ماهر

**M A H E R**

# ACH480 HVAC control program
## Firmware manual

Related documents are listed on page .

**ACH480
HVAC control program**

**Firmware manual**

ac.maher.co.ir

# Table of contents

## 5. Default I/O configuration

## 6. Program features

## *7. Fault tracing*

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## 9. BACnet MS/TP control through the embedded fieldbus interface (EFB)

## 10. N2 control through the embedded fieldbus interface (EFB)

## 11. Fieldbus control through a fieldbus adapter

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# 1

# Introduction to the manual

## Contents of this chapter

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

## Applicability

The manual applies to the ACH480 HVAC control program (version 2.07, firmware AHVDA)

To check the firmware version of the control program in use, see system information (select **Menu > System info > Drive**) or parameter *07.05 Firmware version* on the control panel.

## Safety instructions

Follow all safety instructions.

• Read the **complete safety instructions** in the *Hardware manual* of the drive before you install, commission, or use the drive.

• Read the **firmware function-specific warnings and notes** before changing parameter values. These warnings and notes are included in the parameter descriptions presented in chapter *Parameters* on page *185*.

## Target audience

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

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The manual is written for readers worldwide. Both SI and imperial units are shown. Special US instructions for installations in the United States are given.

## Purpose of the manual

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

## Contents of this manual

The manual consists of the following chapters:

**1**

- *Additional parameter data* (page *551*) contains further information on the parameters.
- *Further information* (inside of the back cover, page *585*) describes how to make product and service inquiries, get information on product training, provide feedback on ABB Drives manuals and find documents on the Internet.

## Related documents

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

| Drive manuals and guides | Code (English) |
|---|---|
| *ACH480 HVAC control program firmware manual* | *3AXD50000247134* |
| *ACH480 hardware manual* | *3AXD50000245949* |
| *ACH480 quick installation and start-up guide* | *3AXD50000247141* |
| *Adaptive programming application guide* | *3AXD50000028574* |
| *ACX-AP-x assistant control panels user's manual* | *3AUA0000085685* |

| Option manuals and guides | |
|---|---|
| *BACnet Protocol Implementation Conformance Statement (PICS) for ACH480* | *3AXD10000786871* |
| *DPMP-01 mounting platform for control panels* | *3AUA0000100140* |
| *DPMP-02/03 mounting platform for control panels* | *3AUA0000136205* |
| *FBIP-21 BACnet/IP adapter module* | *3AXD50000028468* |
| *FCAN-01 CANopen adapter module user's manual* | *3AFE68615500* |
| *FCNA-01 ControlNet adapter module user's manual* | *3AUA0000141650* |
| *FDNA-01 DeviceNet™ adapter module user's manual* | *3AFE68573360* |
| *FECA-01 EtherCAT adapter module user's manual* | *3AUA0000068940* |
| *FEIP-21 Ethernet/IP adapter module user's manual* | *3AXD50000158621* |
| *FENA-01/-11/-21 Ethernet adapter module user's manual* | *3AUA0000093568* |
| *FEPL-02 Ethernet POWERLINK adapter module user's manual* | *3AUA0000123527* |
| *FMBT-21 Modbus/TCP adapter module user's manual* | *3AXD50000158607* |
| *FPBA-01 PROFIBUS DP adapter module user's manual* | *3AFE68573271* |
| *FPNO-21 PROFINET adapter module user's manual* | *3AXD50000158614* |
| *FSCA-01 RS-485 adapter module user's manual* | *3AUA0000109533* |

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

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ACH480-01 manuals

## Categorization by frame (size)

The ACH480 is manufactured in several frames (frame sizes), which are denoted as RN, where N is an integer. Some information which only concern certain frames are marked with the symbol of the frame (RN).

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

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# Terms and abbreviations

| Term/abbreviation | Explanation |
|---|---|
| ACX-AP-x | Assistant control panel, advanced operator keypad for communication with the drive. The ACH480 supports the Hand-Off-Auto panels ACH-AP-H and ACH-AP-W (with a Bluetooth interface) |
| AI | Analog input; interface for analog input signals |
| AO | Analog output; interface for analog output signals |
| BAPO-01 | Side option module for external power supply 24V. |
| BACnet™ | BACnet™ is a registered trademark of American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). |
| BAS | Building automation system |
| BIO-01 | Frontal I/O extension. Can be used simultaneously with a fieldbus adapter module. |
| BMS | Building management system |
| Brake chopper | Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor. |
| Brake resistor | Dissipates the drive surplus braking energy conducted by the brake chopper to heat. Essential part of the brake circuit. See chapter *Brake chopper* in the *Hardware manual* of the drive. |
| Control board | Circuit board in which the control program runs. |
| CCA-01 | Cold configuration adapter |
| CDPI-02 | Communication adapter module |
| DC link | DC circuit between rectifier and inverter |
| DC link capacitors | Energy storage which stabilizes the intermediate circuit DC voltage |
| DI | Digital input; interface for digital input signals |
| DO | Digital output; interface for digital output signals |
| DPMP-01 | Mounting platform for ACX-AP control panel (flange mounting) |
| DPMP-02/03 | Mounting platform for ACX-AP control panel (surface mounting) |
| Drive | Frequency converter for controlling AC motors |
| EFB | Embedded fieldbus |
| FBA | Fieldbus adapter |
| FBIP-21 | Optional BACnet/IP adapter module |
| FCAN-01 | Optional CANopen adapter module |
| FCNA-01 | ControlNet adapter module |
| FDNA-01 | Optional DeviceNet adapter module |
| FECA-01 | Optional EtherCAT adapter module |
| FEIP-21 | Optional Ethernet/IP adapter module |

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| Term/abbreviation | Explanation |
|---|---|
| FENA-01/-11/-21 | Optional Ethernet adapter module for EtherNet/IP, Modbus TCP and PROFINET IO protocols |
| FEPL-02 | Optional Ethernet POWERLINK adapter module |
| FLON-01 | LONWORKS® adapter module |
| FMBT-21 | Optional Modbus/TCP adapter module |
| FPBA-01 | Optional PROFIBUS DP adapter module |
| FPNO-21 | Optional PROFINET adapter module |
| Frame (size) | Refers to drive physical size, for example, R0 and R1. The type designation label attached to the drive shows the frame of the drive, see chapter *Operation principle and hardware description,* section *Type designation label* in the *Hardware manual* of the drive. |
| FSCA-01 | Optional RSA-485 adapter module |
| ID run | Motor identification run. During the identification run, the drive will identify the characteristics of the motor for optimum motor control. |
| IGBT | Insulated gate bipolar transistor |
| Intermediate circuit | See *DC link*. |
| Inverter | Converts direct current and voltage to alternating current and voltage. |
| I/O | Input/Output |
| LONWORKS® | LONWORKS® (local operating network) is a networking platform specifically created to address the needs of control applications. |
| LSW | Least significant word |
| NETA-21 | Remote monitoring tool |
| Network control | With fieldbus protocols based on the Common Industrial Protocol (CIP$^{TM}$), such as DeviceNet and Ethernet/IP, denotes the control of the drive using the Net Ctrl and Net Ref objects of the ODVA AC/DC Drive Profile. For more information, see www.odva.org, and the following manuals:<br>• *FDNA-01 DeviceNet adapter module user's manual* (3AFE68573360 [English]), and<br>• *FENA-01/-11/-21 Ethernet adapter module user's manual* (3AUA0000093568 [English])<br>• *FEIP-21 Ethernet/IP adapter module user's manual* (3AXD50000158621 [English]). |
| Parameter | User-adjustable operation instruction to the drive, or signal measured or calculated by the drive |
| PFC | Single pump and fan control |
| PID controller | Proportional–integral–derivative controller. Drive speed control is based on PID algorithm. |
| PLC | Programmable logic controller |
| PROFIBUS, PROFIBUS DP, PROFINET IO | Registered trademarks of PI - PROFIBUS & PROFINET International |

| Term/abbreviation | Explanation |
|---|---|
| PTC | Positive temperature coefficient, thermistor whose resistance is dependent on temperature. |
| R1, R2 ... | *Frame (size)* |
| RIIO-01 | Frontal standard I/O extension. Can not be used simultaneously with a fieldbus adapter |
| RO | Relay output; interface for a digital output signal. Implemented with a relay. |
| Rectifier | Converts alternating current and voltage to direct current and voltage. |
| SPFC | Soft pump and fan control |
| STO | Safe torque off. See chapter *The Safe torque off function* in the *Hardware manual* of the drive. |

## Cybersecurity disclaimer

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

See also section *Parameter checksum calculation* on page *181*.

