | he type of actual value 2.       | Speed or frequency    |
|       |                                    | For the selections, see parameter 58.28 EFB act1 type.                                                      |                                  | / uint16              |
| 58.30 | EFB status word transparent source | N2 only: Selects the source of actual value 1 when parameter 58.28 EFB act1 type is set to Transparent.     |                                  | Not selected / uint32 |
|       | Not selected                       | None.                                                                                                       |                                  | 0                     |
|       | Other [bit]                        | Source selection (see Term ations (page 137)).                                                              | s and abbrevi-                   | -                     |
| 58.31 | EFB act1 transparent source        | Modbus RTU only: Selects t when parameter 58.28 EFB a ent.                                                  |                                  | Not selected / uint32 |
|       | Not selected                       | None.                                                                                                       |                                  | 0                     |
|       | Other [bit]                        | Source selection (see Term ations (page 137)).                                                              | s and abbrevi-                   | -                     |
| 58.32 | EFB act2 transparent source        | Modbus RTU, N2 only: Select<br>2 when parameter 58.29 EFI<br>parent.                                        |                                  | Not selected / uint32 |
|       | Not selected                       | None.                                                                                                       |                                  | 0                     |
|       | Other [bit]                        | Source selection (see Term ations (page 137)).                                                              | s and abbrevi-                   | -                     |
| 58.33 | Addressing mode                    | Modbus RTU only: Defines to parameters and holding red 400101465535 Modbus red Changes to this parameter to | gisters in the<br>egister range. | Mode 0 / uint16       |
|       |                                    | unit is rebooted or the new parameter 58.06 Communisettings).                                               | settings validated by            |                       |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                     | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Mode 0                      | 16-bit values (groups 199, indexes 199):                                                                                                                                                                                                                                                                                        | 0                            |
|       |                             | 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 199, indexes 199):                                                                                                                                                                                                                                                                                        |                              |
|       |                             | Register address = $420000 + 200 \times$ parameter group + $2 \times$ parameter index. For example, parameter 22.80 would be mapped to register $420000 + 4400 + 160 = 424560$ .                                                                                                                                                |                              |
|       | Mode 1                      | 16-bit values (groups 1255, indexes 1255):                                                                                                                                                                                                                                                                                      | 1                            |
|       |                             | Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712.                                                                                                                                                                      |                              |
|       | Mode 2                      | 32-bit values (groups 1127, indexes 1255):                                                                                                                                                                                                                                                                                      | 2                            |
|       |                             | Register address = $400000 + 512 \times$ parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register $400000 + 11264 + 160 = 411424$ .                                                                                                                                                      |                              |
| 58.34 | Word order                  | Modbus RTU only: Selects in which order 16-bit registers of 32-bit parameters are transferred.                                                                                                                                                                                                                                  | LO-HI / uint16               |
|       |                             | 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).                                                                                                                                                             |                              |
|       | 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 04194303. 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. | - / uint32                   |
|       |                             | 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).                                                                                                                                                             |                              |
|       | 04194303                    | ID.                                                                                                                                                                                                                                                                                                                             | -/1=1                        |

| No.    | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                            | Def / Type<br>FbEq 16b / 32b |
|--------|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 58.41  | Max master                  | BACnet MS/TP only: The highest master address for devices on the BACnet MS/TP bus.                                                                                                                                                                                                                                     | 0 NoUnit / uint16            |
|        |                             | 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).                                                                                                                                                    |                              |
|        | 0127                        | 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.                                                                                                                                                                                                     | 0 NoUnit / uint16            |
|        |                             | 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).                                                                                                                                                    |                              |
|        | 010                         | 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.                                                                                                                                                                                                                           | 0 NoUnit / uint16            |
|        |                             | 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).                                                                                                                                                    |                              |
|        | 010                         | 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.                                                                                                                                                                                       | 10 s / uint16                |
|        |                             | 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).                                                                                                                                                    |                              |
|        | 160 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).                                                                                                                     | CW 16bit / uint32            |
|        |                             | The master defines the type of the data (input or output). The value is transmitted in a Modbus frame consisting of two 16-bit words. If the value is 16-bit, it is transmitted in the LSW (least significant word). If the value is 32-bit, the subsequent parameter is also reserved for it and must be set to None. |                              |
|        | None                        | 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 /<br>Selection | Description                                                                                                                                                                                                    | Def / Type<br>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<br>word      | Parameter 10.99 RO/DIO control word.                                                                                                                                                                           | 31                           |
|        | AO1 data storage            | Parameter 13.91 AO1 data storage.                                                                                                                                                                              | 32                           |
|        | Feedback data<br>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.                                                      | Ref1 16bit / uint32          |
|        |                             | For the selections, see parameter 58.101 Data I/O 1.                                                                                                                                                           |                              |
| 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                                                                                                                                                             | SW 16bit / uint32            |
| 30.10  | Juliu I, O T                | in the drive which the Modbus master accesses when it reads from or writes to register address 400004.                                                                                                         | SW 1001C / GINESE            |
|        |                             | For the selections, see parameter 58.101 Data I/O 1.                                                                                                                                                           |                              |
| 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.                                                      | Act1 16bit / uint32          |
|        |                             | For the selections, see parameter 58.101 Data I/O 1.                                                                                                                                                           |                              |
| 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.                                                      | Act2 16bit / uint32          |
|        |                             | For the selections, see parameter 58.101 Data I/O 1.                                                                                                                                                           |                              |

## 360 Parameters

| No.    | Name / Range /<br>Selection | Description                                                                                                                                 | Def / Type<br>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 /<br>Selection    | Description                                                                                                                                         | Def / Type<br>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.                                                                                                                          | 0000 0000 0000               |
|       |                                | This parameter is read-only.                                                                                                                        | 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.                                                                             |                              |
| b1315 | Reserved                       |                                                                                                                                                     |                              |
|       | 0000hFFFFh                     |                                                                                                                                                     | 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            | Selects the source of the override activation.                                                                                                      | Not Used / uint32            |
|       | source                         | Value 0 of the source deactivates the override.                                                                                                     |                              |
|       |                                | Value 1 of the source activates the override.                                                                                                       |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                                     | Def / Type<br>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                            |
|       | Al1                         | Parameter 12.12 Al1 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 potentiomet-<br>er    | 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 /<br>Selection | Description                                                                                                                                                                                                                              | Def / Type<br>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<br>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<br>motor will be stopped, if the source defined by para-<br>meter 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<br>the motor will be stopped, if the source defined by<br>parameter 20.42 Start interlock 2 is 0.                                                                                  |                              |
| b3    | Start interlock 3           | 1 = The override is not allowed to start the motor or<br>the motor will be stopped, if the source defined by<br>parameter 20.43 Start interlock 3 is 0.                                                                                  |                              |

| No.   | Name / Range /<br>Selection  | Description                                                                                                                                                                          | Def / Type<br>FbEq 16b / 32b       |
|-------|------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| b4    | Start interlock 4            | 1 = The override is not allowed to start the motor or<br>the motor will be stopped, if the source defined by<br>parameter 20.44 Start interlock 4 is 0.                              |                                    |
| b515  | Reserved                     |                                                                                                                                                                                      |                                    |
|       | 0000hFFFFh                   |                                                                                                                                                                                      | 1/1                                |
| 70.20 | Override fault hand-<br>ling | Faults are grouped into high priority faults and low<br>priority faults. The following faults are high priority,<br>and they are displayed and they will stop the drive:             | Fault on high priority<br>/ uint16 |
|       |                              | 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 prior-<br>ity  | 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.                                            | 1                                  |
|       |                              | See parameter 70.21 Override auto reset trials.                                                                                                                                      |                                    |
| 70.21 | Override auto reset trials   | Defines the number of automatic fault resets the drive performs during override operation.                                                                                           | 5 null / uint16                    |
|       |                              | When the parameter is set to 0, reset trials are made continuously during the override operation. A value of 15 defines a specific number of automatic reset trials.                 |                                    |
|       | 05                           | 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<br>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                  |
|       | 00:00:0023:59:59             | Start time.                                                                                                                                                                          | 1 = 1                              |
| 70.42 | Override log 1 end           | Displays the end date of the last Override situation.                                                                                                                                | 01.01.1980 / uint16                |
|       | date                         | If the drive is in Override mode, the parameter shows the current date.                                                                                                              |                                    |
|       | -                            | End date.                                                                                                                                                                            | 1 = 1                              |

| No.   | Name / Range /<br>Selection  | Description                                                                                                                    | Def / Type<br>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            |
|       | 00:00:0023:59:59             | End time.                                                                                                                      | 1 = 1                        |
| 70.44 | Override log 1 fault<br>1    | Displays the last fault, if any, that occurred during the last operation of override.                                          | 0000h / uint16               |
|       | 0000hFFFFh                   | Fault description.                                                                                                             | 1 = 1                        |
| 70.45 | Override log 1 fault<br>2    | Displays the second last fault, if any, that occurred during the last operation of override.                                   | 0000h / uint16               |
|       | 0000hFFFFh                   | Fault description.                                                                                                             | 1 = 1                        |
| 70.46 | Override log 1 fault<br>3    | Displays the third last fault, if any, that occurred during the last operation of override.                                    | 0000h / uint16               |
|       | 0000hFFFFh                   | 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               |
|       | 0000hFFFFh                   | 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               |
|       | 0000hFFFFh                   | 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               |
|       | 0000hFFFFh                   | Warning description.                                                                                                           | 1 = 1                        |
| 70.50 | Override log 2 start<br>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            |
|       | 00:00:0023:59:59             | 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            |
|       | 00:00:0023:59:59             | End time.                                                                                                                      | 1 = 1                        |
| 70.54 | Override log 2 fault<br>1    | Displays the last fault, if any, that occurred during the second last operation of override.                                   | 0000h / uint16               |
|       | 0000hFFFFh                   | Fault description.                                                                                                             | 1 = 1                        |
| 70.55 | Override log 2 fault<br>2    | Displays the second last fault, if any, that occurred during the second last operation of override.                            | 0000h / uint16               |
|       | 0000hFFFFh                   | Fault description                                                                                                              | 1 = 1                        |

| No.   | Name / Range /<br>Selection | Description                                                                                           | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------|------------------------------|
| 70.56 | Override log 2 fault<br>3   | Displays the third last fault, if any, that occurred during the second last operation of override.    | 0000h / uint16               |
|       | 0000hFFFFh                  | Fault description.                                                                                    | 1 = 1                        |
| 70.57 | Override log 2<br>warning 1 | Displays the last warning, if any, that occurred during the second last operation of override.        | 0000h / uint16               |
|       | 0000hFFFFh                  | Warning description.                                                                                  | 1 = 1                        |
| 70.58 | Override log 2<br>warning 2 | Displays the second last warning, if any, that occurred during second the last operation of override. | 0000h / uint16               |
|       | 0000hFFFFh                  | Warning description.                                                                                  | 1 = 1                        |
| 70.59 | Override log 2<br>warning 3 | Displays the third last warning, if any, that occurred during the second last operation of override.  | 0000h / uint16               |
|       | 0000hFFFFh                  | 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            |
|       | 00:00:0023:59:59            | 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            |
|       | 00:00:0023:59:59            | End time.                                                                                             | 1 = 1                        |
| 70.64 | Override log 3 fault<br>1   | Displays the last fault, if any, that occurred during the third last operation of override.           | 0000h / uint16               |
|       | 0000hFFFFh                  | Fault description.                                                                                    | 1 = 1                        |
| 70.65 | Override log 3 fault<br>2   | Displays the second last fault, if any, that occurred during the third last operation of override.    | 0000h / uint16               |
|       | 0000hFFFFh                  | Fault description.                                                                                    | 1 = 1                        |
| 70.66 | Override log 3 fault<br>3   | Displays the third last fault, if any, that occurred during the third last operation of override.     | 0000h / uint16               |
|       | 0000hFFFFh                  | Fault description.                                                                                    | 1 = 1                        |
| 70.67 | Override log 3<br>warning 1 | Displays the last warning, if any, that occurred during the third last operation of override.         | 0000h / uint16               |
|       | 0000hFFFFh                  | Warning description.                                                                                  | 1 = 1                        |
| 70.68 | Override log 3<br>warning 2 | Displays the second last warning, if any, that occurred during third the last operation of override.  | 0000h / uint16               |
|       | 0000hFFFFh                  | Warning description.                                                                                  | 1 = 1                        |

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

| No.   | Name / Range /<br>Selection      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Def / Type<br>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         | 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                            |
|       | 208240 V                         | 208240 V.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1                            |
|       | 380415 V                         | 380415 V.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2                            |
|       | 440480 V                         | 440480 V.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 3                            |
| 95.02 | Adaptive voltage<br>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 sup-<br>ply 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                 |
|       | 065535 V                         | Voltage.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 10 = 1 V / 1 = 1 V           |

| No.   | Name / Range /<br>Selection  | Description                                                                                                                                                                                                                                                                     | Def / Type<br>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. |                                 |
| b0    | Reserved                     |                                                                                                                                                                                                                                                                                 |                                 |
| b1    | ABB Sine filter              | 1 = An ABB sine filter is connected to the output of the drive.                                                                                                                                                                                                                 |                                 |
| b215  | Reserved                     |                                                                                                                                                                                                                                                                                 |                                 |
|       | 0000hFFFFh                   |                                                                                                                                                                                                                                                                                 | 1 = 1 / 1 = 1                   |
| 95.20 | HW options word 1            | Specifies hardware-related options that require differentiated parameter defaults.                                                                                                                                                                                              | 0000 0000 0000<br>0000 / uint16 |
|       |                              | This parameter is not affected by a parameter restore.                                                                                                                                                                                                                          |                                 |
| b0    | Supply frequency<br>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.                                                                                                                                                                                                                                                                      |                                 |
| b112  | Reserved                     |                                                                                                                                                                                                                                                                                 |                                 |
| b13   | du/dt filter activa-<br>tion | 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                     |                                                                                                                                                                                                                                                                                 |                                 |
|       | 0000hFFFFh                   |                                                                                                                                                                                                                                                                                 | 1=1/1=1                         |

| No.    | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Def / Type<br>FbEq 16b / 32b |
|--------|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 95.26  | Motor disconnect detection  | Detects if motor is disconnected and shows a warning of disconnected motor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Disable / uint16             |
|        |                             | When this parameter is enabled, the drive will do the following:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                              |
|        |                             | <ol> <li>The drive detects if the motor is disconnected from the drive (all three phases).</li> <li>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.</li> <li>When motor connection is again detected, the motor returns back to the last active reference before the disconnection was detected.</li> <li>The warning message disappears from the panel.</li> <li>Note: This feature is only available in scalar control mode. This parameter does not affect vector control mode behavior.</li> </ol> |                              |
|        | 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 /<br>Selection | Description                                                                                                                                                                                                                 | Def / Type<br>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.                                                                    | - / uint32                   |
|       |                             | 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 96.10096.102, 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 96.10096.102. 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).                                                                                                                                                                                      |                              |

| No.   | Name / Range /<br>Selection | Description                                                                                                            | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | 099999999                   | 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                     |                                                                                                                        |                              |
| b210  | 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                    |                                                                                                                        |                              |
|       | 0000hFFFFh                  |                                                                                                                        | 1 = 1 / 1 = 1                |
| 96.04 | Macro select                | Selects the control macro. See chapter Default I/O configuration (page 35) for more information.                       | HVAC default /<br>uint16     |
|       |                             | After a selection is made, the parameter reverts automatically to Done.                                                |                              |
|       | 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. | HVAC default /<br>uint16     |
|       |                             | To change the macro, use parameter 96.04 Macro select.                                                                 |                              |
| 96.06 | Parameter restore           | Restores the original settings of the control program, ie, parameter default values.                                   | Done / uint16                |
|       |                             | <b>Note:</b> This parameter cannot be changed while the drive is running.                                              |                              |
|       | Done                        | Restoring is completed.                                                                                                | 0                            |