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

## Contents of this chapter

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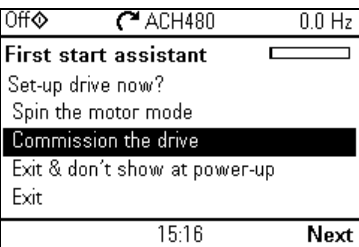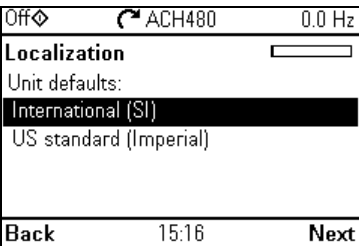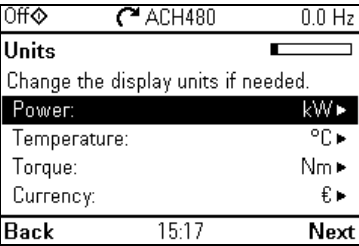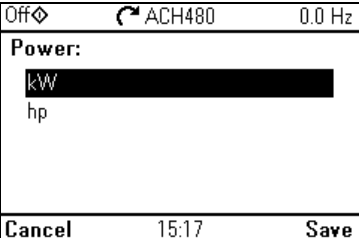
- perform the start-up
- start, stop, change the direction of the motor rotation and adjust the speed of the motor through the I/O interface
- perform an Identification run (ID run) for the drive.

# How to start up the drive

**2**

■ **How to start up the drive using the First start assistant on the Hand-Off-Auto control pane**l

| Safety |
|---|
| ⚠ Do not start-up the drive unless you are a qualified electrician.<br>Read and obey the instructions in chapter *Safety instructions* at the beginning of the *Hardware manual* of the drive. Ignoring the instructions can cause physical injury or death, or damage to the equipment |
| ☐ Check the installation. See chapter *Installation checklist* in the *Hardware manual* of the drive. |
| ☐ ⚠ Make sure there is no active start on (DI1 in factory settings, that is, HVAC default). The drive will start up automatically at power-up if the external run command is on and the drive is in the external control mode.<br>Check that the starting of the motor does not cause any danger.<br>**De-couple the driven machine** if<br>• there is a risk of damage in case of an incorrect direction of rotation, or<br>• a **Normal** ID run is required during the drive start-up, when the load torque is higher than 20% or the machinery is not able to withstand the nominal torque transient during the ID run. |
| **Hints on using the assistant control panel** |
| The two commands at the bottom of the display (**Options** and **Menu** in the figure on the right), show the functions of the two softkeys ⬿ and ⬾ located below the display. The commands assigned to the softkeys vary depending on the context.<br>Use keys ◄, ►, ▲ and ▼ to move the cursor and/or change values depending on the active view.<br>Key ⍰ shows a context-sensitive help page.<br>For more information, see *ACX-AP-x assistant control panels user's manual* (3AUA0000085685 [English]). |
| **1 – First start assistant guided settings:**<br>**Language, motor nominal values, and date and time** |
| ☐ Have the motor name plate data at hand.<br>Power up the drive. |

| | | |
|---|---|---|
| ☐ | The First start assistant guides you through the first start-up.<br><br>The assistant begins automatically. Wait until the control panel enters the view shown on the right.<br><br>Select the language you want to use by highlighting it (if not already highlighted) and pressing ⎯ (**OK**).<br><br>**Note:** After you have selected the language, it takes a few minutes to download the language file to the control panel. | English<br>Deutsch<br>Suomi<br>Français<br>Italiano<br>Nederlands<br>Svenska<br><br>OK ▶ |
| ☐ | Select **Commission the drive** and press ⎯ (**Next**). | Off◇　　　ⵁ ACH480　　　0.0 Hz<br>**First start assistant**　　▭<br>Set-up drive now?<br>Spin the motor mode<br>Commission the drive<br>Exit & don't show at power-up<br>Exit<br>　　　　　　　15:16　　　**Next** |
| ☐ | Select the localization you want to use and press ⎯ (**Next**). | Off◇　　　ⵁ ACH480　　　0.0 Hz<br>**Localization**　　　▭<br>Unit defaults:<br>International (SI)<br>US standard (Imperial)<br><br><br>**Back**　　　15:16　　　**Next** |
| ☐ | Change the units shown on the panel if needed.<br>• Go to the edit view of a selected row by pressing ▶.<br>• Scroll the view with ▲ and ▼.<br>Go to the next view by pressing ⎯ (**Next**). | Off◇　　　ⵁ ACH480　　　0.0 Hz<br>**Units**　　　▬▭<br>Change the display units if needed.<br>Power:　　　　　　　　kW▶<br>Temperature:　　　　　　°C▶<br>Torque:　　　　　　　Nm▶<br>Currency:　　　　　　　€▶<br>**Back**　　　15:17　　　**Next** |
| ☐ | To select a value in an edit view:<br>• Use ▲ and ▼ to select the value.<br>Press ⎯ (**Save**) to accept the new setting, or press ⎯ (**Cancel**) to go back to the previous view without making changes. | Off◇　　　ⵁ ACH480　　　0.0 Hz<br>**Power:**<br>kW<br>hp<br><br><br>**Cancel**　　　15:17　　　**Save** |

**2**

| | | |
|---|---|---|
| ☐ | Set the date and time as well as date and time display formats. <br> • Go to the edit view of a selected row by pressing ▶. <br> • Scroll the view with ▲ and ▼. <br> Go to the next view by pressing ⌐ (**Next**). | Off◇     ⟲ ACH480     0.0 Hz <br> **Date & time**    ▬▬ <br> Please enter the current date and time. <br> Date                  24.02.2017 ▶ <br> Time                   15:17:50 ▶ <br> Show date as    day.month.year ▶ <br> Show time as        24-hour ▶ <br> **Back**       15:17      **Next** |

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

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

⊕       **ABB Motors**    C E   ⊕

3 ∼ motor     M2AA 200 MLA 4

IEC 200 M/L 55

No

Ins.cl. F     IP 55

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

Cat. no    3GAA 202 001 - ADA

6312/C3      ▬      6210/C3      180 kg

⊕              IEC 34-1      ⊕

| | | |
|---|---|---|
| ☐ | Check that the motor data is correct. Values are predefined on the basis of the drive size but you should verify that they correspond to the motor. <br> Start with the motor type. <br> • Go to the edit view of a selected row by pressing ▶. <br> • Scroll the view with ▲ and ▼. <br> Motor nominal cos Φ and nominal torque are optional. <br> Press ⌐ (**Next**) to continue. | Off◇     ⟲ ACH480     0.0 Hz <br> **Motor nominal values**    ▬▬ <br> Find the values on the motor's <br> nameplate, and enter them here: <br> Current:               1.2 A ▶ <br> Speed:             1360 rpm ▶ <br> Voltage:           230.0 V ▶ <br> **Back**       15:18      **Next** |
| ☐ | To change a value in an edit view: <br> • Use ◀ and ▶ to move the cursor left and right. <br> • Use ▲ and ▼ to change the value. <br> Press ⌐ (**Save**) to accept the new setting, or press ⌐ (**Cancel**) to go back to the previous view without making changes. | Off◇     ⟲ ACH480     0.0 Hz <br> **Current:** <br>        1.**2** A <br> ▼ <br> 0.0                         4.8 <br> **Cancel**     15:18     **Save** |

| | | |
|---|---|---|
| ☐ | This step is optional, and requires rotating the motor. Do not do this if it could cause any risk, or if the mechanical set-up does not allow it.<br><br>To do the direction test, select **Spin the motor** and press ⬎ (**Next**). | Off◇　　　　　🗘 ACH480　　　　0.0 Hz<br>**Direction test?**　　　▬▬▬▭<br>Spin the motor to check direction?<br>Spin the motor<br>Not now<br><br>**Back**　　　　15:19　　　　**Next** |
| ☐ | Press the Hand key 🖢ᴴᵃⁿᵈ on the panel to start the drive. | Off◇　　　　　🗘 ACH480　　　　5.0 Hz<br>**Press Hand**　　　▬▬▬▬▭<br>Warning: Until set-up is done, safeties are not active and motor speed is 5 Hz.<br><br>Press Hand now to spin the motor, then check the direction of rotation.<br>**Back**　　　　15:19 |
| ☐ | Check the direction of the motor.<br><br>If it is forward, select **Yes, motor is spinning forward** and press ⬎ (**Next**) to continue.<br><br>If the direction is not forward, select **No, fix direction** and press ⬎ (**Next**) to continue. | Hand◇　　　⤸ ACH480　　⬍5.0 Hz<br>**Is this forward?**　　▬▬▬▬▭<br>Selecting "No, fix direction" tells the drive to change direction, and labels the new direction "forward".<br>Yes, motor is spinning forward<br>No, fix direction<br><br>　　　　　15:19　　　　**Next** |
| ☐ | The first start is now complete and the drive is ready for use.<br><br>Press ⬎ (**Done**) to enter the Home view. | Off◇　　　　　🗘 ACH480　　　　0.0 Hz<br>**First start complete**<br>The drive is ready to run the motor. Press "Hand" to start the motor. To continue commissioning go to Menu > Primary settings.<br><br>　　　　　15:19　　　　**Done** |
| ☐ | The Home view 1 monitoring the values of the selected signals is shown on the panel.<br><br>There are eight different Home view displays. Home view 1 is the default Home view. You can browse them with keys ◀ and ▶. See section *Home view displays* on page *43*. | Off◇　　　　　🗘 ACH480　　　　0.0 Hz<br>Output frequency<br>Hz　　　　　　**0.00**<br>◀ Motor current<br>A　　　　　　**0.00** ▶<br>AI1 actual value<br>V　　　　　　**0.000**<br>**Options**　　　15:19　　　　**Menu** |

**2**

| 2 – Completion of commissioning |
|---|

You can complete the commissioning in five different ways:

| Off◇ | ⟳ ACH480 | 0.0 Hz |
|---|---|---|
| **First start complete** | | |
| The drive is ready to run the motor. Press "Hand" to start the motor. To continue commissioning go to Menu > Primary settings. | | |
| | 15:19 | **Done** |

**1** — **Run & set reference on the panel**

Drive is now ready to be run in the Hand mode.

Press the Hand key ◇ Hand on the panel to start the motor.

Set the reference on the panel.

**2** — **Assistant commissioning**

| Off◇ | ⟳ ACH480 | 0.0 rpm |
|---|---|---|
| **Primary settings** | | |
| HVAC quick setup | | ▶ |
| Start, stop, reference | | ▶ |
| Motor | | ▶ |
| Ramps | | ▶ |
| Limits | | ▶ |
| **Back** | 11:59 | **Select** |

Complete the following two assistants.

Ramps, limits, interlock, run permissive

| Off◇ | ⟳ ACH480 | 0.0 rpm |
|---|---|---|
| **Start, stop, reference** | | |
| ⚒ Basic operation setup | | |
| ⚒ Basic control setup | | |
| Auto control selection: | Primary only | |
| Primary auto control location | | ▶ |
| Interlocks/permissives | | ▶ |
| **Back** | 11:59 | **Select** |

Start/stop, reference and scaling

| Off◇ | ⟳ ACH480 | 0.0 rpm |
|---|---|---|
| **Start, stop, reference** | | |
| ⚒ Basic operation setup | | |
| ⚒ Basic control setup | | |
| Auto control selection: | Primary only | |
| Primary auto control location | | ▶ |
| Interlocks/permissives | | ▶ |
| **Back** | 11:59 | **Select** |

**3** — **HVAC quick setup commissioning**

| Off◇ | ⟳ ACH480 | 0.0 Hz |
|---|---|---|
| **Primary settings** | | |
| HVAC quick setup | | ▶ |
| Start, stop, reference | | ▶ |
| Motor | | ▶ |
| Ramps | | ▶ |
| Limits | | ▶ |
| **Back** | 15:20 | **Select** |

Go through the items on the menu

| Off◇ | ⟳ ACH480 | 0.0 Hz |
|---|---|---|
| **HVAC quick setup** | | |
| Primary start/stop from: | | |
| | DI1 start/stop | |
| Primary reference fr...: AI1 directly ⓘ | | |
| AI1 scaling | | ▶ |
| ☑ Use start interlock 1 | | |
| **Back** | 15:20 | **Edit** |

2

Options 4 and 5:

```
Off◇          C ACH480        0.0 Hz
First start complete
The drive is ready to run the motor.
Press "Hand" to start the motor. To
continue commissioning go to Menu >
Primary settings.


              15:19           Done
```

**④**

**Commissioning with
Primary settings**

Set the start/stop and reference

```
Off◇          C ACH480        0.0 rpm
Primary settings ─────────
HVAC quick setup              ▶
Start, stop, reference        ▶
Motor                         ▶
Ramps                         ▶
Limits                        ▶
Back          11:59          Select
```

Set the motor data

```
Off◇          C ACH480        0.0 Hz
Primary settings ─────────
HVAC quick setup              ▶
Start, stop, reference        ▶
Motor                         ▶
Ramps                         ▶
Limits                        ▶
Back          15:26          Select
```

Set the ramps

```
Off◇          C ACH480        0.0 Hz
Primary settings ─────────
HVAC quick setup              ▶
Start, stop, reference        ▶
Motor                         ▶
Ramps                         ▶
Limits                        ▶
Back          15:26          Select
```

Set the limits

```
Off◇          C ACH480        0.0 Hz
Primary settings ─────────
HVAC quick setup              ▶
Start, stop, reference        ▶
Motor                         ▶
Ramps                         ▶
Limits                        ▶
Back          15:26          Select
```

Continue with further adjustments,
see section *Primary settings* on
page *48*.

**⑤**

**Commissioning with
parameters.
For advanced users only.**

```
Off◇          C ACH480        0.0 rpm
Main menu ─────────
   Energy efficiency          ▶
   Backups                    ▶
   Parameters                 ▶
Exit          12:05          Select
```

```
Off◇          C ACH480        0.0 rpm
Parameters ─────────
Complete List                 ▶
Favorites                     ▶
Modified                      ▶

Back          12:05          Select
```

See chapter *Parameters*
on page *321*.

```
Off◇          C ACH480        0.0 rpm
Complete list ─────────
01 Actual values              ▶
03 Input references           ▶
04 Warnings and faults        ▶
05 Diagnostics                ▶
06 Control and status words   ▶
Back          12:05          Select
```
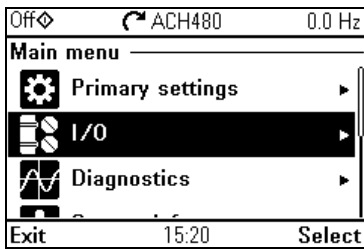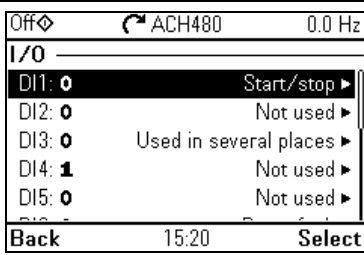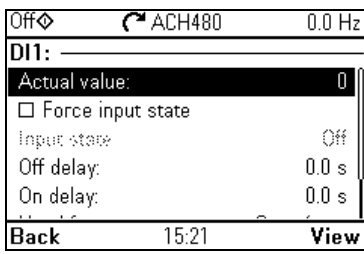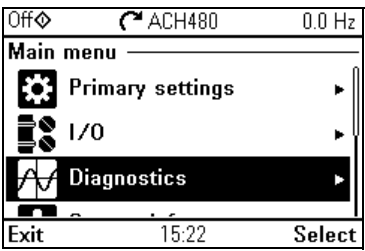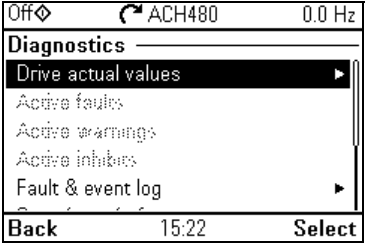
**2**