| No. | Name / Range /<br>Selection    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Def / Type<br>FbEq 16b / 32b |
|-----|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|     | Restore defaults               | Restores all editable parameter values to default values, except  motor data and ID run results l/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 96.10096.102. | 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 96.10096.102.  parameter group 49 Panel port communication (page 348) parameters.                                                                                   |                              |
|     | Reset all fieldbus<br>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<br>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 de-<br>faults   | 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 /<br>Selection | Def / Type<br>FbEq 16b / 32b                                                                                                                                                                                                           |                    |
|-------|-----------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| 96.07 | Parameter save<br>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                                              | Done / uint16      |
|       |                             | 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. |                    |
|       |                             | <b>Note:</b> 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                        | 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).                                                                                              | No action / uint16 |
|       |                             | The value reverts to 0 automatically.                                                                                                                                                                                                  |                    |
|       | 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.                                                                                                                                                                                           | n/a / uint16       |
|       |                             | This parameter is read-only.                                                                                                                                                                                                           |                    |
|       |                             | See also section Data storage parameters (page 132).                                                                                                                                                                                   |                    |
|       | 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                 |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                     |                   | Def / Type<br>FbEq 16b / 32b |  |  |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|-------------------|------------------------------|--|--|
| 96.11 | User set save/load          | Enables the saving<br>sets of parameter s<br>sets (page 128).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                     |                   | No action / uint16           |  |  |
|       |                             | The set that was in drive is in use afte                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                     |                   |                              |  |  |
|       |                             | 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 |                     |                   |                              |  |  |
|       | No action                   | Load or save oper                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ation complete; no  | ormal operation.  | 0                            |  |  |
|       | User set I/O mode           | Load user parame<br>set I/O mode in1 a                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ter set using parar | neters 96.12 User | 1                            |  |  |
|       | Load set 1                  | Load user parame                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 2                   |                   |                              |  |  |
|       | Load set 2                  | Load user parame                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 3                   |                   |                              |  |  |
|       | Load set 3                  | Load user parame                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ter set 3.          | 4                 |                              |  |  |
|       | Load set 4                  | Load user parame                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | ter set 4.          |                   | 5                            |  |  |
|       | Save to set 1               | Save user paramet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ter set 1.          |                   | 18                           |  |  |
|       | Save to set 2               | Save user paramet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 19                  |                   |                              |  |  |
|       | Save to set 3               | Save user paramet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ter set 3.          |                   | 20                           |  |  |
|       | Save to set 4               | Save user paramet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | ter set 4.          |                   | 21                           |  |  |
| 96.12 | User set I/O mode in1       | When parameter 90 set I/O mode, selewith parameter 96                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | cts the user param  | eter set together | Not selected / uint32        |  |  |
|       |                             | Status of source<br>defined by par.<br>96.12                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                     |                   |                              |  |  |
|       |                             | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0                   | Set 1             |                              |  |  |
|       |                             | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0                   | Set 2             |                              |  |  |
|       |                             | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                   | Set 3             |                              |  |  |
|       |                             | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 1                   | Set 4             |                              |  |  |
|       | Not selected                |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 0                   |                   |                              |  |  |
|       | Selected                    | 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                     |                   | 1                            |  |  |

| No.   | Name / Range /<br>Selection | Description                                                                                                                   | Def / Type<br>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<br>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).                                                                                               |                                 |
| b515  | Reserved                    |                                                                                                                               |                                 |
|       | 0000hFFFFh                  |                                                                                                                               | 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 /<br>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 /<br>Selection     | Description                                                                                                                                                                                                                                                                                                    | Def / Type<br>FbEq 16b / 32b    |
|-------|---------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 96.24 | Full days since 1st<br>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. | 12055 days / uint16             |
|       |                                 | This may be necessary if the fieldbus protocol does not support time synchronization.                                                                                                                                                                                                                          |                                 |
|       | 159999 days                     | Days since beginning of 1980.                                                                                                                                                                                                                                                                                  | 1 = 1 days / 1 = 1 days         |
| 96.25 | Time in minutes<br>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                  |
|       | 01439 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                   |
|       | 059999 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<br>/ uint16 |
| b0    | Power applied                   | 1 = Enabled = Event B5A2 Power applied will be logged.                                                                                                                                                                                                                                                         |                                 |
|       |                                 | 0 = Disabled = Event will not be logged.                                                                                                                                                                                                                                                                       |                                 |
| b1    | Hand mode selec-<br>ted         | 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 com-<br>mand         | 1 = Enabled = Event B687 Auto start command will be logged.                                                                                                                                                                                                                                                    |                                 |
|       |                                 | 0 = Disabled = Event will not be logged.                                                                                                                                                                                                                                                                       |                                 |
| b5    | Auto stop com-<br>mand          | 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.                                                                                                                                                                                                                                                                       |                                 |
| b815  | Reserved                        |                                                                                                                                                                                                                                                                                                                |                                 |

| No. Name / Range / Selection |                                                                                                                                                                                                                                                                                                                                                                                                                                   | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Def / Type<br>FbEq 16b / 32b |  |
|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--|
|                              | 0000hFFFFh                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 1=1/1=1                      |  |
|                              |                                                                                                                                                                                                                                                                                                                                                                                                                                   | Clears all events from the drive's fault and event logs.<br>See section Warning/fault history (page 406).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Done / uint16                |  |
|                              | Done                                                                                                                                                                                                                                                                                                                                                                                                                              | 0 = No action.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 0                            |  |
|                              | Reset                                                                                                                                                                                                                                                                                                                                                                                                                             | 1 = Clear the loggers.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | 1                            |  |
| 96.54                        | 6.54 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                                                                                                                                                                                                                                                                                                                                                                                                                         | 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 pre-<br>vent 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<br>word                                                                                                                                                                                                                                                                                                                                                                                                          | Bits 89 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 1213 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 B): Value of parameter 96.69 Actual checksum B): Value of parameter 96.69 Actual checksum B is copied into parameter 96.69 Actual checksum B is copied into parameter 96.72 Approved checksum B. |                              |  |
| b07                          | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                          | рр                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                              |  |
| b8                           | Approved checksum<br>A                                                                                                                                                                                                                                                                                                                                                                                                            | 1 = Enabled: Checksum A (96.71) is observed.<br>0 = Disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                              |  |
| b9                           | Approved checksum<br>B                                                                                                                                                                                                                                                                                                                                                                                                            | 1 = Enabled: Checksum B (96.72) is observed.<br>0 = Disabled.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                              |  |
| b1011                        | Reserved                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                              |  |

| No.   | Name / Range /<br>Selection                           | Description                                                                                                                                                                                                            | Def / Type<br>FbEq 16b / 32b |
|-------|-------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| b12   | Set approved                                          | 1 = Set: Copy value of 96.68 into 96.71.                                                                                                                                                                               |                              |
|       | checksum A                                            | 0 = Done (copy has been made).                                                                                                                                                                                         |                              |
| b13   | Set approved                                          | 1 = Set: Copy value of 96.69 into 96.72.                                                                                                                                                                               |                              |
|       | checksum B                                            | 0 = Done (copy has been made).                                                                                                                                                                                         |                              |
| b1415 | 15 Reserved                                           |                                                                                                                                                                                                                        |                              |
|       | 0000hFFFFh                                            |                                                                                                                                                                                                                        | 1=1/1=1                      |
| 96.68 | Actual checksum A                                     | Displays the actual parameter configuration checksum A.                                                                                                                                                                | 0000 0000h / uint32          |
|       |                                                       | 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 0000hFFFF<br>FFFFh                               | Actual checksum.                                                                                                                                                                                                       | 1 = 1                        |
| 96.69 | Actual checksum B                                     | checksum B Displays the actual parameter configuration checksum B.                                                                                                                                                     |                              |
|       |                                                       | Checksum B calculation does not include                                                                                                                                                                                |                              |
|       |                                                       | <ul><li>fieldbus settings</li><li>motor data settings, and</li><li>energy data settings parameters.</li></ul>                                                                                                          |                              |
|       |                                                       | 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 0000hFFFF<br>FFFFh                               | Actual checksum.                                                                                                                                                                                                       | 1 = 1                        |
| 96.70 | Disable adaptive                                      | Enables/disables the adaptive program (if present).                                                                                                                                                                    | Yes / uint16                 |
|       | program                                               | See also section Adaptive programming (page 48).                                                                                                                                                                       |                              |
|       | No                                                    | Adaptive program enabled.                                                                                                                                                                                              | 0                            |
|       | Yes                                                   | Adaptive program disabled.                                                                                                                                                                                             | 1                            |
| 96.71 | Approved checksum<br>A                                | Approved (reference) checksum A.                                                                                                                                                                                       | 0000 0000h / uint32          |
|       | 0000 0000hFFFF<br>FFFFh                               | Approved checksum A.                                                                                                                                                                                                   | 1 = 1                        |
| 96.72 | Approved checksum B. Approved (reference) checksum B. |                                                                                                                                                                                                                        | 0000 0000h / uint32          |
|       | 0000 0000hFFFF<br>FFFFh                               | Approved checksum B.                                                                                                                                                                                                   | 1 = 1                        |

| No.    | Name / Range /<br>Selection                                                           | Description                                                                                                                                                                                                                                                                                                                                                                                                          | Def / Type<br>FbEq 16b / 32b |
|--------|---------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
| 96.78  | Legacy Modbus<br>mapping                                                              | Enables a Modbus user to access a select set of parameters using legacy register numbering.                                                                                                                                                                                                                                                                                                                          | Disable / uint16             |
|        |                                                                                       | See the supported parameters in section Parameters supported by Modbus backwards compatibility with legacy drives (page 398).                                                                                                                                                                                                                                                                                        |                              |
|        |                                                                                       | Parameter <i>96.78 550 Compatibility mode</i> will be replaced by parameters <i>96.78 Legacy Modbus mapping</i> and <i>96.79 Legacy control profile in firmware versions 2.15 or later.</i>                                                                                                                                                                                                                          |                              |
|        | Disable                                                                               | Using legacy register numbering disabled.                                                                                                                                                                                                                                                                                                                                                                            | 0                            |
|        | Enable                                                                                | Using legacy register numbering enabled.                                                                                                                                                                                                                                                                                                                                                                             | 1                            |
|        |                                                                                       | 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.                                                                                                                                                                                                                                                                           |                              |
|        |                                                                                       | 16-bit values (groups 199, indexes 199):                                                                                                                                                                                                                                                                                                                                                                             |                              |
|        |                                                                                       | Register address = 40000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 40000 + 2200 + 80 = 42280.                                                                                                                                                                                                                                                              |                              |
| 96.79  | Legacy control pro-<br>file                                                           | Enables using a legacy control profile.                                                                                                                                                                                                                                                                                                                                                                              | Not selected / uint16        |
|        |                                                                                       | <b>Note:</b> Parameter <i>96.78 550 Compatibility mode</i> will be replaced by parameters <i>96.78</i> Legacy Modbus mapping and <i>96.79</i> Legacy control profile in firmware versions <i>2.15</i> or later.                                                                                                                                                                                                      |                              |
|        | 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                                                                      | (Visible when user lock is open)                                                                                                                                                                                                                                                                                                                                                                                     | 10000000 / uint32            |
|        | code                                                                                  | 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).                                                                                                                                                                                                                                                                                                                                                                               |                              |
|        | 1000000099999999                                                                      | New user pass code.                                                                                                                                                                                                                                                                                                                                                                                                  | 1 = 1                        |
| 96.101 | Confirm user pass                                                                     | (Visible when user lock is open)                                                                                                                                                                                                                                                                                                                                                                                     | 10000000 / uint32            |
|        | code Confirms the new user pass code entered in paramet 96.100 Change user pass code. |                                                                                                                                                                                                                                                                                                                                                                                                                      |                              |
|        | 1000000099999999                                                                      | Confirmation of new user pass code.                                                                                                                                                                                                                                                                                                                                                                                  | 1 = 1                        |

| No.    | Name / Range /<br>Selection   | Description                                                                                                                                                                                                                                                                                                                                                       | Def / Type<br>FbEq 16b / 32b    |
|--------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|
| 96.102 | User lock functionality       | Selects the actions or functionalities to be prevented by the user lock. Parameter 96.03 Access level status                                                                                                                                                                                                                                                      | 0000 0000 0000<br>0000 / uint16 |
|        |                               | <ul> <li>Shows which access are selected.</li> <li>Note: <ul> <li>The changes made take effect only when the user lock is closed. See parameter 96.02 Pass code.</li> <li>ABB recommends you select all the actions and functionalities unless otherwise required by the application.</li> </ul> </li> </ul>                                                      |                                 |
| b0     | Disable ABB access<br>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.<br>1 = Backups are disabled.                                                                                                                                                                                                                                                                                                             |                                 |
| b5     | Enable override lock          | 1 = Override locked. Parameter group 70 Over-<br>ride (page 361) parameters and reference or control<br>chain parameters that have been selected to be used<br>for override are write protected.                                                                                                                                                                  |                                 |
| b6     | Protect AP                    | 1 = Creating a backup and restoring from a backup prevented.                                                                                                                                                                                                                                                                                                      |                                 |
| b      | Reserved                      |                                                                                                                                                                                                                                                                                                                                                                   |                                 |
| b7     | Disable panel<br>bluetooth    | 1 = Bluetooth disabled on ACH-AP-W control panel. If<br>the drive is part of a panel bus, Bluetooth is disabled<br>on all control panels.                                                                                                                                                                                                                         |                                 |
| b810   | Reserved                      |                                                                                                                                                                                                                                                                                                                                                                   |                                 |
| b11    | Disable OEM access<br>level 1 | 1 = OEM access level 1 disabled.                                                                                                                                                                                                                                                                                                                                  |                                 |
| b12    | Disable OEM access<br>level 2 | 1 = OEM access level 2 disabled.                                                                                                                                                                                                                                                                                                                                  |                                 |
| b13    | Disable OEM access<br>level 3 | 1 = OEM access level 3 disabled.                                                                                                                                                                                                                                                                                                                                  |                                 |
| b1415  | Reserved                      |                                                                                                                                                                                                                                                                                                                                                                   |                                 |
|        | 0000hFFFFh                    |                                                                                                                                                                                                                                                                                                                                                                   | 1/1                             |

| No.   | Name / Range /<br>Selection   |                                                                                                                                                                                                                                                                                                        |                  |  |  |  |
|-------|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|--|--|--|
| 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).                                                                                                                                              | 4 kHz / uint32   |  |  |  |
|       |                               | Higher switching frequency results in lower acoustic motor noise. Lower switching frequency generates less switching losses and reduce EMC emissions.                                                                                                                                                  |                  |  |  |  |
|       |                               | <b>Note:</b> If you have a multimotor system, contact your local ABB representative.                                                                                                                                                                                                                   |                  |  |  |  |
|       |                               | <b>Note:</b> With an ABB EX motor, follow the instructions given in the ABB EX motor documentation.                                                                                                                                                                                                    |                  |  |  |  |
|       | 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.                                                                                                                                                                                                                           | 1.5 kHz / uint32 |  |  |  |
|       |                               | 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.                                                                                                                                                                                                                                 |                  |  |  |  |
|       |                               | <b>Note:</b> With an ABB EX motor, follow the instructions given in the ABB EX motor documentation.                                                                                                                                                                                                    |                  |  |  |  |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                    | Def / Type<br>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.                                                                                                                               | 100 percent / real32         |
|       |                             | 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%). |                              |
|       | 0200 %                      | 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.                                                                                                                                                                                                                                               | -2 percent / real32          |
|       |                             | <b>Note:</b> 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.                                                                                                                                                                                                       |                              |
|       | -550 %                      | 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)).                                                                                                                                                                                                                                                | Disabled / uint16            |
|       |                             | <b>Note:</b> This is an expert level parameter and should not be adjusted without appropriate skill.                                                                                                                                                                                                                                                                                           |                              |
|       | Disabled                    | Flux braking is disabled.                                                                                                                                                                                                                                                                                                                                                                      | 0                            |
|       | Moderate                    | Flux level is limited during the braking. Deceleration time is longer compared to full braking.                                                                                                                                                                                                                                                                                                | 1                            |
|       | Full                        | Maximum braking power. Almost all available current is used to convert the mechanical braking energy to thermal energy in the motor.                                                                                                                                                                                                                                                           | 2                            |
|       |                             | 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.                                                                                                                                                                                                                              |                              |