| 3 – Additional settings in the Primary settings menu – I/O menu |
|---|

| | |
|---|---|
| After the additional adjustments, make sure that the actual I/O wiring matches the I/O use in the control program.<br>In the **Main** menu, select a **I/O** and press ⬓ (**Select**) to enter the **I/O** menu. | Off◇  ⟲ ACH480  0.0 Hz<br>Main menu ────────<br>⚙ **Primary settings** ▶<br>**I/O** ▶<br>⩗⩘ **Diagnostics** ▶<br>Exit  15:20  **Select** |
| Select a the connection you want to check and press ⬓ (**Select**) (or ▶). | Off◇  ⟲ ACH480  0.0 Hz<br>I/O ────────<br>DI1: **0**  Start/stop ▶<br>DI2: **0**  Not used ▶<br>DI3: **0**  Used in several places ▶<br>DI4: **1**  Not used ▶<br>DI5: **0**  Not used ▶<br>Back  15:20  **Select** |
| To view the details of a parameter that cannot be adjusted via the **I/O** menu, press ⬓ (**View**). | Off◇  ⟲ ACH480  0.0 Hz<br>DI1: ────────<br>Actual value:  0<br>☐ Force input state<br>Input state  Off<br>Off delay:  0.0 s<br>On delay:  0.0 s<br>Back  15:21  **View** |
| To adjust the value of a parameter, press ⬓ (**Edit**), adjust the value using ▲, ▼, ◀ and ▶ keys and press ⬓ (**Save**). Note that the actual wiring must match the new value.<br>Go back to the **Main** menu by pressing ⬓ (**Back**) repeatedly. | Off◇  ⟲ ACH480  0.0 Hz<br>DI1: ────────<br>☐ Force input state<br>Input state  Off<br>Off delay:  0.0 s<br>On delay:  0.0 s<br>Used for:  Start/stop<br>Back  15:21  **Edit**<br><br>Off◇  ⟲ ACH480  0.0 Hz<br>**Used for:**<br>Not used<br>DI1 start/stop<br>DI1 start/stop, DI2 direction<br>DI1 forward, DI2 reverse<br>DI1P start, DI2 stop<br>Cancel  15:21  **Save** |

| | 4 – Diagnostics menu | |
|---|---|---|
| ☐ | After making the additional adjustments and checking the I/O connections, use the **Diagnostics** menu to make sure that the setup is functioning correctly.<br><br>In the **Main** menu, select **Diagnostics** and press ⎌ (**Select**) (or ▶). | Off◇　　　　⌒ ACH480　　　0.0 Hz<br>**Main menu** ─────────<br>⚙ **Primary settings**　　　▶<br>▣▪ **I/O**　　　　　　　　▶<br>〽 **Diagnostics**　　　　▶<br>Exit　　　　　15:22　　　Select |
| ☐ | Select the diagnostics item you want to view and press ⎌ (**Select**).<br><br>Return to the **Diagnostics** menu by pressing ⎘ (**Back**). | Off◇　　　　⌒ ACH480　　　0.0 Hz<br>**Diagnostics** ─────────<br>Drive actual values　　　　▶<br>Active faults<br>Active warnings<br>Active inhibits<br>Fault & event log　　　　▶<br>Back　　　　15:22　　　Select |

## How to control the drive through the I/O interface

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

- the motor start-up is performed, and
- the default parameter settings of the HVAC default configurations are in use.

| Preliminary settings | |
|---|---|
| If you need to change the direction of rotation, check that limits allow reverse direction. Check parameter group *30 Limits* and make sure that the minimum limit has a negative value and the maximum limit has a positive value. | |
| **Note:** Default settings only allow forward direction. | |
| Make sure that the control connections are wired according to the connection diagram given for the HVAC default. | See section *HVAC default* on page *78*. |
| Make sure that the drive is in external control. To switch to external control, press key [ **Auto** ]. | In external control, the panel display shows text **Auto** at the top left. |
| **Starting and controlling the speed of the motor** | |
| Start by switching digital input DI1 on. | |
| The arrow starts rotating. It is dotted until the setpoint is reached. | |
| Regulate the drive output frequency (motor speed) by adjusting voltage of analog input AI. | |
| **Note:** If the drive will not start, check that the start interlock 1 (parameter *20.41*) is active (1). For the HVAC default, the start interlock 1 is connected to DI4 by default. | |



| Stopping the motor | |
|---|---|
| Switch digital input DI1 off. The arrow stops rotating. | |

**2**

# How to perform the ID run

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

• parameter *99.13 ID run requested* selection is *Standstill* and

• parameter *99.04 Motor control mode* selection is *Vector*.

In most applications there is no need to perform a separate ID run. 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 (PM) is used (parameter *99.03 Motor type* is set to *Permanent magnet motor*), or

• synchronous reluctance motor (SynRM) is used (parameter *99.03 Motor type* is set to *SynRM*), or

• drive operates near zero speed references, or

• operation at torque range above the motor nominal torque, over a wide speed range is needed.

Do the ID run with the ID run assistant by selecting **Menu > Primary settings > Motor > ID run** (see page *32*) or with parameter *99.13 ID run requested* (see page *36*).

**Note:** If motor parameters (*99 Motor data*) are changed after the ID run, it must be repeated.

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

• change the control mode to vector with the **Control mode** assistant (go to **Menu > Primary settings > Motor > Control mode)** and follow the instructions. The ID run assistant then guides you through the ID run.

or
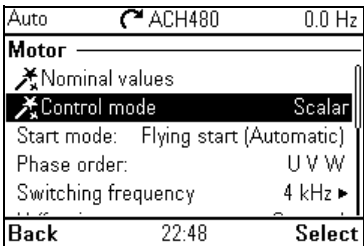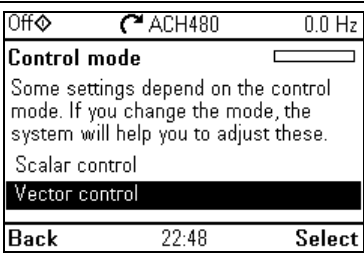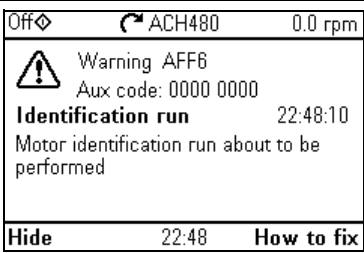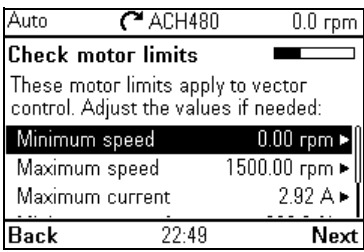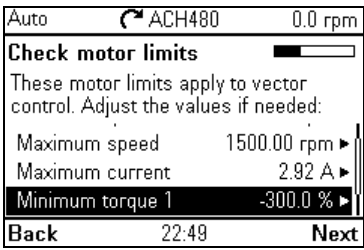
• set parameter *99.04 Motor control mode* to *Vector*, and

  • for I/O controlled drive, check parameters in groups *22 Speed reference selection*, *23 Speed reference ramp*, *12 Standard AI*, *30 Limits* and *46 Monitoring/scaling settings*.
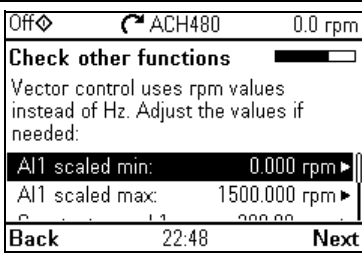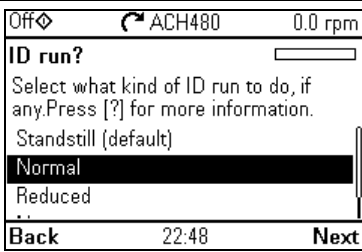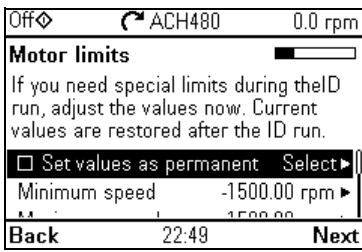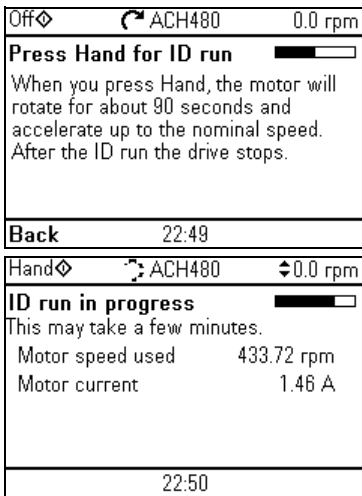
### ID run procedure
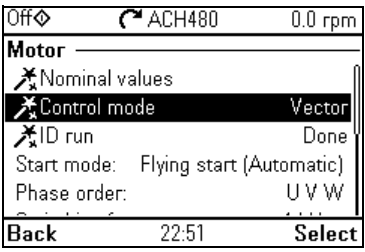
**With the ID run assistant**

**2**

| Pre-check |
|---|
| ⚠️⚠️ **WARNING!** The motor will run at up to approximately 50…80% of the nominal speed during the ID run. The motor will rotate in the forward direction. **Make sure that it is safe to run the motor before performing the ID run!** |
| ☐ De-couple the motor from the driven equipment |
| ☐ Check that the values of the motor data parameters are equivalent to those on the motor nameplate. |
| ☐ Check that the STO circuit is closed. |
| The assistant will ask if you want to use temporary motor limits. They must meet the following conditions: |
| ☐ Minimum speed ≤ 0 rpm |
| ☐ Maximum speed = motor rated speed (Normal ID run procedure needs the motor to be run at 100% speed.) |
| ☐ Maximum current > $I_{HD}$ |
| ☐ Maximum torque > 50% |
| ☐ Make sure that the panel is in the Off mode control (text Off shown at the top left). Press the Off key ⊘ to switch to the Off mode. |

| ID run | |
|---|---|
| ☐ Go to the **Main** menu by pressing ⌐ (**Menu**) in the Home view. Select **Primary settings** and press ⌐ (**Select**) (or ▶). | Off◇　　　↻ ACH480　　　0.0 Hz<br>**Main menu**<br>⚙ **Primary settings**　▶<br>▮▮ I/O　▶<br>〰 Diagnostics　▶<br>Exit　　　22:47　　　Select |
| ☐ Select **Motor** and press ⌐ (**Select**) (or ▶). | Auto　　　↻ ACH480　　　0.0 Hz<br>**Primary settings**<br>HVAC quick setup　▶<br>Start, stop, reference　▶<br>Motor　▶<br>Ramps　▶<br>Limits<br>Back　　　22:47　　　Select |

| | | |
|---|---|---|
| ☐ | If the control modes is scalar, select **Control mode** and press ⬭ (**Select**) (or ▶) and continue to the next step. | Auto    ⟳ ACH480    0.0 Hz<br>**Motor** ─────<br>✗Nominal values<br>✗Control mode      Scalar<br>Start mode:   Flying start (Automatic)<br>Phase order:       U V W<br>Switching frequency    4 kHz ▶<br>**Back**     22:48     **Select** |
| ☐ | Select **Vector control** and press ⬭ (**Select**) (or ▶). | Off◈    ⟳ ACH480    0.0 Hz<br>**Control mode**     ▭<br>Some settings depend on the control mode. If you change the mode, the system will help you to adjust these.<br>Scalar control<br>Vector control<br>**Back**     22:48     **Select** |
| ☐ | Warning message **Identification run** is shown. Press ⬭ (**Hide**) to continue. | Off◈    ⟳ ACH480    0.0 rpm<br>⚠   Warning  AFF6<br>     Aux code: 0000 0000<br>**Identification run**     22:48:10<br>Motor identification run about to be performed<br>**Hide**     22:48    **How to fix** |
| ☐ | Check the motor speed limits. The following must be true:<br>• Minimum speed ≤ 0 rpm<br>• Maximum speed = motor rated speed. | Auto    ⟳ ACH480    0.0 rpm<br>**Check motor limits**    ▰▱<br>These motor limits apply to vector control. Adjust the values if needed:<br>Minimum speed     0.00 rpm ▶<br>Maximum speed    1500.00 rpm ▶<br>Maximum current      2.92 A ▶<br>**Back**     22:49     **Next** |
| ☐ | Check the motor current as well as torque limits. The following must be true:<br>• Maximum current > $I_{HD}$<br>• Maximum torque > 50%.<br>Press ⬭ (**Next**). | Auto    ⟳ ACH480    0.0 rpm<br>**Check motor limits**    ▰▱<br>These motor limits apply to vector control. Adjust the values if needed:<br>Maximum speed    1500.00 rpm ▶<br>Maximum current      2.92 A ▶<br>Minimum torque 1    -300.0 % ▶<br>**Back**     22:49     **Next** |

**2**

| | | |
|---|---|---|
| ☐ | Check AI1 scaling, see parameters *12.19 AI1 scaled at AI1 min* and *12.20 AI1 scaled at AI1 max*.<br>Press ⤵ (**Next**). | Off◇      ↻ ACH480      0.0 rpm<br>**Check other functions** ▬▬▬<br>Vector control uses rpm values instead of Hz. Adjust the values if needed:<br>▐ AI1 scaled min:     0.000 rpm ▶<br>AI1 scaled max:    1500.000 rpm ▶<br>**Back**     22:48     **Next** |
| ☐ | Select the type of ID run you want to do and press ⤵ (**Next**). | Off◇      ↻ ACH480      0.0 rpm<br>**ID run?**     ▭<br>Select what kind of ID run to do, if any.Press [?] for more information.<br>Standstill (default)<br>▐ Normal ▌<br>Reduced<br>**Back**     22:48     **Next** |
| ☐ | Check the motor limits shown on the panel. If you need other limits during the ID run you can enter them here. The originals limits will be restored after the ID run, unless you select **Set values as permanent**.<br>Press ⤵ (**Next**). | Off◇      ↻ ACH480      0.0 rpm<br>**Motor limits** ▬▬▬<br>If you need special limits during theID run, adjust the values now. Current values are restored after the ID run.<br>☐ Set values as permanent  Select▶<br>Minimum speed     -1500.00 rpm ▶<br>**Back**     22:49     **Next** |
| ☐ | Press the Hand key (◇) to start the ID run.<br>In general, it is recommended not to press any control panel keys during the ID run. However, you can stop the ID run at any time by pressing the Off key (◎).<br>During the ID run a progress view is shown.<br>After the ID run is completed, text **ID run done** is shown. The LED stops blinking.<br>If the ID run fails, fault *FF61 ID run* is shown. See chapter *Fault tracing* on page *185* for more information. | Off◇      ↻ ACH480      0.0 rpm<br>**Press Hand for ID run** ▬▬▬<br>When you press Hand, the motor will rotate for about 90 seconds and accelerate up to the nominal speed. After the ID run the drive stops.<br><br>**Back**     22:49<br>Hand◇    ⌐⌐ ACH480      ⇕0.0 rpm<br>**ID run in progress** ▬▬▬<br>This may take a few minutes.<br>Motor speed used     433.72 rpm<br>Motor current     1.46 A<br><br>22:50 |

| | | |
|---|---|---|
| ☐ | After the ID run is completed, text **Done** is shown on row **ID run**. | Off◇　　　↻ ACH480　　　0.0 rpm<br>**Motor** ───────────────<br>✗Nominal values<br>✗Control mode　　　　　　Vector<br>✗ID run　　　　　　　　　Done<br>Start mode:　Flying start (Automatic)<br>Phase order:　　　　　　U V W<br>**Back**　　　　22:51　　　**Select** |