| No.   | Name / Range /<br>Selection                                                                                                                                                                                                                       | Descripti                                                         | on                                                                                                                                            |                                            |                                                                                      |                                                |                                   | Def / Type<br>FbEq 16b / 32b               |
|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------|-----------------------------------|--------------------------------------------|
| 97.08 | Optimizer minimum torque                                                                                                                                                                                                                          | dynamics                                                          | This parameter can be used to improve the control lynamics of a synchronous reluctance motor or a salient permanent magnet synchronous motor. |                                            |                                                                                      |                                                |                                   | 0.0 percent / real32                       |
|       |                                                                                                                                                                                                                                                   | As a rule of<br>torque mu<br>the motor<br>at low spe              | ust rise w<br>r current                                                                                                                       | rith minin                                 | num delay                                                                            | . This will                                    | increase                          |                                            |
|       | 0.0 1600.0 %                                                                                                                                                                                                                                      | Optimize                                                          | r torque                                                                                                                                      | limit.                                     |                                                                                      |                                                |                                   | 10 = 1 % / 10 = 1 %                        |
| 97.11 | This parameter can be used to improve torque ac acy in closed-loop control of an induction motor. I mally, the motor identification run provides suffic torque accuracy, but manual fine-tuning can be applications to achie optimal performance. |                                                                   |                                                                                                                                               |                                            |                                                                                      | tor. Nor-<br>ufficient<br>applied              | 100 percent / real32              |                                            |
|       | 25 400 %                                                                                                                                                                                                                                          | be adjust                                                         |                                                                                                                                               |                                            |                                                                                      | ill.                                           |                                   | 1 10/ /1 10/                               |
| 97.13 | 25400 %  IR compensation                                                                                                                                                                                                                          | Rotor tim<br>Defines th                                           |                                                                                                                                               |                                            |                                                                                      |                                                |                                   | 1 = 1 % / 1 = 1 %<br>1.95 percent / real32 |
|       |                                                                                                                                                                                                                                                   | 100% – 15% – 15% – Typical IR 3-phase PN (kW) IR compensation (%) | a high bannot be w(%) elative out ompensation of nominal comper UN = 400  3  2.3                                                              | Field were frequency usation via 0 V (380. | ay torque  a. IR 5%.  Relative . IR compe akening poir  alues are :415 V) c  15  1.3 | output voltansation.  Int  Shown be drives  37 | age. No  • f(Hz)  elow.  132  0.6 |                                            |
|       |                                                                                                                                                                                                                                                   | See also s                                                        |                                                                                                                                               |                                            | nsation fo                                                                           | or scalar r                                    | notor                             |                                            |

| No.   | Name / Range /<br>Selection                  | Description                                                                                                                                                                                                                                                                  | Def / Type<br>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 tem-<br>perature adapta-<br>tion | 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 temperat-<br>ure                   | 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          |
|       | 0200 %                                       | 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         |
|       | 0200 %                                       | 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. |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                   | Def / Type<br>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.                                                                | 0 percent / real32           |
|        |                             | A squirrel-cage motor slips under load. Increasing the frequency as the motor torque increases compensates for the slip.                                      |                              |
|        |                             | <b>Note:</b> This parameter is only effective in scalar motor control mode (parameter 99.04 Motor control mode is set to Scalar).                             |                              |
|        | 0200 %                      | 0% = No slip compensation.                                                                                                                                    | 1 = 1 % / 100 = 1 %          |
|        |                             | 0 200% = Increasing slip compensation. 100% means full slip compensation according to parameters 99.08 Motor nominal frequency and 99.09 Motor nominal speed. |                              |
| 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Def / Type<br>FbEq 16b / 32b     |
|-------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|
| 98    | User motor para-<br>meters  | 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                                                                                                                                                                                                                                                   |                                  |
| 98.01 | User motor model mode       | Shaft performance.  Activates the motor model parameters 98.0298.12 and 98.14.                                                                                                                                                                                                                                                                                                                                                                                                        | Not selected / uint16            |
|       |                             | Note:  Parameter value is automatically set to zero when ID run is selected by parameter 99.13 ID run requested. The values of parameters 98.0298.12 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                | Parameters 98.0298.12 inactive.                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 0                                |
|       | Motor parameters            | The values of parameters 98.0298.12 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<br>pu       | Stator resistance in per unit.                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 100000 = 1 pu /<br>100000 = 1 pu |
| 98.03 | Rr user                     | Defines the rotor resistance $R_R$ of the motor model.<br><b>Note:</b> This parameter is valid only for asynchronous motors.                                                                                                                                                                                                                                                                                                                                                          | 0.00000 pu / real32              |
|       | 0.00000 0.50000<br>pu       | Rotor resistance in per unit.                                                                                                                                                                                                                                                                                                                                                                                                                                                         | 100000 = 1 pu /<br>100000 = 1 pu |
| 98.04 | Lm user                     | Defines the main inductance $L_M$ of the motor model.<br><b>Note</b> : This parameter is valid only for asynchronous motors.                                                                                                                                                                                                                                                                                                                                                          | 0.00000 pu / real32              |
|       | 0.00000<br>10.00000 pu      | Main inductance in per unit.                                                                                                                                                                                                                                                                                                                                                                                                                                                          | 100000 = 1 pu /<br>100000 = 1 pu |
| 98.05 | SigmaL user                 | Defines the leakage inductance $\delta L_S$ .  Note: This parameter is valid only for asynchronous motors.                                                                                                                                                                                                                                                                                                                                                                            | 0.00000 pu / real32              |
|       | 0.00000 1.00000<br>pu       | Leakage inductance in per unit.                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 100000 = 1 pu /<br>100000 = 1 pu |

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

| No.   | Name / Range /<br>Selection | Description                                                                                                            | Def / Type<br>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<br>mH        | Quadrature axis inductance.                                                                                            | 1 = 1 mH / 100 = 1<br>mH     |

| Name / Range /<br>Selection                                                                                  | Description                                                                                                                                                                                                | Def / Type<br>FbEq 16b / 32b                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 mo-<br>tor                                                                                      | Standard squirrel cage AC induction motor (asynchronous induction motor).                                                                                                                                  | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Permanent magnet motor                                                                                       | Permanent magnet motor. Three-phase AC synchronous motor with permanent magnet rotor and sinusoidal BackEMF voltage.                                                                                       | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                                                                                              | 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                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| PMaSynRM                                                                                                     | Permanent Magnet Assisted Synchronous Reluctance Motor.                                                                                                                                                    | 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 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).                                                                  | 0                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|                                                                                                              | Requires motor identification run (ID run). See parameter 99.13 ID run requested.                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                                                                              | 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 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|                                                                                                              | Selection  Motor data  Motor type  Asynchronous motor  Permanent magnet motor  PMaSynRM  Motor control mode                                                                                                | Motor data  Motor configuration settings.  Motor type  Selects the motor type.  Note: This parameter cannot be changed while the drive is running.  Asynchronous motor  Standard squirrel cage AC induction motor (asynchronous induction 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.  PMaSynRM  Permanent Magnet Assisted Synchronous Reluctance Motor.  Motor control mode  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. |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Def / Type<br>FbEq 16b / 32b |
|-------|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Scalar                      | Scalar control. Suitable for most applications, if top performance is not required.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1                            |
|       |                             | 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).                                                                                                          |                              |
|       |                             | <b>Note:</b> 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).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                              |
| 99.06 | Motor nominal cur-<br>rent  | 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.                                                                                                                                                                                                                                                                                                                                                                                          | 14.3 A / real32              |
|       |                             | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                              |
|       | 0.0 50.0 A                  | Nominal current of the motor. The allowable range:  vector control mode: 1/62 × I <sub>N</sub> of the drive  scalar control mode: 02 × I <sub>N</sub> 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.                                                                                                                                                                                                                                                                                                                                                                                                                                            | 230.0 V / real32             |
|       |                             | <ul> <li>Note:</li> <li>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.</li> <li>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.</li> <li>This parameter cannot be changed while the drive is running.</li> </ul> |                              |

| No.   | Name / Range /<br>Selection        | Description                                                                                                                                                                                                                                     | Def / Type<br>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.                                                                                                                                             | 1445 rpm / real32                           |
|       |                                    | <b>Note:</b> This parameter cannot be changed while the drive is running.                                                                                                                                                                       |                                             |
|       | 030000 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. | 4.00 kW or hp /<br>real32                   |
|       |                                    | <b>Note:</b> This parameter cannot be changed while the drive is running.                                                                                                                                                                       |                                             |
|       |                                    | For 16-bit scaling, see parameter 46.04 Power scaling.                                                                                                                                                                                          |                                             |
|       | 0.00 10000.00 kW<br>or hp          | Nominal power of the motor.                                                                                                                                                                                                                     | 1 = 1 kW or hp / 100<br>= 1 kW or hp        |
| 99.11 | Motor nominal cos φ                |                                                                                                                                                                                                                                                 |                                             |
|       |                                    | <ul> <li>Note:</li> <li>Do not enter an estimated value. If you do not know the exact value, leave the parameter at zero.</li> <li>This parameter cannot be changed while the drive is running.</li> </ul>                                      |                                             |
|       | 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.                                                                                                 | 0.000 Nm or lbft /<br>uint32                |
|       |                                    | <b>Note:</b> This parameter cannot be changed while the drive is running.                                                                                                                                                                       |                                             |
|       | 0.000<br>4000000.000 Nm<br>or lbft | Nominal motor torque.                                                                                                                                                                                                                           | 1 = 100 Nm or lbft /<br>1000 = 1 Nm or lbft |

| No.   | Name / Range /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Def / Type<br>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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | None / uint16                |
|       |                             | 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.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                              |
|       |                             | <ul> <li>Note: <ul> <li>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.</li> <li>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%.</li> <li>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.</li> <li>Once the ID run is activated, it can be canceled by stopping the drive.</li> <li>The ID run must be performed every time any of the motor parameters (99.04, 99.0699.12) have been changed.</li> <li>Ensure that the Safe Torque Off and emergency stop circuits (if any) are closed during the ID run.</li> <li>Mechanical brake (if present) is not opened by the logic for the ID run.</li> <li>This parameter cannot be changed while the drive is running.</li> </ul> </li> </ul> |                              |
|       | 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 /<br>Selection | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Def / Type<br>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 decoupled 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 50100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!                                                                                                                                                                                    |                              |
|     | 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 50100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN! |                              |
|     | 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).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                              |

| No.   | Name / Range /<br>Selection     | Description                                                                                                                                                                                                                                                                                                                                                                                                   | Def / Type<br>FbEq 16b / 32b |
|-------|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|
|       | Adaptive                        | Adaptive ID run. Improves the motor model accuracy during normal operation of the drive.                                                                                                                                                                                                                                                                                                                      | 8                            |
|       |                                 | 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.                  |                              |
|       |                                 | <b>Note:</b> For vector control only.                                                                                                                                                                                                                                                                                                                                                                         |                              |
| 99.14 | Last ID run per-<br>formed      | 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 cal-<br>culated | Calculated number of pole pairs in the motor.                                                                                                                                                                                                                                                                                                                                                                 | 0 NoUnit / uint16            |
|       | 01000                           | 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 |                              |
|       | 111/14                          | ensures that "forward" is in fact the correct direction.                                                                                                                                                                                                                                                                                                                                                      |                              |
|       | UVW                             | Normal.                                                                                                                                                                                                                                                                                                                                                                                                       | 0                            |
|       | UWV                             | 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<br>word 1 bit Supply fre-<br>quency 60 Hz = 50 Hz |              |
|-------------------------------|--------------------------------------------------------------------|--------------|
| 11.45 Freq in 1 at scaled max | 1500.000                                                           | 1800.000     |
| 12.20 Al1 scaled at Al1 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<br>word 1 bit Supply fre-<br>quency 60 Hz = 50 Hz | 95.20 HW options<br>word 1 bit Supply fre-<br>quency 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                    | Al 1           | Read only  |
| 01.21                    | Al 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                    | СВ ТЕМР          | 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 |



# 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



#### 

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<br>(hex) | Event name /<br>Aux. code | Cause                                                                                                                                                                                  | What to do                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|---------------|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1080          | Backup/Restore<br>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<br>typically due to earth fault in motor or<br>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<br>(hex) | Event name /<br>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<br>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<br>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<br>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<br>(hex) | Event name /<br>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<br>undervoltage   | Intermediate circuit DC voltage is not sufficient because of a missing supply phase, blown fuse or fault in the rectifier bridge.                                                                                        |                                                                                                                                                                                                                                                                                                                                                                             |
| 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<br>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<br>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<br>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<br>(hex) | Event name /<br>Aux. code       | Cause                                                                                                                       | What to do                                                                                                                                                                                                        |
|---------------|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4380          | Excess temp<br>difference       | High temperature difference between the IGBTs of different phases.                                                          | Check the motor cabling.<br>Check cooling of drive module.                                                                                                                                                        |
| 4981          | External<br>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.<br>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<br>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<br>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<br>communication<br>loss    | Communication failure to standard I/O.                                                                                      | Try resetting the fault or cycle the power to the drive.                                                                                                                                                          |
| 5681          | PU<br>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<br>communication<br>internal | Internal communication error.                                                                                               | Contact your local ABB representative.                                                                                                                                                                            |
| 5691          | Measurement<br>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<br>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<br>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<br>(hex) | Event name /<br>Aux. code | Cause                                                                            | What to do                                                                                                                                                                                                                                                                              |
|---------------|---------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                           |                                                                                  | appears frequently, please replace the drive.                                                                                                                                                                                                                                           |
| 5697          | Charging<br>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<br>mismatch      | The calculated parameter checksum does not match any enabled reference checksum. | Check that all necessary approved (reference) checksums (96.7196.72 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<br>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<br>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 th program.                                                                                                                                                                                                                                            |

| Code<br>(hex) | Event name /<br>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<br>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                                                                                               | Ensure that a valid user parameter set exists. Reload if uncertain.                                                                                     |
|               |                              | requested set does not exist                                                                                                               |                                                                                                                                                         |
|               |                              | set is not compatible with control<br>program                                                                                              |                                                                                                                                                         |
|               |                              | drive was switched off during loading.                                                                                                     |                                                                                                                                                         |
| 64E1          | Kernel<br>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<br>system          | Parameter load or save failed.                                                                                                             | Try forcing a save using parameter 96.07 Parameter save manually.<br>Retry.                                                                             |
| 6591          | Backup/Restore<br>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<br>communication<br>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<br>configuration<br>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<br>firmware could not be loaded.<br>Version mismatch between EFB<br>protocol firmware and drive firmware. | Contact your local ABB representative.                                                                                                                  |