**With parameter** *99.13 ID run requested*

| Pre-check |
|---|

| | ⚠⚠ | **WARNING!** The motor will run at up to approximately 50…80% of the nominal speed during the ID run. The motor will rotate in the forward direction. **Make sure that it is safe to run the motor before performing the ID run!** |
|---|---|---|
| ☐ | | De-couple the motor from the driven equipment |
| ☐ | | Check that the values of the motor data parameters are equivalent to those on the motor nameplate. |
| ☐ | | Check that the STO circuit is closed. |
| | | If parameter values (from group *10 Standard DI, RO* to group *99 Motor data*) are changed before the ID run, check that the new settings meet the following conditions: |
| ☐ | | *30.11 Minimum speed* ≤ 0 rpm |
| ☐ | | *30.12 Maximum speed* = motor rated speed (Normal ID run procedure needs the motor to be run at 100% speed.) |
| ☐ | | *30.17 Maximum current* > $I_{HD}$ |
| ☐ | | *30.20 Maximum torque 1* > 50% or *30.24 Maximum torque 2* > 50%, depending on which torque limit set is in use according to parameter *30.18 Torq lim sel*. |
| | | Check that signals |
| ☐ | | run permissive (parameter *20.40 Run permissive*) is active |
| ☐ | | Make sure that the panel is in the Off mode control (text Off shown at the top left). Press the Off key ⊘ to switch to the Off mode. |

| ID run | |
|---|---|

| ☐ | Go to the **Main** menu by pressing ⌇ (**Menu**) in the Home view. Press ▲. | Off◇   ↻ ACH480   0.0 rpm<br>── Main menu ──<br>⚙ **Primary settings** ▶<br>▤ I/O ▶<br>▥ Diagnostics ▶<br>▬<br>Exit   22:51   Select |
|---|---|---|
| ☐ | Select **Parameters** and press ⌇ (**Select**) (or ▶). | Off◇   ↻ ACH480   0.0 rpm<br>── Main menu ──<br>▥ Energy efficiency ▶<br>▧ Backups ▶<br>▤ **Parameters** ▶<br>Exit   22:51   Select |

| | | |
|---|---|---|
| ☐ | Select **Complete list** and press ⬡ (**Select**) (or ▶). | Off◇    ↻ ACH480    0.0 rpm<br>**Parameters** ────────<br>Complete List          ▶<br>Favorites            ▶<br>Modified             ▶<br><br>**Back**      22:51      **Select** |
| ☐ | Scroll the page with ▲ and ▼, and select parameter group **99 Motor data** and press ⬡ (**Select**) (or ▶). | Off◇    ↻ ACH480    0.0 rpm<br>**Complete list** ────────<br>95 HW configuration      ▶<br>96 System             ▶<br>97 Motor control         ▶<br>98 User motor parameters   ▶<br>99 Motor data            ▶<br>**Back**      22:52      **Select** |
| ☐ | Scroll the page with ▲ and ▼, and select parameter **99.13 ID run requested** and press ⬡ (**Select**) (or ▶). | Off◇    ↻ ACH480    0.0 rpm<br>99 **Motor data** ────────<br>99.09 Motor nominal speed   1430 rpm<br>99.10 Motor nominal power   0.75 kW<br>99.11 Motor nominal cos φ     0.00<br>99.12 Motor nominal torque   0.000 Nm<br>99.13 ID run requested       None<br>**Back**      22:52      **Edit** |
| ☐ | Select the ID run type and press ⬡ (**Save**) (or ▶). | Off◇    ↻ ACH480    0.0 rpm<br>99.13 **ID run requested**<br>   [0] None<br>   [1] Normal<br>   [2] Reduced<br>   [3] Standstill<br>   [6] Advanced<br>**Cancel**     22:52      **Save** |

**2**

| | |
|---|---|
| ☐ | Panel LED starts blinking green to indicate an active warning (*AFF6*). |
| | The *AFF6* warning view is shown when no key has been pressed for one minute. Pressing ⌣ (**How to fix**) shows text informing that the ID run will be done at the next start. You can hide the warning view by pressing ⌿ (**Hide**). |
| | Press the Hand key (⟨◇⟩) to start the ID run. |
| | In general, it is recommended not to press any control panel keys during the ID run. However, you can stop the ID run at any time by pressing the Off key (⟨⊘⟩). |
| | During the ID run the arrow is rotating at the top. |
| | After the ID run is completed, text **ID run done** is shown. The LED stops blinking. |
| | If the ID run fails, fault *FF61 ID run* is shown. See chapter *Fault tracing* on page *185* for more information. |

```
Off◇          ↻ ACH480        0.0 rpm
  ⚠    Warning  AFF6
       Aux code: 0000 0000
Identification run          22:52:29
Motor identification run about to be
performed

Hide            22:52        How to fix
```

```
Hand◇         ⋮ ACH480      ⇕0.0 rpm
99 Motor data ──────────
99.09 Motor nominal speed    1430 rpm
99.10 Motor nominal power     0.75 kW
99.11 Motor nominal cos φ         0.00
99.12 Motor nominal torque   0.000 Nm
99.13 ID run requested         Normal
Back            22:52            Edit
```

# 3

Control panel

## Contents of this chapter

This chapter contains instructions for removing and reinstalling the assistant control panel and briefly describes its display, keys and key shortcuts. For more information, see *ACX-AP-x assistant control panels user's manual* (3AUA0000085685 [English]).

## Removing and reinstalling the control panel

To remove the control panel, press the retaining clip at the top (1a) and pull it forward from the top edge (1b).
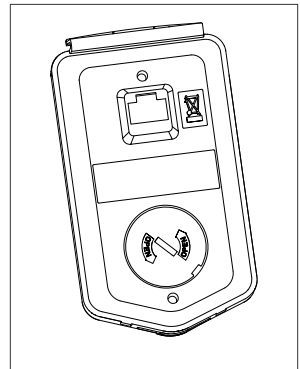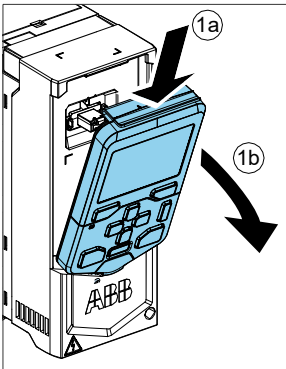
To reinstall the control panel, put the bottom of the container in position (1a), press the retaining clip at the top (1b) and push the control panel in at the top edge (1c).
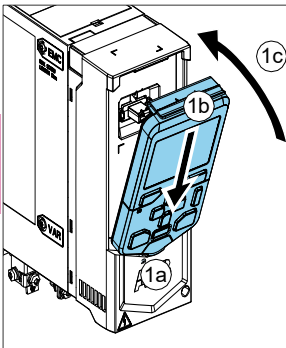


## Layout of the standard Hand-Off-Auto panel control panel



| 1 | *Layout of the control panel display* | 6 | *The arrow keys* |
|---|---|---|---|
| 2 | *Left softkey* | 7 | Off (see *Hand, Off and Auto*) |
| 3 | *Right softkey* | 8 | Hand (see *Hand, Off and Auto*) |
| 4 | Status LED, see chapter *Maintenance and hardware diagnostics*, section *LEDs* in the *Hardware manual of the drive*. | 9 | Auto (see *Hand, Off and Auto*) |
| 5 | *Help* | 10 | USB connector |

## Layout of the control panel display

In most views, the following elements are shown on the display:
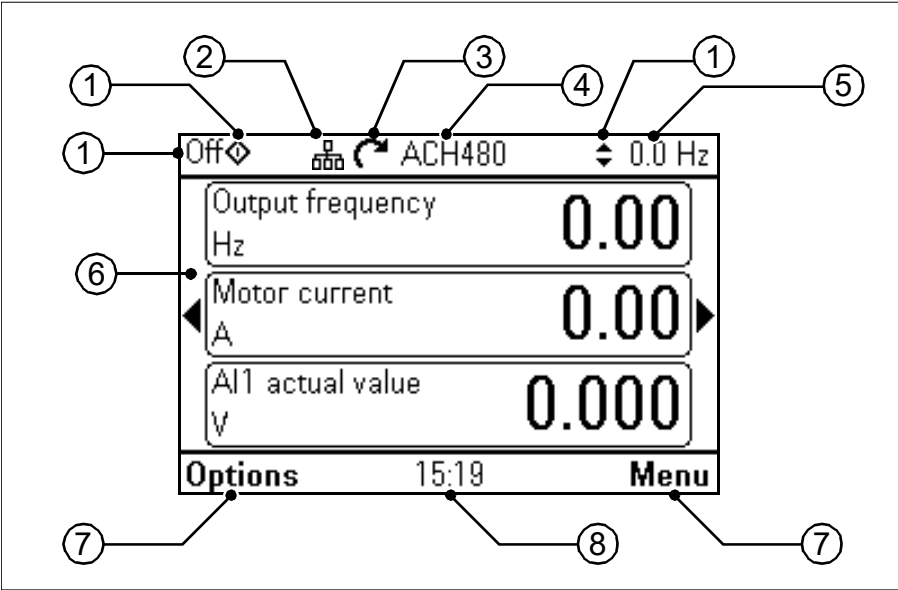