| Code<br>(hex) | Event name /<br>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          | Al overvoltage             | An overvoltage has been detected on<br>an analog input.<br>The analog input has temporarily been<br>changed to voltage mode and will be<br>changed back to current mode when<br>the Al signal level is back within<br>acceptable limits | _                                                                                                                                                                                                                                                             |
| 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.<br>Check fault function parameters.                                                                                                                                                                                       |
| 7122          | Motor<br>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 35.5135.53 and 35.5535.56.                                                                                                      |
| 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<br>temperature   | Brake resistor temperature has<br>exceeded fault limit defined by<br>parameter 43.11 Brake resistor fault<br>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<br>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<br>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<br>(hex) | Event name /<br>Aux. code | Cause                                                                                                                                                                                                                                       | What to do                                                                                                                                                                                                                                                                                   |
|---------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                           |                                                                                                                                                                                                                                             | Replace brake chopper (if replaceable)                                                                                                                                                                                                                                                       |
| 7192          | BC IGBT<br>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<br>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 (23.1123.15 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<br>Other             | 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. Contact your local ABB representative                                                              |
| 8001          | ULC<br>underload          | User load curve: Signal has been too long under the underload curve.                                                                                                                                                                        | quoting the auxiliary code.  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<br>(hex) | Event name /<br>Aux. code | Cause                                                                                                                                                                     | What to do                                                                                                                                                                                                                                                                                                                                         |
|---------------|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                           |                                                                                                                                                                           | the load curve (parameter group 37 User load curve (page 308)).                                                                                                                                                                                                                                                                                    |
| 0A08          | Al supervision fault      | An analog signal is outside the limits specified for the analog input.                                                                                                    | Check signal level at the analog inpu<br>Check the wiring connected to the<br>input.<br>Check the minimum and maximum<br>limits of the input in parameter grou<br>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<br>(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 signa                                                                                                                                                                                                                                                                                 |
| 80B3          | Signal supervision 4      | Fault generated by the signal supervision 4 function.                                                                                                                     | Check the source of the fault (parameter 32.37 Supervision 4 signa                                                                                                                                                                                                                                                                                 |
| 80B4          | Signal supervision 5      | Fault generated by the signal supervision 5 function.                                                                                                                     | Check the source of the fault (parameter 32.47 Supervision 5 signa                                                                                                                                                                                                                                                                                 |
| 80B5          | Signal supervision 6      | Fault generated by the signal supervision 6 function.                                                                                                                     | Check the source of the fault (parameter 32.57 Supervision 6 signa                                                                                                                                                                                                                                                                                 |
| 9081          | External event<br>1       | Fault in external device 1.                                                                                                                                               | Check the external device.<br>Check setting of parameter 31.01<br>External event 1 source.                                                                                                                                                                                                                                                         |
| 9082          | External event<br>2       | Fault in external device 2.                                                                                                                                               | Check the external device.<br>Check setting of parameter 31.03<br>External event 2 source.                                                                                                                                                                                                                                                         |
| 9083          | External event<br>3       | Fault in external device 3.                                                                                                                                               | Check the external device.<br>Check setting of parameter 31.05<br>External event 3 source.                                                                                                                                                                                                                                                         |
| 9084          | External event<br>4       | Fault in external device 4.                                                                                                                                               | Check the external device.<br>Check setting of parameter 31.07<br>External event 4 source.                                                                                                                                                                                                                                                         |
| 9085          | External event<br>5       | Fault in external device 5.                                                                                                                                               | Check the external device.<br>Check setting of parameter 31.09<br>External event 5 source.                                                                                                                                                                                                                                                         |
| A2A1          | Current calibration       | Current offset and gain measurement calibration will occur at next start.                                                                                                 | Informative warning (see paramete 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 paramet group 23 Speed reference ramp (page 223) (speed control) or a frequency reference chain (page 23 (frequency control). Also check parameters 46.01 Speed scaling, 46.4 Frequency scaling and 46.03 Torque scaling. Check motor and motor cable (including phasing and delta/star connection). |

| Code<br>(hex) | Event name /<br>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<br>typically due to earth fault in motor or<br>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<br>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<br>(hex) | Event name /<br>Aux. code                | Cause                                                                            | What to do                                                                                                                                                                                                                                                                                                                                                                  |
|---------------|------------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                          |                                                                                  | parameter may cause the motor to<br>rush uncontrollably, or may overload<br>the brake chopper or resistor.<br>Check the supply voltage.<br>If the problem persists, contact your<br>local ABB representative.                                                                                                                                                               |
| A3A2          | DC link<br>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.                                                                       |
| АЗАА          | DC not<br>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<br>temperature<br>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<br>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<br>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<br>temperature                    | Power unit module temperature is excessive.                                      | Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up.                                                                                                                                                                                                                                                                           |

| Code<br>(hex) | Event name /<br>Aux. code           | Cause                                                                                               | What to do                                                                                                                                                                                                                                                         |
|---------------|-------------------------------------|-----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                     |                                                                                                     | Check motor power against drive power.                                                                                                                                                                                                                             |
| A4B1          | Excess<br>temperature<br>difference | High temperature difference between the IGBTs of different phases.                                  | Check the motor cabling.<br>Check cooling of drive module.                                                                                                                                                                                                         |
| A4F6          | IGBT<br>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<br>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 <i>The Safe torque off function</i> 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<br>powerfail               | Power unit power supply failure.                                                                    | Contact your local ABB representative                                                                                                                                                                                                                              |
| A5ED          | Measurement<br>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<br>feedback                | State feedback from output phases does not match control signals.                                   | Contact your local ABB representative                                                                                                                                                                                                                              |
| A5F0          | Charging<br>feedback                | Charging feedback signal missing.                                                                   | Check the feedback signal coming from the charging system.                                                                                                                                                                                                         |
| A686          | Checksum<br>mismatch                | The calculated parameter checksum does not match any enabled reference checksum.                    | Check that all necessary approved (reference) checksums (96.7196.72 are enabled in 96.55 Checksum contro 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<br>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<br>data                    | Parameters in parameter group 99<br>Motor data (page 390) have not been<br>set.                     | Check that all the required parameters in parameter group 99 Motor data (page 390) have been set.                                                                                                                                                                  |

| Code<br>(hex) | Event name /<br>Aux. code          | Cause                                                                                                                                        | What to do                                                                                                                                                                                                                                                                                                                                   |
|---------------|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                    |                                                                                                                                              | <b>Note:</b> It is normal for this warning tappear during the start-up and continue until the motor data is entered.                                                                                                                                                                                                                         |
| A6A6          | Voltage<br>category<br>unselected  | The voltage category has not been defined.                                                                                                   | Set voltage category in parameter 95.01 Supply voltage.                                                                                                                                                                                                                                                                                      |
| A6B0          | User lock is<br>open               | The user lock is open, ie. user lock configuration parameters 96.10096.102 are visible.                                                      | Close the user lock by entering an invalid pass code in parameter 96.0 Pass code. See section User lock (page 133).                                                                                                                                                                                                                          |
| A6B1          | User pass<br>code not<br>confirmed | A new user pass code has been<br>entered in parameter 96.100 Change<br>user pass code but not confirmed in<br>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 confirmithe new code. See section User lock (page 133).                                                                                                                                                         |
| A6E5          | AI<br>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 analcinput whose settings are in conflic Adjust parameter 12.15 Al1 unit selection/12.25 Al2 unit selection.  Note: Control board reboot (either cycling the power or through parameter 96.08 Control board bo is required to validate any changes the hardware settings. |
| A6E6          | ULC configuration                  | User load curve configuration error.                                                                                                         | Check the auxiliary code. See actio for each code below.                                                                                                                                                                                                                                                                                     |
|               | 0000                               | Speed points inconsistent.                                                                                                                   | Check that each speed point (parameters 37.1137.15) has a high value than the previous point.                                                                                                                                                                                                                                                |
|               | 0001                               | Frequency points inconsistent.                                                                                                               | Check that each frequency point (parameters 37.1637.20) has a high value than the previous point.                                                                                                                                                                                                                                            |
|               | 0002                               | Underload point above overload point.                                                                                                        | Check that each overload point (parameters 37.3137.35) has a high value than the corresponding underload point (parameters 37.2137.25).                                                                                                                                                                                                      |
|               | 0003                               | Overload point below underload point.                                                                                                        | Check that each overload point (parameters 37.3137.35) has a high value than the corresponding underload point (parameters 37.2137.25).                                                                                                                                                                                                      |
| A780          | Motor stall                        | Motor is operating in stall region because of e.g. excessive load or insufficient motor power.                                               | Check motor load and drive rating<br>Check fault function parameters.                                                                                                                                                                                                                                                                        |
| A783          | Motor<br>overload                  | Motor current is too high.                                                                                                                   | Check the motor, and the machine coupled to motor, for overload.                                                                                                                                                                                                                                                                             |

| Code<br>(hex) | Event name /<br>Aux. code        | Cause                                                                                                          | What to do                                                                                                                                                                                                                                                                                                                |
|---------------|----------------------------------|----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                  |                                                                                                                | Adjust the parameters used for the motor overload function (parameters 35.5135.53 and 35.5535.56).                                                                                                                                                                                                                        |
| A784          | Motor<br>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<br>motor are connected and<br>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<br>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<br>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 43.0843.10).                                                                                                                                                                                                                                                                 |
| A79B          | BC short<br>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<br>excess<br>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<br>(hex) | Event name /<br>Aux. code    | Cause                                                                                                                                                                 | What to do                                                                                                                                                                                     |
|---------------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                              |                                                                                                                                                                       | Check that drive supply AC voltage is not excessive.                                                                                                                                           |
| A7AC          | I/O module<br>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<br>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          | Al supervision warning       | An analog signal is outside the limits specified for the analog input.                                                                                                | Check signal level at the analog input<br>Check the wiring connected to the<br>input.<br>Check the minimum and maximum<br>limits of the input in parameter group<br>12 Standard AI (page 173). |
| A8A1          | RO Life<br>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<br>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<br>(hex) | Event name /<br>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<br>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<br>speed<br>warning   | User load curve: X-axis points (speed) are not valid.        | Check that points fulfill conditions.<br>See parameter 37.11 ULC speed table<br>point 1.                                                                                                                                                        |
| A8C1          | ULC overload<br>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<br>underload<br>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<br>underload<br>table | User load curve: Underload curve points are not valid.       | Check that points fulfill conditions.<br>See parameter 37.21 ULC underload<br>point 1.                                                                                                                                                          |
| A8C6          | ULC invalid<br>overload table     | User load curve: Overload curve points are not valid.        | Check that points fulfill conditions.<br>See parameter 37.31 ULC overload<br>point 1.                                                                                                                                                           |
| A8C8          | ULC invalid<br>frequency<br>table | User load curve: X-axis points<br>(frequency) are not valid. | Check that points fulfill conditions.<br>500.0 Hz ≤ 37.16 < 37.17 < 37.18 <<br>37.19 < 37.20 ≤ 500.0 Hz. See parameter<br>37.16 ULC frequency table point 1.                                                                                    |
| A981          | External event<br>1               | Fault in external device 1.                                  | Check the external device.<br>Check setting of parameter 31.01<br>External event 1 source.                                                                                                                                                      |
| A982          | External event<br>2               | Fault in external device 2.                                  | Check the external device.<br>Check setting of parameter 31.03<br>External event 2 source.                                                                                                                                                      |
| A983          | External event                    | Fault in external device 3.                                  | Check the external device.<br>Check setting of parameter 31.05<br>External event 3 source.                                                                                                                                                      |
| A984          | External event                    | Fault in external device 4.                                  | Check the external device.                                                                                                                                                                                                                      |

| Code<br>(hex) | Event name /<br>Aux. code           | Cause                                                                                  | What to do                                                                                                                                                                                                                            |
|---------------|-------------------------------------|----------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               |                                     |                                                                                        | Check setting of parameter 31.07<br>External event 4 source.                                                                                                                                                                          |
| A985          | External event<br>5                 | Fault in external device 5.                                                            | Check the external device.<br>Check setting of parameter 31.09<br>External event 5 source.                                                                                                                                            |
| AF88          | Season<br>configuration<br>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 date34.63 Season 4 start date.                                                                                                                 |
| AF8C          | Process PID<br>sleep mode           | The drive is entering sleep mode.                                                      | Informative warning. See section<br>Process PID control (page 81), and<br>parameters 40.43 Set 1 sleep<br>level40.48 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<br>Autotune torque step) or decrease<br>speed step (25.39 Autotune speed<br>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<br>stop (off2)            | Drive has received an emergency stop<br>(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<br>stop (off1 or<br>off3) | Drive has received an emergency stop<br>(mode selection off1 or off3)<br>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<br>(hex) | Event name /<br>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.                                    |                                                                                                                                                                                                            |
| AFED          | Run<br>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<br>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<br>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<br>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<br>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<br>forced<br>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<br>permissive<br>forced<br>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<br>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<br>(hex) | Event name /<br>Aux. code | Cause                                                                            | What to do                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|---------------|---------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B683          | Auto mode<br>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<br>mismatch      | The calculated parameter checksum does not match any enabled reference checksum. | Check that all necessary approved (reference) checksums (parameters 96.7196.72) are enabled in paramete 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<br>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<br>off 1      | Safe torque off function is active, ie.<br>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<br>off 2      | Safe torque off function is active, ie.<br>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<br>Motor nominal current and 30.17<br>Maximum current. Make sure that<br>30.17 Maximum current > 99.06 Moto<br>nominal current.                                                                                                                                                                                                                                                                                      |

| Code<br>(hex) | Event name /<br>Aux. code | Cause                                                                                     | What to do                                                                                                                                                                                                   |
|---------------|---------------------------|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|               | 0002                      | Maximum speed limit or calculated                                                         | Check that the drive is dimensioned correctly according to the motor. Check settings of parameters                                                                                                           |
|               |                           | field weakening point too low.                                                            | 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                                                                                                                                                                                               |
|               |                           |                                                                                           | <ul> <li>30.12 Maximum speed &gt; (0.55 ×<br/>99.09 Motor nominal speed) &gt;<br/>(0.50 × synchronous speed)</li> </ul>                                                                                      |
|               |                           |                                                                                           | • 30.11 Minimum speed < 0, and                                                                                                                                                                               |
|               |                           |                                                                                           | <ul> <li>supply voltage &gt; (0.66 × 99.07<br/>Motor nominal voltage).</li> </ul>                                                                                                                            |
|               | 0003                      | Maximum torque limit too low.                                                             | Check settings of parameter 99.12<br>Motor nominal torque, and the torque<br>limits in parameter group 30<br>Limits (page 249).<br>Make sure that the maximum torque<br>limit in force is greater than 100%. |
|               | 0004                      | Current measurement calibration did not finish within reasonable time.                    | Contact your local ABB representative and quote this fault and auxiliary code                                                                                                                                |
|               | 00050008                  | 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                                                                                                                                 |
|               | 000E0010                  | 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.                                                                                                             |

#### 428 Fault tracing

| Code<br>(hex) | Event name /<br>Aux. code     | Cause                                                                           | What to do                                                                              |
|---------------|-------------------------------|---------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
|               |                               |                                                                                 | Contact your local ABB representative and quote this fault and auxliary code.           |
| FF63          | STO<br>diagnostics<br>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.                                        |



# 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:

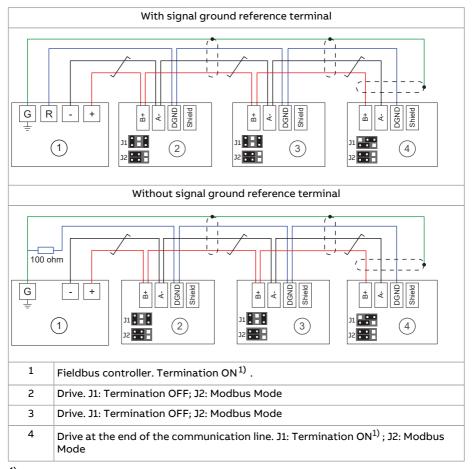
- 1. Power-down the drive, wait for 5 minutes.
- 2. Place the jumper to "panel mode".
- 3. Connect the assistant control panel onto the drive.
- 4. Power-up the drive.
- 5. The drive identifies the panel automatically and you can use it. Be noted that at this moment the EFB does not work.
- 6. After 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.



<sup>1)</sup> **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 CON                        | 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<br>58.29 EFB act2 type | Speed or frequency,<br>Transparent, General,<br>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 400001465536 (10065535) 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<br><br>58.114 Data I/O 14 | For example, the default settings (I/Os 16 contain the control word, the status word, two references and two actual values) | ter accesses when it reads from or<br>writes to the register address cor-<br>responding to Modbus In/Out<br>parameters.                                                       |
|                                             |                                                                                                                             | Select the parameters that you want to read or write through the Modbus I/O words.                                                                                            |
|                                             | RO/DIO control word, AO1<br>data storage, Feedback<br>data storage, Setpoint<br>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.