1.  **Control location and related icons**: Indicates how the drive is controlled:
    *   **No text**: The drive is in local control, but controlled from another device. The icons in the top pane indicate which actions are allowed:

| Text/Icons | Starting from this control panel | Stopping from this control panel | Giving reference from this panel |
|---|---|---|---|
| | Not allowed | Not allowed | Not allowed |

    *   **Local**: The drive is in local control, and controlled from this control panel. The icons in the top panel indicate which actions are allowed:

| Text/Icons | Starting from this control panel | Stopping from this control panel | Giving reference from this panel |
|---|---|---|---|
| Off ◇ ↕ | Allowed | Drive is stopped | Not allowed |
| Hand ◇ ↕ | Allowed | Allowed | Allowed |

- • **External** The drive is in external control, ie, controlled through I/O or fieldbus. The icons in the top pane indicate which actions are allowed with the control panel:

**3**

| Text/Icons | | Starting from this control panel | Stopping from this control panel | Giving reference from this panel |
|---|---|---|---|---|
| Auto | | Not allowed | Not allowed | Not allowed |
| Auto | ◈ | Allowed | Allowed | Not allowed |
| Auto | ⬍ | Not allowed | Allowed | Allowed |
| Auto | ◈ ⬍ | Allowed | Allowed | Allowed |

2. **Panel bus:** Indicates that there are more than one drive connected to this panel. To switch to another drive, go to **Options > Select drive**.

3. **Status icon**: Indicates the status of the drive and the motor. The direction of the arrow indicates forward (clockwise) or reverse (counter-clockwise) rotation.
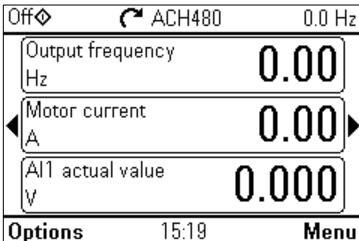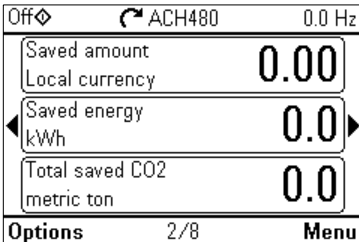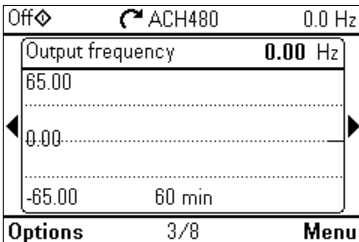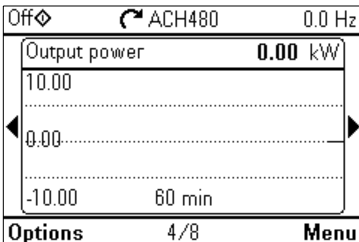
| Status icon | Animation | Drive status |
|---|---|---|
| ↻ | - | Stopped |
| ↻ | - | Stopped, start inhibited |
| ↻↔↻ | Blinking | Stopped, start command given but start inhibited. See **Menu > Diagnostics** on the control panel |
| ↻↔✗ | Blinking | Faulted |
| ↻↔ | Blinking | Running, at reference, but the reference value is 0 |
| ↻↔↻ | Rotating | Running, not at reference |
| ↻↔↻ | Rotating | Running, at reference |
| ∭ | - | Pre-heating (motor heating) active |
| Zᶻ | - | PID sleep mode active |
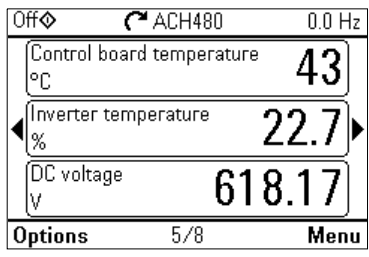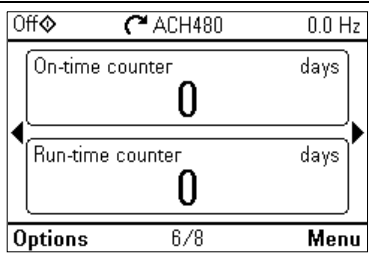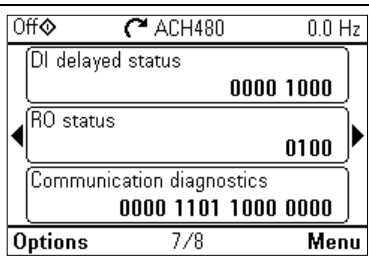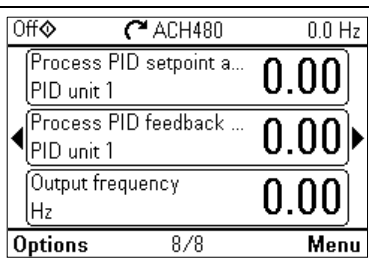
4. **Drive name**: If a name has been given, it is displayed in the top pane. By default, it is "ACH480". You can change the name on the control panel by selecting **Menu > Primary settings > Clock, region, display** (see page *68*).

5. **Reference value**: Speed, frequency, etc. is shown with its unit. For information on changing the reference value in the **Primary settings** menu (see page *54*).

6. **Content area**: The actual content of the view is displayed in this area. The content varies from view to view. The example view on page *41* is the main view of the control panel which is called the Home view.

7. **Softkey selections**: Displays the functions of the softkeys ( ▱ and ▱ ) in a given context.

8. **Clock**: The clock displays the current time. You can change the time and time format on the control panel by selecting **Menu > Primary settings > Clock, region, display** (see page *68*).

You can adjust the display contrast and back light functionality on the control panel by selecting **Menu > Primary settings > Clock, region, display** (see page *68*).

# Home view displays

There are eight different Home view displays. Home view 1 is the default Home view. You can browse them with the arrow keys ( ◀ and ▶ ).

| | |
|---|---|
| Home view 1 (default Home view):<br>• Output frequency (Hz): Parameter *01.06 Output frequency*<br>• Motor current (A): Parameter *01.07 Motor current*<br>• AI1 actual value (V or mA): Parameter *12.11 AI1 actual value* | Off◇   ↻ ACH480   0.0 Hz<br>Output frequency<br>Hz     **0.00**<br>Motor current<br>A     **0.00**<br>AI1 actual value<br>V     **0.000**<br>Options    15:19    Menu |
| Home view 2:<br>• Saved amount (Local currency): Parameter *45.07 Saved amount*<br>• Saved energy (kWh): Parameter *45.04 Saved energy*<br>• Total saved CO2 (metric ton): *45.09 CO2 reduction in tons* | Off◇   ↻ ACH480   0.0 Hz<br>Saved amount<br>Local currency   **0.00**<br>Saved energy<br>kWh     **0.0**<br>Total saved CO2<br>metric ton     **0.0**<br>Options    2/8    Menu |
| Home view 3:<br>• Output frequency shown as a graphical representation during the last 60 minutes: Parameter *01.06 Output frequency* | Off◇   ↻ ACH480   0.0 Hz<br>Output frequency   **0.00** Hz<br>65.00<br>0.00<br>-65.00    60 min<br>Options    3/8    Menu |
| Home view 4:<br>• Output frequency shown as a graphical representation during the last 60 minutes: Parameter *01.14 Output power* | Off◇   ↻ ACH480   0.0 Hz<br>Output power   **0.00** kW<br>10.00<br>0.00<br>-10.00    60 min<br>Options    4/8    Menu |