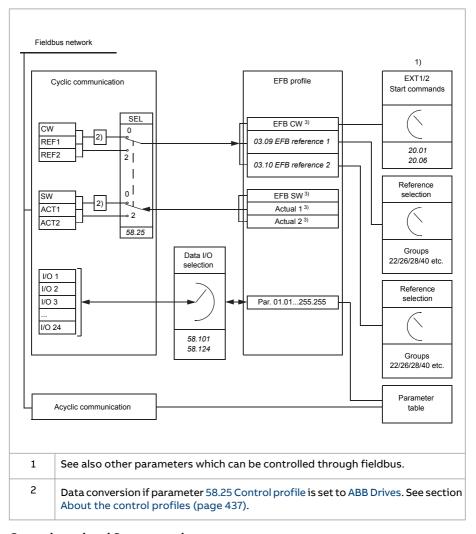
| Parameter                 | Setting for fieldbus control | Function/Information                                                                                                 |  |  |  |
|---------------------------|------------------------------|----------------------------------------------------------------------------------------------------------------------|--|--|--|
| CONTROL COMMAND SO        | URCE 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 S                                    | 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                                         |                              |                                                                                                    |  |  |  |
| selecting Other (see Term<br>1 or 03.10 EFB reference 2. | s and abbreviations (pa      | rirtually any signal selector parameter by age 16)), then either 03.09 EFB reference               |  |  |  |
| 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<br>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                                     | ND SETPOINT                  |                                                                                                    |  |  |  |
| 40.08 Set 1 feedback 1 source                            | Feedback data stor-<br>age   | Connect the bits of the storage parameter (10.99 RO/DIO control word) to the                       |  |  |  |
| 40.16 Set 1 setpoint 1 source                            | Setpoint data storage        | digital input/outputs of the drive.                                                                |  |  |  |
| 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.



#### 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.

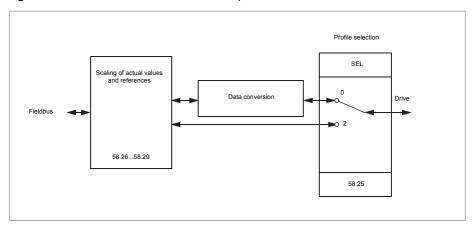
**Note:** Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

#### 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   | 0 OFF1_CONTROL    | 1     | Proceed to READY TO OPERATE.                                                                                                                                                       |
|     |                   | 0     | Stop along currently active deceleration ramp. Proceed to <b>OFF1 ACTIVE</b> ; proceed to <b>READY TO SWITCH ON</b> unless other interlocks (OFF2, OFF3) are active.               |
| 1   | OFF2_CONTROL      | 1     | Continue operation (OFF2 inactive).                                                                                                                                                |
|     |                   | 0     | Emergency OFF, coast to stop.                                                                                                                                                      |
|     |                   |       | Proceed to <b>OFF2 ACTIVE</b> , proceed to <b>SWITCH-ON INHIBITED</b> .                                                                                                            |
| 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 <b>OPERATION ENABLED</b> .                                                                                                                                              |
|     |                   |       | <b>Note:</b> 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 <b>OPERATION INHIB-ITED</b> .                                                                                                                        |
| 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   | 5 RAMP_HOLD       |       | 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 <b>OPERATING. Note:</b> 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.                                                                                                                                                                   |
| 89  | 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                                                                                                                                              |
| 13  | USER_1        |       | drive logic for application-specific functionality.                                                                                                                                          |
| 14  | USER_2        |       |                                                                                                                                                                                              |
| 15  | USER_3        |       |                                                                                                                                                                                              |

## Status Word for the ABB Drives profile

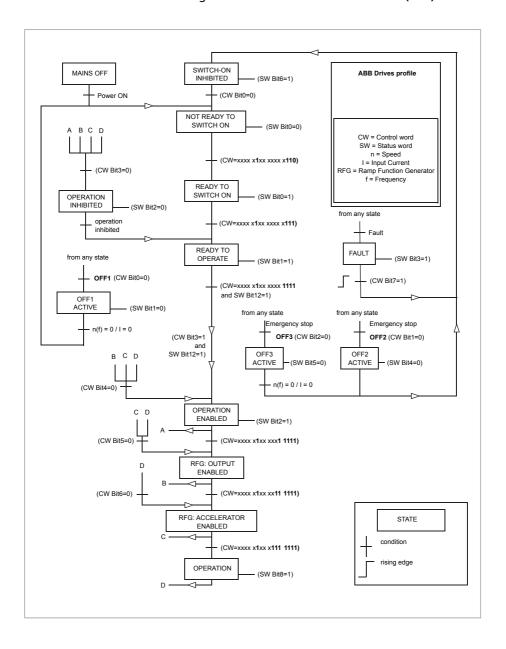
The table below shows the fieldbus Status Word for the ABB Drives control profile. The embedded fieldbus interface converts the drive Status Word into this form for the fieldbus. The upper case boldface text refers to the states shown in State transition diagram (page 441).

| 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                                                                                                   |
| 12  | USER_1       |       | logic for application-specific 12 USER_1 functionality.                                                                                       |
| 13  | USER_2       |       |                                                                                                                                               |
| 14  | USER_3       |       |                                                                                                                                               |
| 15  | Reserved     |       | ,                                                                                                                                             |

## State transition diagram

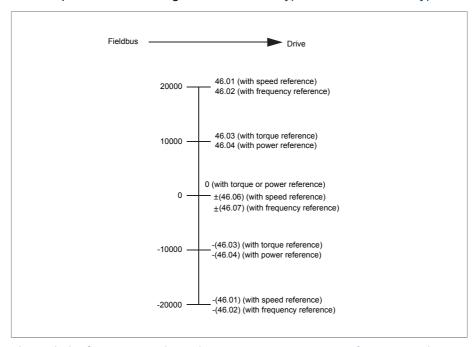
The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile, and configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections Control Word (page 437) and Status Word for the ABB Drives profile (page 439).



#### 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.

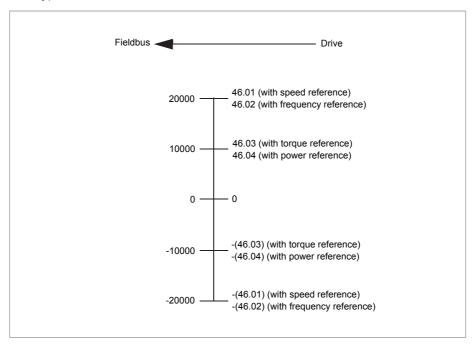


The scaled references are shown by parameters 03.09 EFB reference 1 and 03.10 EFB reference 2.

#### **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.                                                                  |  |
| 400007400024     | Data in/out 724.                                                                                                                 |  |
|                  | Selected by parameters 58.107 Data I/O 7 58.114 Data I/O 14.                                                                     |  |
| 400025400089     | Unused                                                                                                                           |  |
| 400090400100     | Error code access. See section Error code registers (holding registers 400090400100) (page 455).                                 |  |
| 400101465536     | 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 79).                                          |
|     |                | 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 79 are all 0.                                                                |
| 8   | STOPMODE_EMER- | 1     | Emergency ramp stop mode.                                                                                                   |
|     | GENCY_RAMP     | 0     | (no op) Default to parameter stop mode if bits 79 are all 0.                                                                |
| 9   | STOPMODE_COAST | 1     | Coast stop mode.                                                                                                            |
|     |                | 0     | (no op) Default to parameter stop mode if bits 79 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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 23   | USER_1                       |       | drive logic for application-specific functionality.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 24   | USER_2                       |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 25   | USER_3                       |       | 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 2631 | Reserved                     |       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|      |                              |       | The state of the s |

# 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-<br>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 46.3146.33 |
|     |                                     | 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-<br>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   |
| 23   | USER_1                           |       | logic for application-specific functionality. |
| 24   | USER_2                           |       |                                               |
| 25   | USER_3                           |       |                                               |
| 26   | REQ_CTL                          | 1     | Control is requested in this channel.         |
|      |                                  | 0     | Control is not requested in this channel.     |
| 2731 | 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 registers (4X references). |  |
| 05h  | Write Single Coil      | Forces a single coil (0X reference) to 0 or 1.                  |  |
| 06h  | Write Single Register  | Writes a single holding register (4X reference).                |  |

| Code | Function name                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |
|------|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 08h  | Diagnostics                   | Provides a series of tests for checking the communication, or for checking various internal error conditions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |
|      |                               | Supported subcodes:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
|      |                               | <ul> <li>O0h Return Query Data: Echo/loopback test.</li> <li>O1h Restart Comm Option: Restarts and initializes the EFB, clears communications event counters.</li> <li>O4h Force Listen Only Mode</li> <li>O4h Clear Counters and Diagnostic Register</li> <li>OBh Return Bus Message Count</li> <li>OCh Return Bus Comm. Error Count</li> <li>ODh Return Bus Exception Error Count</li> <li>OEh Return Slave Message Count</li> <li>OFh Return Slave No Response Count</li> <li>Oh Return Slave NAK (negative acknowledge) Count</li> <li>11h Return Slave Busy Count</li> <li>12h Return Bus Character Overrun Count</li> <li>14h Clear Overrun Counter and Flag</li> </ul> |  |
| 0Bh  | Get Comm Event Counter        | Returns a status word and an event count.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| OFh  | 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 o holding registers (4X references).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |
| 16h  | Mask Write Register           | Modifies the contents of a 4X register usin a combination of an AND mask, an OR mas and the register's current contents.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
| 17h  | Read/Write Multiple Registers | Writes the contents of a contiguous block o 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 | OEh Read Device Identification: Allows reading the identification and other information.  Supported ID codes (access type): O0h: Request to get the basic device identification (stream access) O4h: Request to get one specific identification object (individual access)  Supported Object IDs: O0h: Vendor Name ("ABB") O1h: Product Code (for example, "AINFX") O2h: Major Minor Revision (combination of contents of parameters 07.05 Firmware version and 58.02 Protocol ID). O3h: 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.                                                                         |  |
|      |                      | <b>Note:</b> 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 400090400100) (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  |
| 80000     | 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     | AT_SETPOINT        | Status Word bit 8   |
| 10009     |                    |                     |
| 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 (9195).                                                                                                                                                                                                                                                             |
| 91        | Error Function Code                | Function code of the failed query.                                                                                                                                                                                                                                                                     |
| 92        | Error Code                         | Set when exception code 04h is generated (see table above).  Oh No error  Oth Low/High limit exceeded  Oth Faulty Index: Unavailable index of an array parameter  Oth Incorrect Data Type: Value does not match the data type of the parameter  Given Branch Bror: 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.                                                                                                                                                                                                                                                          |



# 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**

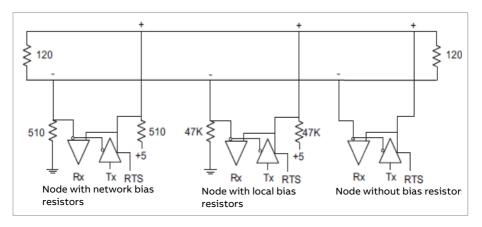
BACnet is an open standard for data communication that enables interoperability between different building systems (eg fire, security, lighting, HVAC, elevator, etc.) and devices in building automation and control applications. It enables data sharing among different types of devices from a broad set 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.
- 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.

 $\textbf{Note}: The \ object \ in stance \ value \ should \ be \ unique \ and \ in \ the \ range \ 1...4194303.$ 

- 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.

- 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 field-<br>bus with Ext1 selec-<br>ted | BV10          |
| 20.06 Ext2 commands | Embedded fieldbus | Start/stop by field-<br>bus with Ext2 selec-<br>ted | 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<br>ref1 | 8 = EFB ref1 <sup>1)</sup> | Frequency reference source 1                   | AV16<br>Input Reference1  |
| 28.15 Ext2 frequency<br>ref1 | 9 = EFB ref2 1)            | Frequency reference source 2                   | AV17<br>Input Reference 2 |
| 46.02 Frequency scaling      | 50.00 Hz <sup>1)</sup>     | 16-bit scaling of frequency-related parameters | No direct BACnet object   |

<sup>1)</sup> 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 <sup>1)</sup> | Speed reference source 1                   | AV16<br>Input Reference1  |
|-----------------------|----------------------------|--------------------------------------------|---------------------------|
| 22.18 Ext2 speed ref1 | 9 = EFB ref2 <sup>1)</sup> | Speed reference source 2                   | AV17<br>Input Reference 2 |
| 46.01 Speed scaling   | 1500 rpm <sup>1)</sup>     | 16-bit scaling of speed-related parameters | No direct BACnet object   |

<sup>1)</sup> 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 field-<br>bus | Run permission by fieldbus                    | BV12          |
| No direct drive para-<br>meter. Via BACnet<br>object the fault reset<br>always goes through. | -                           | Fault reset via field-<br>bus                 | BV14          |
| 20.41 Start interlock                                                                        | 15 = Embedded field-<br>bus | Source for start inter-<br>lock 1 is fieldbus | BV20          |
| 20.42 Start interlock<br>2                                                                   | 15 = Embedded field-<br>bus | Source for start inter-<br>lock 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<br>word bit0 | Relay output 1 controlled by fieldbus | воо           |

## **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 | BO0BO5        |

### **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                                  | A00                     |
| 13.17 AO1 source min | 0.0 1)                | Minimum value of<br>signal selected by<br>parameter 13.12 AO1<br>source | No direct BACnet object |
| 13.18 AO1 source max | 100.0 1)              | Maximum value of<br>signal selected by<br>parameter 13.12 AO1<br>source | No direct BACnet object |

<sup>1)</sup> 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 | A00           |

#### 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<br>1 source | 10 = Feedback data<br>storage | Feedback 1 source<br>data storage | AV43          |
| 40.09 Set 1 feedback<br>2 source | 10 = Feedback data<br>storage | Feedback 2 source<br>data storage | AV43          |
| 40.16 Set 1 setpoint 1 source    | 24 = Setpoint data<br>storage | Setpoint 1 source<br>data storage | AV42          |
| 40.17 Set 1 setpoint 2 source    | 24 = Setpoint data<br>storage | Setpoint 2 source<br>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<br>1 = Fault<br>2 = Last speed<br>3 = Speed ref safe<br>4 = Fault always<br>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<br>mode | 1 = Any message<br>2 = Cw / Ref1 / Ref2 | Defines which message types reset the timeout counter for detecting an EFB communication loss.                                                                          |
|----------------------------------|-----------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 58.16 Communication loss time    | 0.06000.0 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)                               | AVO           |
| 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<br>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 | AV132 |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
|                        | the drive is again up and run-<br>ning, the parameter value is<br>set to the value it had before<br>the power cycle.                                                                              |       |
| 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.                                                                   | AV133 |
|                        | If the power is cycled, after<br>the drive is again up and run-<br>ning, the parameter value is<br>set to the value it had before<br>the power cycle.                                             |       |
| 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<br>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<br>voltage           | 0, 2000                  | V    | R                         |
| AV3       | Output-<br>Voltage  | AC output<br>voltage         | 0, 2000                  | V    | R                         |
| AV4       | Output-Cur-<br>rent | Output cur-<br>rent of drive | 0, nominal current       | A    | R                         |

| AV5  | Output-<br>Torque         | Output<br>torque of mo-<br>tor as a per-<br>centage of<br>nominal<br>torque | -1600, 1600            | %  | R |
|------|---------------------------|-----------------------------------------------------------------------------|------------------------|----|---|
| AV6  | Output-<br>Power          | Output<br>power in kW                                                       | nominal<br>power (+/-) | kW | R |
| AV31 | Output-<br>Speed          | Actual motor speed                                                          | -200, 200              | %  | R |
| AV32 | Output-Cur-<br>rent-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 <sup>1)</sup>             | Defines the node address of the drive on the fieldbus link.                                                                     |
| 58.40 Device object ID        | 51 <sup>1)</sup>              | 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 <sup>1)</sup> | 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 field-<br>bus interface as the source<br>of start and stop commands<br>for external control location<br>1. |

| 28.11 Ext1 frequency ref1 | Selects embedded fieldbus reference 1 as the source for frequency reference 1. |
|---------------------------|--------------------------------------------------------------------------------|
|---------------------------|--------------------------------------------------------------------------------|

<sup>1)</sup> Example

# **Object/Property support matrix**

The following table summarizes the object types/properties supported and default values:

| Prop-<br>erty             | Object type     |                  |                 |                 |                  |                 |                     |      |
|---------------------------|-----------------|------------------|-----------------|-----------------|------------------|-----------------|---------------------|------|
|                           | Binary<br>input | Binary<br>output | Binary<br>value | Analog<br>input | Analog<br>output | Analog<br>value | Multistate<br>value | Loop |
| Object<br>identifi-<br>er | R               | R                | R               | R               | R                | R               | R                   | R    |
| Object<br>name            | W, P            | W, P             | R               | W, P            | W, P             | R(1)            | R                   | W,P  |
| Object<br>type            | R               | R                | R               | R               | R                | R               | R                   | R    |
| Present<br>value          | R               | С                | С               | R               | С                | С               | R                   | R    |
| Status<br>flags           | R               | R                | R               | R               | R                | R               | R                   | R    |
| Event<br>state            | R               | R                | R               | R               | R                | R               | R                   | R    |
| Out-of-<br>service        | W               | W                | W               | W               | W                | W               | W                   | W    |
| Polarity                  | W, P            | W, P             |                 |                 |                  |                 |                     |      |
| Active<br>text            | R               | R                | R               |                 |                  |                 |                     |      |
| Inactive<br>text          | R               | R                | R               |                 |                  |                 |                     |      |
| Units                     |                 |                  |                 | R               | R                | R               |                     |      |

| Min<br>present<br>value    |                                                                                                                                                                                                                                |  |      |     | R   | R    | R    |   |   |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|------|-----|-----|------|------|---|---|
| Max<br>present<br>value    |                                                                                                                                                                                                                                |  |      |     | R   | R    | R    |   |   |
| Priority<br>array          |                                                                                                                                                                                                                                |  | R    | R   |     | R    | R    |   |   |
| Relin-<br>quish<br>default |                                                                                                                                                                                                                                |  | W, P | W,P |     | W, P | W, P |   |   |
| COV in-<br>crement         |                                                                                                                                                                                                                                |  |      |     | W,P | W,P  | W,P  |   |   |
| Number<br>of<br>states     |                                                                                                                                                                                                                                |  |      |     |     |      |      | R |   |
| State<br>text              |                                                                                                                                                                                                                                |  |      |     |     |      |      | R |   |
| Property<br>list           | R                                                                                                                                                                                                                              |  | R    | R   | R   | R    | R    | R | R |
|                            | <ul> <li>R = Read only, W = Writable, C = Commandable, P = Persist</li> <li>AV16, AV17, AV21, AV22, AV40- AV44, AV55, AV56, AV59, AV120-129 have W, P</li> <li>Max length of writable object names is 25 characters</li> </ul> |  |      |     |     |      |      |   |   |

**Device object instance summary** 

The following table summarizes the device object supported:

| Device object     |      |                              |                  |  |  |  |
|-------------------|------|------------------------------|------------------|--|--|--|
| Property          | Flag | Туре                         | Default value    |  |  |  |
| Object identifier | W, P | OID                          | 4194303          |  |  |  |
| Object name       | W, P | CharString,<br>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,<br>max length 100 | "ACH180 is a high-<br>performance variable<br>speed drive designed<br>for HVAC and refriger-<br>ation applications." |
| Location                        | W, P | CharString,<br>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 BACnetCOV-<br>Subscription |  |  |  |
| 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 |
|-----------|-------------|-----------------------------|----------------------|---------------------------|
| ВІО       | RO1-Monitor | Status of relay<br>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                         |
| ВІ7       | 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 |
|-----------|-------------|----------------------------------|----------------------|---------------------------|
| воо       | RO1-Command | Output state of relay 1          | On / Off             | С                         |
| BO5       | DO1-Command | Output state of digital output 1 | On / Off             | С                         |

# 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 |
|-----------|-------------------------|-----------------------------------|------------------------|---------------------------|
| BVO       | RUN-STOP-Mon-<br>itor   | Drive's run<br>status             | Run / Stop             | R                         |
| BV1       | Direction-Monit-<br>or  | Rotational direction of the motor | Reverse / For-<br>ward | R                         |
| BV2       | OK-FAULT-Monit-<br>or   | Actual fault<br>status of drive   | Fault / OK             | R                         |
| BV3       | EXT1-EXT2-Mon-<br>itor  | Actual control source             | Ext2 / Ext1            | R                         |
| BV4       | HAND-AUTO-<br>Monitor   | Actual operating mode.            | Hand / Auto            | R                         |
| BV5       | Warning-Monitor         | Actual warning status             | Warning / OK           | R                         |
| BV7       | Ready-Monitor           | Actual ready<br>status            | Ready / Not-<br>Ready  | R                         |
| BV8       | At-Setpoint-<br>Monitor | Actual at set-<br>point status    | Yes / No               | R                         |
| BV9       | Enabled-Monitor         | Actual run en-<br>abled status    | Enable / Disable       | R                         |
| BV10      | RUN-STOP-Com-<br>mand   | Command to start drive            | Run / Stop             | С                         |

| BV11      | Direction-Com-<br>mand        | Command to rotational direction                                                                                                                                                                                                   | Reverse / Forward | С |
|-----------|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|---|
| BV12      | Run-Permissive-<br>Command    | Command to run<br>permissive com-<br>mand                                                                                                                                                                                         | Enable / Disable  | С |
| BV13      | EXT1-EXT2-Com-<br>mand        | Commanded to external 1 or external 2 selection                                                                                                                                                                                   | Ext2 / Ext1       | С |
| BV14      | Fault-Reset-<br>Command       | Commanded to fault reset                                                                                                                                                                                                          | Reset / No        | W |
| BV15-BV16 | <reserved></reserved>         |                                                                                                                                                                                                                                   |                   |   |
| BV17      | Lock-Parameters               | Actual status of parameter lock.                                                                                                                                                                                                  | Lock / Unlock     | R |
| BV18      | Control-Over-<br>ride-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          | С |
| BV19      | Control-Over-<br>ride-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-<br>Command | Command to start enable 1                                            | Enable / Disable          | С |
|------|-------------------------------|----------------------------------------------------------------------|---------------------------|---|
| BV21 | Start-Interlock-<br>2-Command | Command to start enable 2                                            | Enable / Disable          | С |
| BV24 | Started-Monitor               | Actual start<br>status                                               | Started / Not-<br>Started | R |
| BV25 | Safe-Torque-Off-<br>Monitor   | Actual status of<br>Safe Torque Off                                  | Active / OK               | R |
| BV26 | Underload-Monit-<br>or        | Indicates if ULC<br>signal is lower<br>than the Under-<br>load curve | Underload / OK            | R |
| BV27 | Overload-Monit-<br>or         | Indicates if ULC<br>signal is higher<br>than the over-<br>load curve | Overload / OK             | R |
| BV28 | Motor-Heating-<br>Command     | Command to motor heating mode                                        | On / Off                  | W |
| BV29 | Motor-Heating-<br>Monitor     | Actual status of motor heating mode                                  | On / Off                  | R |
| BV30 | User0-Monitor                 | Actual status of<br>"User bit0" in<br>drive status<br>word           | On / Off                  | R |
| BV31 | User1-Monitor                 | Actual status of<br>"User bit1" in<br>drive status<br>word           | On / Off                  | R |
| BV32 | User2-Monitor                 | Actual status of<br>"User bit2" in<br>drive status<br>word           | On / Off                  | R |
| BV33 | User3-Monitor                 | Actual status of<br>"User bit3" in<br>drive status<br>word           | On / Off                  | R |

| BV34 | User0-Command              | Commands<br>"User bit0" in<br>drive status<br>word                                                               | On / Off    | С |
|------|----------------------------|------------------------------------------------------------------------------------------------------------------|-------------|---|
| BV35 | User1-Command              | Commands<br>"User bit1" in<br>drive status<br>word                                                               | On / Off    | С |
| BV36 | User2-Command              | Commands<br>"User bit2" in<br>drive status<br>word                                                               | On / Off    | С |
| BV37 | User3-Command              | Commands<br>"User bit3" in<br>drive status<br>word                                                               | On / Off    | С |
| BV38 | <reserved></reserved>      |                                                                                                                  |             |   |
| BV39 | Parameter-Save-<br>Command | Command to<br>save drive para-<br>meters and<br>BACnet property<br>data (properties<br>marked as<br>'P=Persist') | Save / No   | W |
| BV40 | PID-Set-Select             | Command to<br>Process PID set1<br>or Process PID<br>set2 selection                                               | Set1 / Set2 | W |

# Analog input object instance summary

The following table summarizes the analog input objects supported:

| Object ID | Default object name | Description                                  | Min / Max<br>present value | Units       | Present value access type |
|-----------|---------------------|----------------------------------------------|----------------------------|-------------|---------------------------|
| AIO       | Al1-Monitor         | Indicates the input level of analog input 1. | 0100                       | Percent (%) | R                         |

# Analog output object instance summary

The following table summarizes the analog output objects supported:

| Object ID | Default object name | Description                                                             | Min / Max<br>present value | Units   | Present value access type |
|-----------|---------------------|-------------------------------------------------------------------------|----------------------------|---------|---------------------------|
| A00       | AO1-Com-<br>mand    | Controls analog output 1 (drive must be configured for BACnet control). | 0100                       | Percent | С                         |

**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<br>present value | Units | Present value access type |
|-----------|---------------------|----------------------|----------------------------|-------|---------------------------|
| AVO       | Output-RPM          | Motor speed          | 0, nominal speed           | rpm   | R                         |
| AV1       | Output-Freq         | Output frequency     | -500, 500                  | Hz    | R                         |
| AV2       | DC-Voltage          | DC bus<br>voltage    | 0,<br>2000                 | V     | R                         |
| AV3       | Output-<br>Voltage  | AC output<br>voltage | 0,<br>2000                 | V     | R                         |

| AV4      | Output-Cur-<br>rent            | Output cur-<br>rent of drive                                                                 | 0,<br>nominal cur-<br>rent | A     | R |
|----------|--------------------------------|----------------------------------------------------------------------------------------------|----------------------------|-------|---|
| AV5      | Output-<br>Torque              | Output<br>torque of mo-<br>tor as a per-<br>centage of<br>nominal<br>torque                  | -1600,<br>1600             | %     | R |
| AV6      | Output-<br>Power               | Output<br>power in kW                                                                        | nominal<br>power (+/-)     | kW    | R |
| AV7      | Operating-<br>Temp-Range       | Heatsink<br>temperature                                                                      | -40,<br>160                | %     | R |
| AV8      | Kilowatt-<br>Hour-Meter-R      | Drive's cumulative energy usage. This value is resettable.                                   | 0,65535                    | kWh   | W |
| AV9      | Kilowatt-<br>Hour-Meter-<br>NR | Drive's cumu-<br>lative energy<br>usage. This<br>value is not<br>resettable.                 | 0,<br>65535999999          | kWh   | R |
| AV10     | Process-PID-<br>Feedback       | This object is<br>the process<br>PID feedback<br>signal.                                     | 0,<br>100                  | %     | R |
| AV11     | Process-PID-<br>Deviation      | This object is<br>the process<br>PID output<br>signal's devi-<br>ation from its<br>setpoint. | 0,<br>100                  | %     | R |
| AV12AV13 | <reserved></reserved>          |                                                                                              |                            |       |   |
| AV14     | Running-<br>Hours              | Drive's reset-<br>table run<br>time (reset by<br>writing 0).                                 | 0,<br>3.40282347e38        | hours | R |
| AV15     | Motor-Temp-<br>Degrees-C       | Motor temper-<br>ature                                                                       | -10,<br>200                | °C    | R |

| -        |                        |                                                                       |              |          |   |
|----------|------------------------|-----------------------------------------------------------------------|--------------|----------|---|
| AV16     | Input-Refer-<br>ence-1 | Speed set-<br>point 1                                                 | -150,<br>150 | %        | С |
| AV17     | Input-Refer-<br>ence-2 | Speed set-<br>point 2.                                                | -150,<br>150 | %        | С |
| AV18     | Active-Fault           | Displays<br>most recent<br>fault cur-<br>rently active.               |              |          | R |
| AV19     | Previous-<br>Fault-1   | Displays<br>most recent<br>stored (non-<br>active) fault              |              |          | R |
| AV20     | Previous-<br>Fault-2   | Displays the<br>second most<br>recent stored<br>(non-active)<br>fault |              |          | R |
| AV21     | AO1-Monitor            | Output level<br>of analog<br>output 1                                 | 0,<br>100    | %        | R |
| AV22     | <reserved></reserved>  |                                                                       |              |          |   |
| AV23     | Accel-1-<br>Seconds    | Ramp1 accel-<br>eration time                                          | 0,<br>1800   | S        | W |
| AV24     | Decel-1-<br>Seconds    | Ramp 1 deceleration time                                              | 0,<br>1800   | S        | W |
| AV25     | Mbox-Param             | Parameter<br>number to be<br>used by mail-<br>box function.           |              | No Units | W |
| AV26     | Mbox-Data              | Set (W) or indicate (R) of the data value of mailbox function         |              | No Units | W |
| AV27AV28 | <reserved></reserved>  |                                                                       |              |          |   |

| AV29      | Min-Speed                       | Defines the<br>allowed min-<br>imum output<br>frequency                                                                                              | -500,<br>500               | Hz | W |
|-----------|---------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|----|---|
| AV30      | Max-Speed                       | Defines the<br>allowed max-<br>imum output<br>frequency                                                                                              | -500,<br>500               | Hz | W |
| AV31      | Output-<br>Speed                | Actual motor speed                                                                                                                                   | -200,<br>200               | %  | R |
| AV32      | Output-Cur-<br>rent-Range       | Actual motor current                                                                                                                                 | 0,<br>200                  | %  | R |
| AV33      | Max-Current                     | Max motor<br>current                                                                                                                                 | 0,<br>nominal cur-<br>rent | А  | W |
| AV34      | DC-ripple                       | Vp-p ripple<br>on DC bus                                                                                                                             | 0,<br>200                  | V  | R |
| AV35-AV39 | <reserved></reserved>           |                                                                                                                                                      |                            |    |   |
| AV40      | LOOP-Feed-<br>back-Monitor      | Loop control-<br>ler feedback<br>value after<br>source selec-<br>tion, mathem-<br>atical func-<br>tion and filter-<br>ing (read-<br>only)            | 0,<br>100                  | %  | R |
| AV41      | LOOP-Set-<br>point-Monit-<br>or | Loop control-<br>ler setpoint<br>value after<br>source selec-<br>tion, mathem-<br>atical func-<br>tion limita-<br>tion and<br>ramping<br>(read-only) | 0,100                      | %  | R |

| AV42      | LOOP-Set-<br>point           | Command to<br>store loop<br>controller<br>setpoint<br>value used as<br>input for the<br>process                                                     | 0,100       | %        | С |
|-----------|------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----------|---|
| AV43      | LOOP-Feed-<br>back           | Stores the<br>feedback<br>value for loop<br>controller                                                                                              | 0,<br>100   | %        | W |
| AV44      | LOOP-Output                  | Loop control-<br>ler output                                                                                                                         | 0,<br>100   | %        | R |
| AV45      | LOOP- Gain                   | Loop control-<br>ler gain                                                                                                                           | 0.1,<br>100 | No Units | W |
| AV46      | LOOP-Integra-<br>tion-Time   | Loop control-<br>ler integra-<br>tion time                                                                                                          | 0,<br>3600  | S        | W |
| AV47-AV48 | <reserved></reserved>        |                                                                                                                                                     |             |          |   |
| AV49      | LOOP-Devi-<br>ation-Monitor  | Loop control-<br>ler deviation                                                                                                                      | 0,<br>100   | %        | R |
| AV50-AV52 | <reserved></reserved>        |                                                                                                                                                     |             |          |   |
| AV53      | LOOP-1-Gain                  | Loop control-<br>ler gain (set<br>2)                                                                                                                | 0.1,<br>100 | No Units | W |
| AV54      | LOOP-1-Integ-<br>ration-Time | Loop control-<br>ler integra-<br>tion time (set<br>2)                                                                                               | 0,<br>3600  | s        | W |
| AV55      | LOOP-2-Feed-<br>back-Monitor | External loop<br>controller<br>feedback<br>value after<br>source selec-<br>tion, mathem-<br>atical func-<br>tion and filter-<br>ing (read-<br>only) | 0,<br>100   | %        | R |

| AV56AV119 | <reserved></reserved> |                                                                                                                            |          |   |
|-----------|-----------------------|----------------------------------------------------------------------------------------------------------------------------|----------|---|
| AV120     | Data-IO-1             | Holds the<br>value of drive<br>parameter,<br>which is<br>mapped us-<br>ing Data I/O<br>parameter<br>58.101                 | No Units | W |
| AV121     | Data-IO-2             | Holds the<br>value of drive<br>parameter,<br>which is<br>mapped us-<br>ing Data I/O<br>parameter<br>58.102                 | No Units | W |
| AV122     | Data-IO-3             | Holds the<br>value of drive<br>parameter,<br>which is<br>mapped us-<br>ing Data I/O<br>parameter<br>58.103                 | No Units | W |
| AV123     | Data-IO-4             | Holds the<br>value of drive<br>parameter,<br>which is<br>mapped us-<br>ing Data I/O<br>parameter<br>58.104                 | No Units | W |
| AV124     | Data-IO-5             | Holds the<br>value of drive<br>parameter,<br>which is<br>mapped us-<br>ing Data I/O<br>parameter<br>58.105 (Read-<br>only) | No Units | R |

| AV125 | Data-IO-6  | Holds the<br>value of drive<br>parameter,<br>which is<br>mapped us-<br>ing Data I/O<br>parameter<br>58.106 (Read-<br>only) | No Units | R |
|-------|------------|----------------------------------------------------------------------------------------------------------------------------|----------|---|
| AV126 | Data-IO-7  | Holds the<br>value of drive<br>parameter,<br>which is<br>mapped us-<br>ing Data I/O<br>parameter<br>58.107 (Read-<br>only) | No Units | R |
| AV127 | Data-IO-8  | Holds the<br>value of drive<br>parameter,<br>which is<br>mapped us-<br>ing Data I/O<br>parameter<br>58.108 (Read-<br>only) | No Units | R |
| AV128 | Data-IO-9  | Holds the<br>value of drive<br>parameter,<br>which is<br>mapped us-<br>ing Data I/O<br>parameter<br>58.109 (Read-<br>only) | No Units | R |
| AV129 | Data-IO-10 | Holds the<br>value of drive<br>parameter,<br>which is<br>mapped us-<br>ing Data I/O<br>parameter<br>58.110 (Read-<br>only) | No Units | R |

| AV130 | Kilowatt-<br>Hour-This-<br>Hour | Current hour<br>energy con-<br>sumption | 0,<br>3.40282347e38 | kWh | R |
|-------|---------------------------------|-----------------------------------------|---------------------|-----|---|
| AV131 | Kilowatt-<br>Hour-Last-<br>Hour | Last hour en-<br>ergy con-<br>sumption  | 0,<br>3.40282347e38 | kWh | R |
| AV132 | Kilowatt-<br>Hour-This-<br>Day  | Current day<br>energy con-<br>sumption  | 0,<br>3.40282347e38 | kWh | R |
| AV133 | Kilowatt-<br>Hour-Last-<br>Day  | Last day en-<br>ergy con-<br>sumption   | 0,<br>3.40282347e38 | kWh | R |

# 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-<br>Reference | Indicates whether the drive is under Hand or Auto control, or if Override mode is active. | Off,<br>Hand,<br>Auto,<br>Override | R                         |

| MSV1 | Active-Fault-1 | Enumerated                         | None,                          | R |
|------|----------------|------------------------------------|--------------------------------|---|
|      |                | type of the most recent fault cur- | Comm-Error,                    |   |
|      |                | rently active                      | Overcurrent,                   |   |
|      |                |                                    | Overtemperat-<br>ure,          |   |
|      |                |                                    | Overspeed,                     |   |
|      |                |                                    | Overvoltage,                   |   |
|      |                |                                    | Undervoltage,                  |   |
|      |                |                                    | Short-Circuit,                 |   |
|      |                |                                    | Ground-Fault,                  |   |
|      |                |                                    | Motor-Overload,                |   |
|      |                |                                    | Inverter-Over-<br>load,        |   |
|      |                |                                    | Motor-Under-<br>load,          |   |
|      |                |                                    | External-Fault,                |   |
|      |                |                                    | Operator-Inter-<br>face-Error, |   |
|      |                |                                    | Config-Error,                  |   |
|      |                |                                    | Feedback-Fail-<br>ure,         |   |
|      |                |                                    | Output-Phase-<br>Loss          |   |
|      |                |                                    | Motor-Stall,                   |   |
|      |                |                                    | Power-Unit-Er-<br>ror,         |   |
|      |                |                                    | Input-Phase-<br>Fault,         |   |
|      |                |                                    | Internal-Failure,              |   |
|      |                |                                    | STO-Active,                    |   |
|      |                |                                    | Other                          |   |

| 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, |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------|

| MSV4 | Active-Warning-  | Enumerated<br>type of the most<br>recent warning<br>currently active          | None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other | R |
|------|------------------|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| MSV5 | Active-Warning-2 | Enumerated<br>type of the 2nd<br>most recent<br>warning cur-<br>rently active | None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other | R |

| MSV6 | Active-Warning-3 | Enumerated<br>type of the 3rd<br>most recent<br>warning cur-<br>rently 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 |
|------|------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|------|------------------|-------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|

# Loop object instance summary

The following table summarizes the loop objects supported:

| Object ID | Object<br>name | Descrip-<br>tion                               | Manipu-<br>lated vari-<br>able refer-<br>ence | Controlled<br>variable<br>reference | Setpoint<br>reference    | Present<br>value<br>access<br>type |
|-----------|----------------|------------------------------------------------|-----------------------------------------------|-------------------------------------|--------------------------|------------------------------------|
| LOOP0     | LOOP-Set1      | Loop ob-<br>ject for pro-<br>cess PID<br>set 1 | AV44<br>Present<br>Value                      | AV43<br>Present<br>Value            | AV42<br>Present<br>Value | R                                  |
| LOOP1     | LOOP-Set2      | Loop ob-<br>ject for pro-<br>cess PID<br>set 2 | AV44<br>Present<br>Value                      | AV43<br>Present<br>Value            | AV42<br>Present<br>Value | R                                  |

**Note**: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.



# 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

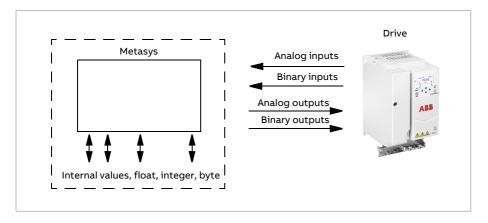
The N2 fieldbus connection to the drive is based on an industry standard RS-485 physical interface. The N2 fieldbus protocol is a master-slave type, serial communication protocol, used by the Johnson Controls Metasys® system. In the Metasys architecture the N2 fieldbus connects object interfaces and 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:

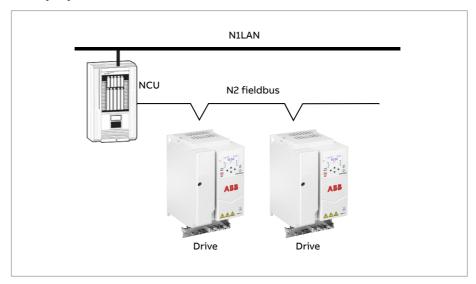
- analog output value in engineering units
- override value is used to change the analog output value. It is not possible to return to the previous value by removing the override. The Override feature is used only to change the value.

Binary output - the binary output objects support the following features:

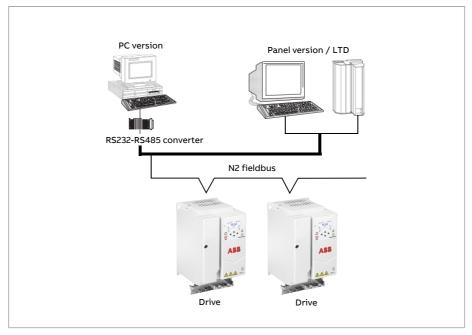
- · binary output value
- override value is used to change the binary output value. It is not possible to return to the previous value by removing the override. The Override feature is used only to change the value.

#### 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.

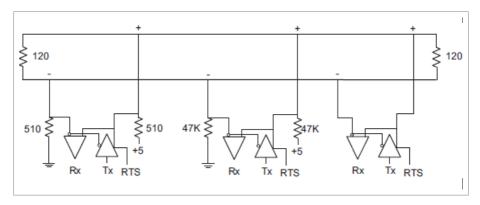
#### Drive device type

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 para-<br>meter             | Scale<br>factor | Units | Range       | Notes |  |  |
| Al1              | OUTPUT<br>FRE-<br>QUENCY | 01.06 Out-<br>put fre-<br>quency | 100             | Hz    | 0250        |       |  |  |
| AI2              | RATED<br>SPEED           | 01.62 Abs<br>motor<br>speed %    | 100             | %     | 0100        |       |  |  |
| AI3              | SPEED                    | 01.01 Mo-<br>tor speed<br>used   | 100             | rpm   | 09999       |       |  |  |
| AI4              | CURRENT                  | 01.07 Mo-<br>tor current         | 100             | A     | 09999       |       |  |  |
| AI5              | TORQUE                   | 01.10 Mo-<br>tor torque          | 100             | %     | -200<br>200 |       |  |  |
| Al6              | POWER                    | 01.17 Motor<br>shaft<br>power    | 10              | kW    | 09999       |       |  |  |

|      |                        | N                                             | 2 analog in     | puts  |            |                                                                |
|------|------------------------|-----------------------------------------------|-----------------|-------|------------|----------------------------------------------------------------|
| No   | Object                 | Drive para-<br>meter                          | Scale<br>factor | Units | Range      | Notes                                                          |
| AI7  | DRIVE TEM-<br>PERATURE | 05.11 Invert-<br>er temper-<br>ature          | 10              | %     | -40160     |                                                                |
| AI8  | KILOWATT<br>HOURS      | 01.58 Cumulative inverter energy (resettable) | 10              | kW    | 065535     |                                                                |
| AI9  | MEGA-<br>WATT<br>HOURS | Derived<br>value                              | 10000           | MWh   | 065535     | Parameter<br>01.54 Cumulat-<br>ive inverter en-<br>ergy / 1000 |
| Al10 | RUN TIME               | 05.03<br>Hours run                            | 10              | h     | 065535     |                                                                |
| A11  | DC BUS<br>VOLTAGE      | 01.11 DC<br>voltage                           | 100             | V     | 0999       |                                                                |
| Al12 | OUTPUT<br>VOLTAGE      | 01.13 Out-<br>put voltage                     | 1               | V     | 0999       |                                                                |
| Al13 | PRC PID<br>FEEDBACK    | 40.97 Process PID feedback %                  | 100             | %     | 0100       |                                                                |
| Al14 | PRC PID<br>DEVIATION   | 40.99 Process PID deviation %                 | 100             | %     | 0100       |                                                                |
| AI17 | LAST<br>FAULT          | Derived<br>value                              | 1               |       | fault code | Most recent fault                                              |
| Al18 | PREV<br>FAULT          | Derived<br>value                              | 1               |       | fault code | Second most recent fault                                       |
| Al19 | OLDEST<br>FAULT        | Derived<br>value                              | 1               |       | fault code | Third most re-<br>cent fault                                   |
| Al20 | AI 1 ACTU-<br>AL       | 12.101 Al1<br>percent<br>value                | 100             | %     | 0100       |                                                                |

|      | N2 analog inputs      |                                |                 |       |       |                                                                                                                        |  |  |
|------|-----------------------|--------------------------------|-----------------|-------|-------|------------------------------------------------------------------------------------------------------------------------|--|--|
| No   | Object                | Drive para-<br>meter           | Scale<br>factor | Units | Range | Notes                                                                                                                  |  |  |
| AI21 | AI 2 ACTU-<br>AL      | 12.102 AI2<br>percent<br>value | 100             | %     | 0100  |                                                                                                                        |  |  |
| AI22 | AO 1 ACTU-<br>AL      | 13.11 AO1<br>actual<br>value   | 1000            | mA    | 020   |                                                                                                                        |  |  |
| AI23 | <reserved></reserved> |                                |                 |       |       |                                                                                                                        |  |  |
| AI24 | MOTOR<br>TEMP         | Derived<br>value               | 1               | °C    | 0200  | 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<br>start command<br>1 = Drive has not re-<br>ceived start com-<br>mand |  |  |  |  |  |
| BI2              | FORWARD/REVERSE       | Status Word, bit 11               | 0 = Forward, 1 = Reverse                                                                  |  |  |  |  |  |
| ВІЗ              | 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                                                                           |  |  |  |  |  |
| BI5BI9           | <reserved></reserved> |                                   |                                                                                           |  |  |  |  |  |
| BI10             | INPUT 1 STATUS        | 10.02 DI delayed<br>status, bit 0 | 0 = Off, 1 = On                                                                           |  |  |  |  |  |
| BI11             | INPUT 2 STATUS        | 10.02 DI delayed<br>status, bit 1 | 0 = Off, 1 = On                                                                           |  |  |  |  |  |
| BI12             | INPUT 3 STATUS        | 10.02 DI delayed<br>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<br>status, bit 4 | 0 = Off, 1 = On                                                                           |  |  |  |  |  |
| BI15             | <reserved></reserved> |                                   |                                                                                           |  |  |  |  |  |
| BI16             | EXTERNAL 2 SELECT     | DCU Status Word, bit<br>14        | 0 = EXT1 active, 1 = EXT2 active                                                          |  |  |  |  |  |
| BI17             | HAND/AUTO             | DCU Status Word, bit<br>12        | 0 = AUTO, 1 = HAND                                                                        |  |  |  |  |  |
| BI18             | ALARM                 | DCU Status Word, bit<br>16        | 0 = OK, 1 = Warn-<br>ing/alarm                                                            |  |  |  |  |  |
| BI20             | DRIVE READY           | DCU Status Word, bit<br>0         | 0 = Not ready, 1 =<br>Ready                                                               |  |  |  |  |  |

| N2 binary inputs |                |                            |                                 |  |  |  |  |  |
|------------------|----------------|----------------------------|---------------------------------|--|--|--|--|--|
| No               | Object         | Range                      |                                 |  |  |  |  |  |
| BI21             | AT SETPOINT    | DCU Status Word, bit<br>7  | 0 = No, 1 = At set-<br>point    |  |  |  |  |  |
| BI22             | RUN ENABLED    | DCU Status Word, bit       | 0 = Not enabled, 1 =<br>Enabled |  |  |  |  |  |
| BI23             | N2 LOCAL MODE  | DCU Status Word, bit<br>13 | 0 = Auto, 1 = N2 local          |  |  |  |  |  |
| BI24             | N2 CONTROL SRC | DCU Status Word, bit<br>26 | 0 = No, 1 = Yes                 |  |  |  |  |  |
| BI25             | N2 REF1 SRC    | DCU Status Word, bit<br>27 | 0 = No, 1 = Yes                 |  |  |  |  |  |
| BI26             | N2 REF2 SRC    | DCU Status Word, bit<br>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 para-<br>meter | Scale<br>factor | Units | Range | Notes |  |
| AO1               | REFER-<br>ENCE 1 | Reference 1          | 10              | %     | 0100  |       |  |
| AO2               | REFER-<br>ENCE 2 | Reference 2          | 10              | %     | 0100  |       |  |

|     | N2 analog outputs |                                 |                 |       |          |                                                                                                                                                                                     |  |  |  |
|-----|-------------------|---------------------------------|-----------------|-------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|
| No  | Object            | Drive para-<br>meter            | Scale<br>factor | Units | Range    | Notes                                                                                                                                                                               |  |  |  |
| AO3 | ACCEL<br>TIME 1   | No direct<br>mapping            | 1000            | S     | 0.11800  | 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<br>TIME 1   | No direct<br>mapping            | 1000            | S     | 0.11800  | 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           | 30.17 Max-<br>imum cur-<br>rent | 100             | А     | 01.3*I2N |                                                                                                                                                                                     |  |  |  |
| A06 | PID1-CONT<br>GAIN | 40.32 Set 1<br>gain             | 100             | %     | 0.1100   |                                                                                                                                                                                     |  |  |  |

|      | N2 analog outputs     |                                          |                 |       |        |       |  |  |  |
|------|-----------------------|------------------------------------------|-----------------|-------|--------|-------|--|--|--|
| No   | Object                | Drive para-<br>meter                     | Scale<br>factor | Units | Range  | Notes |  |  |  |
| AO7  | PID1-CONT<br>I-TIME   | 40.33 Set 1 integration time             | 10              | S     | 0.1600 |       |  |  |  |
| AO8  | PID1-CONT<br>D-TIME   | 40.34 Set 1<br>derivation<br>time        | 10              | S     | 010    |       |  |  |  |
| AO9  | PID1-CONT<br>D FILTER | 40.35 Set 1<br>derivation<br>filter time | 10              | S     | 010    |       |  |  |  |
| AO10 | PID2-CONT<br>GAIN     | 41.32 Set 2<br>gain                      | 100             | %     | 0.1100 |       |  |  |  |
| AO11 | PID2-CONT<br>I-TIME   | 41.33 Set 2 integration time             | 10              | S     | 0.1600 |       |  |  |  |
| AO12 | PID2-CONT<br>D-TIME   | 41.34 Set 2<br>derivation<br>time        | 1000            | S     | 010    |       |  |  |  |
| AO13 | PID2-CONT<br>D FILTER | 41.35 Set 2<br>derivation<br>filter time | 10              | S     | 010    |       |  |  |  |
| AO14 | COMMAND<br>AO 1       | 13.91 AO1<br>data stor-<br>age           | 10              | %     | 0100   |       |  |  |  |

|      | N2 analog outputs |                      |                 |       |       |                                                                                                                                                                                                                                                                                                                                    |  |
|------|-------------------|----------------------|-----------------|-------|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| No   | Object            | Drive para-<br>meter | Scale<br>factor | Units | Range | Notes                                                                                                                                                                                                                                                                                                                              |  |
| AO17 | SPD OUT<br>MIN    | Derived value        | 10              | %     | 0200  | writing:  • scalar mode: 30.13 Minimum frequency = AO17 * 99.08 Motor nomina frequency • vector mode: 30.1: Minimum speed = AO17 * 99.09 Motor nomina speed. Reading: • scalar mode: 99.08 Motor nomina frequency, 30.13 Minimum frequency, 30.13 Minimum frequency • vector mode: 99.09 Motor nomina speed / 30.11 Minimum speed. |  |

|      | N2 analog outputs         |                      |                 |       |        |                                                                                                                                                                                                                                                                                                                                     |  |
|------|---------------------------|----------------------|-----------------|-------|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| No   | Object                    | Drive para-<br>meter | Scale<br>factor | Units | Range  | Notes                                                                                                                                                                                                                                                                                                                               |  |
| AO18 | SPD OUT MAX               | Derived value        | 10              | %     | 0200   | Writing:  • scalar mode: 30.14 Maximum frequency = A017 * 99.08 Motor nominal frequency • vector mode: 30.12 Maximum speed = A017 * 99.09 Motor nominal speed. Reading: • scalar mode: 99.08 Motor nominal frequency/30.13 Minimum frequency/30.13 Minimum frequency • vector mode: 99.09 Motor nominal speed /30.11 Minimum speed. |  |
| AO19 | MAILBOX<br>PARAMET-<br>ER |                      | 1               |       | 065535 | Mailbox fea-<br>ture is not sup-<br>ported                                                                                                                                                                                                                                                                                          |  |
| AO20 | MAILBOX<br>DATA           |                      | 1               |       | 065535 | Mailbox fea-<br>ture is not sup-<br>ported                                                                                                                                                                                                                                                                                          |  |

# 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<br>Word, bit 0 and<br>bit 1 | 0 = Stop,<br>1 = Start to<br>Speed | Stop: set bit 0,<br>clear bit 1<br>Start: set bit 1,<br>clear bit 0       |  |  |
| BO2               | FORWARD/RE-<br>VERSE  | DCU Control<br>Word, bit 12             | 0 = Forward,<br>1 = Reverse        |                                                                           |  |  |
| воз               | PANEL LOCK            | Derived                                 | 0 = Open,<br>1 = Locked            | Derived from<br>96.03 Access<br>level status, bit<br>14 parameter<br>lock |  |  |
| BO4               | RUN ENABLE            | Derived value                           | 0 = Enable,<br>1 = Disable         | Invert DCU control word bit 6, RUN_DISABLE                                |  |  |
| BO5               | REF1/REF2 SE-<br>LECT | DCU Control<br>Word, bit 5, EXT         | 0 = Ref1,<br>1 = Ref2              |                                                                           |  |  |
| BO6               | FAULT RESET           | DCU Control<br>Word, bit 4, RE-<br>SET  | Change 0 -> 1<br>Resets            |                                                                           |  |  |
| ВО7               | COMMAND RO 1          | 10.99 RO/DIO<br>control word, bit<br>0  | 0 = Off, 1 = On                    |                                                                           |  |  |
| BO8               | COMMAND RO 2          | 10.99 RO/DIO<br>control word, bit<br>1  | 0 = Off, 1 = On                    |                                                                           |  |  |
| ВО9               | COMMAND RO 3          | 10.99 RO/DIO<br>control word, bit<br>2  | 0 = Off, 1 = On                    |                                                                           |  |  |
| BO10              | COMMAND RO 4          | 10.99 RO/DIO<br>control word, bit<br>3  | 0 = Off, 1 = On                    |                                                                           |  |  |

| N2 binary outputs |                            |                                               |                                                                                                    |                                                                                                                                                                   |  |  |
|-------------------|----------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|
| No                | Object                     | Drive parameter                               | Range                                                                                              | Notes                                                                                                                                                             |  |  |
| BO11              | COMMAND RO 5               | 10.99 RO/DIO<br>control word, bit<br>4        | 0 = Off, 1 = On                                                                                    |                                                                                                                                                                   |  |  |
| BO12              | COMMAND RO 6               | 10.99 RO/DIO<br>control word, bit<br>5        | 0 = Off, 1 = On                                                                                    |                                                                                                                                                                   |  |  |
| BO13              | RESET RUN TIME             | Indirectly map-<br>ping                       | 0 = N/A, 1 = On<br>(Reset run rime,<br>05.03 Hours run)                                            |                                                                                                                                                                   |  |  |
| BO14              | RESET KWH<br>COUNT         | Indirectly map-<br>ping                       | 0 = N/A, 1 = On<br>(Reset kWh<br>count 01.58 Cu-<br>mulative inverter<br>energy (reset-<br>table)) |                                                                                                                                                                   |  |  |
| BO15              | PRC PID SELECT             | 40.57 PID<br>set1/set2 selection (indirectly) | 0 = SET1,<br>1 = SET2                                                                              | If BO15 = 0,<br>40.57 PID<br>set1/set2 selec-<br>tion is set to PID<br>Set1 (1).<br>If BO15 = 1, 40.57<br>PID set1/set2 se-<br>lection is set to<br>PID Set2 (2). |  |  |
| BO16              | N2 LOCAL CTL <sup>1)</sup> | DCU Control<br>Word, bit 16                   | 0 = Auto, 1 = N2                                                                                   |                                                                                                                                                                   |  |  |
| BO17              | N2 LOCAL REF <sup>1)</sup> | DCU Control<br>Word, bit 17                   | 0 = Auto, 1 = N2                                                                                   |                                                                                                                                                                   |  |  |
| BO18              | SAVE PARAMET-<br>ERS       | 96.07 Parameter save manually (indirectly)    | 0 = N/A, 1 = On<br>(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 |  |  |

<sup>1)</sup> 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"



# **Control chain diagrams**

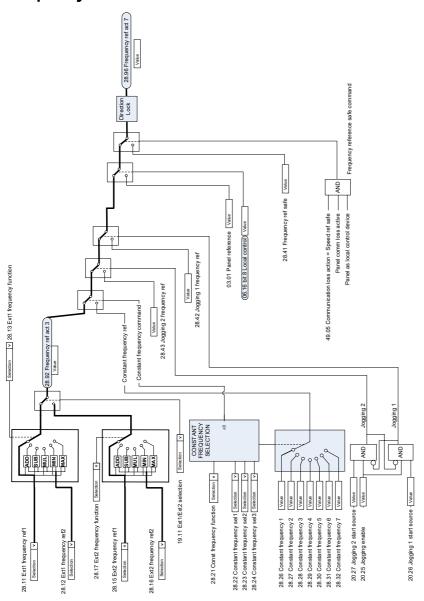
#### Contents of this chapter

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.

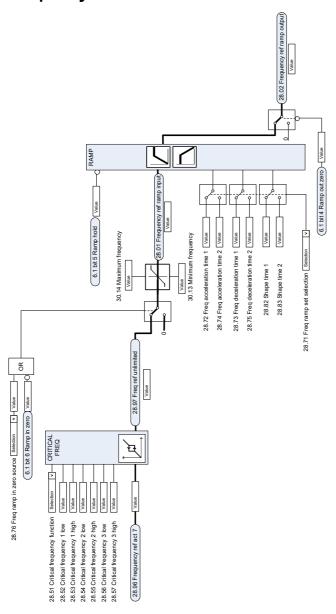
For a more general diagram, see section Operating modes of the drive (page 46).

**Note:** The panel references in the diagrams refer to ACX-AP-x Assistant control panels and the Drive Composer PC tool.

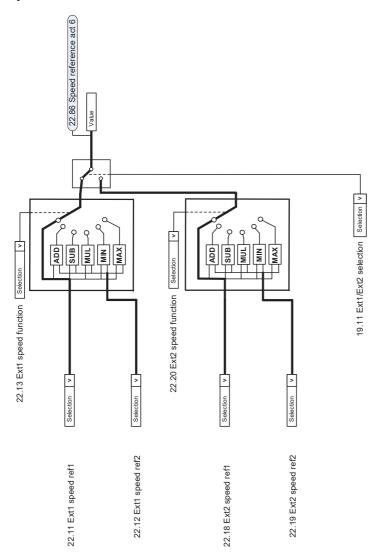
# Frequency reference selection



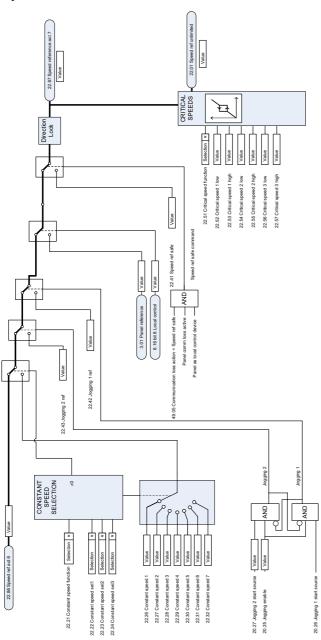
# Frequency reference modification



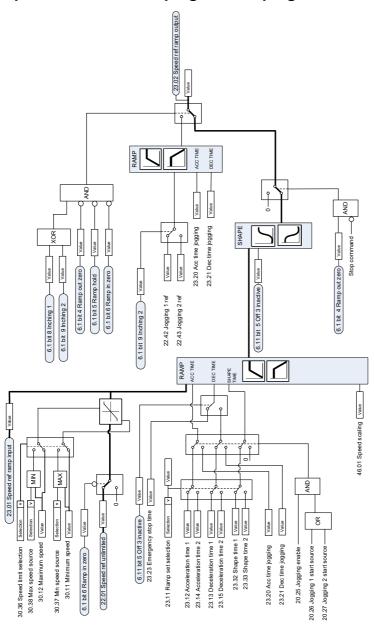
# Speed reference source selection I



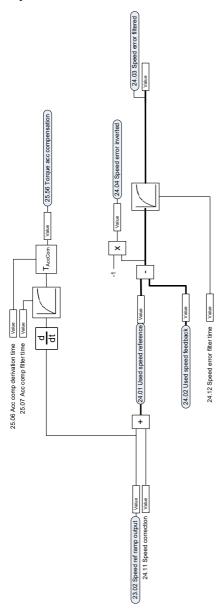
# Speed reference source selection II



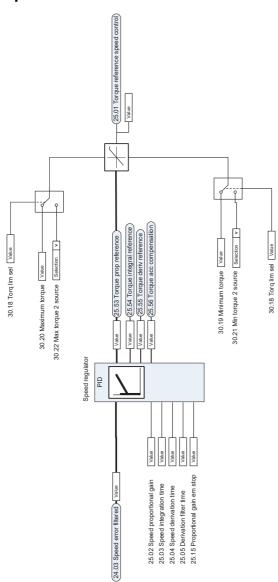
# Speed reference ramping and shaping



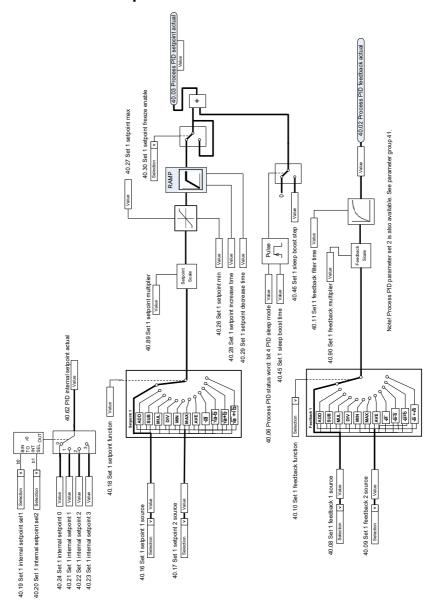
# **Speed error calculation**



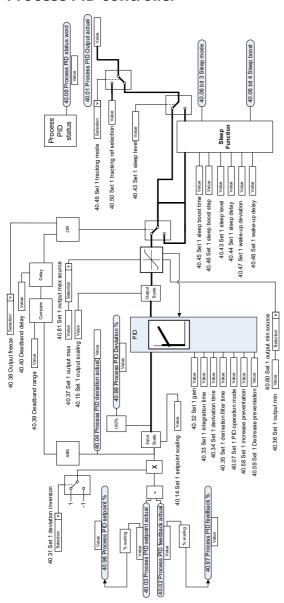
# **Speed controller**



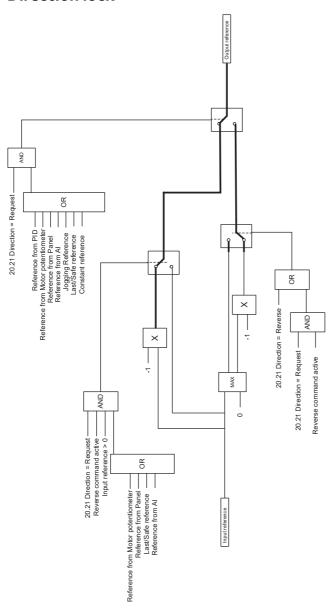
# Process PID setpoint and feedback source selection



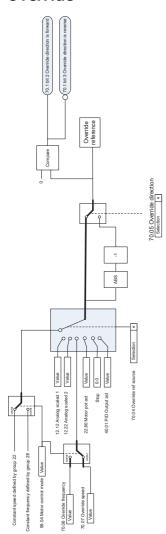
#### **Process PID controller**



#### **Direction lock**



# Override



70.02 Override enable (Swedon IV) ON 1810 Override Enable) AND (70.1 bit Override And Override activation source (Swedon) IV

#### **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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3AXD50000955893B