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| | |
|---|---|
| Home view 5:<br>• Control board temperature (°C): Parameter *05.10 Control board temperature*<br>• Inverter temperature (%): Parameter *05.11 Inverter temperature*<br>• DC voltage (V): Parameter *01.11 DC voltage* | Off◇　　　⌒ ACH480　　0.0 Hz<br>Control board temperature<br>°C　　　　　　　　　43<br>◀ Inverter temperature<br>%　　　　　　　　22.7 ▶<br>DC voltage<br>V　　　　　　618.17<br>**Options**　　5/8　　**Menu** |
| Home view 6:<br>• On-time counter (days): Parameter *05.01 On-time counter*<br>• Run-time counter (days): Parameter *05.02 Run-time counter* | Off◇　　　⌒ ACH480　　0.0 Hz<br>On-time counter　　　days<br>　　　　0<br>◀　　　　　　　　　▶<br>Run-time counter　　days<br>　　　　0<br>**Options**　　6/8　　**Menu** |
| Home view 7:<br>• DI delayed status, that is, status of DI6…DI1 (DI1 is bit 0, the rightmost bit): Parameter *10.02 DI delayed status*<br>• RO status, that is, status of RO3…RO1 (RO1 is bit 0, the rightmost bit): Parameter *10.21 RO status*<br>• Communication diagnostics: Parameter *58.07 Communication diagnostics* | Off◇　　　⌒ ACH480　　0.0 Hz<br>DI delayed status<br>　　　　　　0000 1000<br>RO status<br>◀　　　　　　0100 ▶<br>Communication diagnostics<br>　　0000 1101 1000 0000<br>**Options**　　7/8　　**Menu** |
| Home view 8:<br>• Process PID setpoint actual (PID unit 1): Parameter *40.03 Process PID setpoint actual*<br>• Process PID feedback actual (PID unit 1): Parameter *40.02 Process PID feedback actual*<br>• Output frequency (Hz): Parameter *01.06 Output frequency* | Off◇　　　⌒ ACH480　　0.0 Hz<br>Process PID setpoint a…<br>PID unit 1　　　　0.00<br>◀ Process PID feedback …<br>PID unit 1　　　　0.00 ▶<br>Output frequency<br>Hz　　　　　　　0.00<br>**Options**　　8/8　　**Menu** |

# Keys

The keys of the control panel are described below.



**Left softkey**

The left softkey (⬭) is usually used for exiting and canceling. Its function in a given situation is shown by the softkey selection in the bottom left corner of the display.

Holding ⬭ down exits each view in turn until you are back in the Home view. This function does not work in special screens.

**Right softkey**

The right softkey (⬭) is usually used for selecting, accepting and confirming. The function of the right softkey in a given situation is shown by the softkey selection in the bottom right corner of the display.

**The arrow keys**

The up and down arrow keys (▲ and ▼) are used to highlight selections in menus and selection lists, to scroll up and down on text pages, and to adjust values when, for example, setting the time, entering a passcode or changing a parameter value.

The left and right arrow keys (◀ and ▶) are used to move the cursor left and right in parameter editing and to move forward and backward in assistants. In menus, ◀ and ▶ function the same way as ⬭ and ⬭, respectively.

**Help**

The help key (?) opens a help page. The help page is context-sensitive, in other words, the content of the page is relevant to the menu or view in question.

**Hand, Off and Auto**

The ACH480 can be in local or external control. The local control has two modes: Hand and Off. See also the diagram in section *Local control vs. external control* on page .

Hand key (◇):

- In local control / Off mode: Starts the drive. The drive will switch to the Hand mode.
- In external control: Switches the drive to local control / Hand mode, keeping it running.

Off key ($\boxed{\textcircled{\oslash}}$):
*   Stops the drive and switches to the Off mode.

Auto key ($\boxed{\text{Auto}}$):
*   In local control: The drive will switch to external control.

## Key shortcuts

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The table below lists key shortcuts and combinations. Simultaneous key presses are indicated by the plus sign (+).

| Shortcut | Available in | Effect |
|---|---|---|
| $\boxed{\ominus}$ + $\boxed{\ominus}$ + $\boxed{\blacktriangle}$ | any view | Save a screenshot. Up to fifteen images may be stored in the control panel memory. To transfer images to PC, connect the assistant control panel to PC with a USB cable and the panel will mount itself as an MTP (media transfer protocol) device. Pictures are stored in the screen shots folder. For more instructions, see *ACX-AP-x assistant control panels user's manual* (3AUA0000085685 [English]). |
| $\boxed{\ominus}$ + $\boxed{\blacktriangle}$, $\boxed{\ominus}$ + $\boxed{\blacktriangledown}$ | any view | Adjust backlight brightness. |
| $\boxed{\ominus}$ + $\boxed{\blacktriangle}$, $\boxed{\ominus}$ + $\boxed{\blacktriangledown}$ | any view | Adjust display contrast. |
| $\boxed{\blacktriangle}$ or $\boxed{\blacktriangledown}$ | Home view | Adjust reference. |
| $\boxed{\blacktriangle}$ + $\boxed{\blacktriangledown}$ | parameter edit views | Revert an editable parameter to its default value. |
| $\boxed{\blacktriangleleft}$ + $\boxed{\blacktriangleright}$ | view showing a list of selections for a parameter | Show/hide selection index numbers. |
| $\boxed{\ominus}$ (keep down) | any view | Return to the Home view by pressing down the key until the Home view is shown. |

# 4

# Settings, I/O and diagnostics on the control panel

## Contents of this chapter

This chapter provides detailed information about the **Primary settings**, **I/O, Diagnostics, System info, Energy efficiency** and **Backups** menus on the control panel.

To get to these menus from the Home view, first select **Menu** to go the **Main** menu, and in the **Main** menu, select the menu you want

```
Off◇        ⟳ ACH480      0.0 Hz
┌─────────────────────────────────┐
│ Output frequency        0.00     │
│ Hz                               │
│ Motor current           0.00     │
│ A                                │
│ AI1 actual value        0.000    │
│ V                                │
Options       16:00        Menu
```

```
Off◇        ⟳ ACH480      0.0 Hz
Main menu ──────────────────────
 ⚙  Primary settings          ▶
 ▪▪ I/O                        ▶
 ⚡ Diagnostics                ▶
Exit          16:00       Select
```

## Primary settings

```
Off◇        ↻ ACH480        0.0 Hz
Primary settings ─────────────
HVAC quick setup                ►
Start, stop, reference          ►
Motor                           ►
Ramps                           ►
Limits                          ►
Back           16:00        Select
```
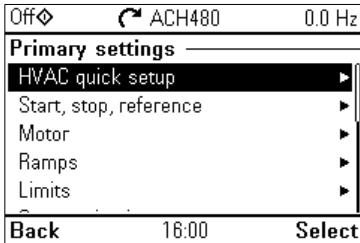
To go the **Primary settings** menu from the Home view, select **Menu > Primary settings**.

After making the guided settings using the first start assistant, you may want to select another default configuration by selecting **Start, stop, reference > Basic control set-up > How do you want to control?** and then selecting a default configuration.

The **Primary settings** menu enables you to adjust and define additional settings used in the drive.

We recommend that you make at least these additional settings:

• Set **Start, stop, reference** values
• **Ramps**
• **Limits**

With the **Primary settings** menu, you can also adjust settings related to the motor, fieldbus communication, PID, override, fault functions, advanced functions and clock, region and display. In addition, you can reset the fault and event logs, panel Home view, parameters not related to hardware, fieldbus settings, motor data and ID run results, all parameters, end user texts as well as reset everything to factory defaults.

Note that the **Primary settings** menu only enables you to modify some of the settings: more advanced configuration is done via the parameters: Select **Menu > Parameters**. For more information on the different parameters, see chapter *Parameters* on page *321*.

In the **Setting** menu, the ⚠ symbol indicates multiple connected signals/parameters. The 🛠 symbol indicates that the setting provides an assistant when modifying the parameters.

To get more information on **Primary settings** menu items, press the [?] key to open the help page.

The sections below provide detailed information about the contents of the different submenus available in the **Primary settings** menu.

■ **HVAC quick setup**

```
Off◇          ⤳ ACH480        0.0 Hz
HVAC quick setup ─────────────
Primary start/stop from:
                      DI1 start/stop
Primary reference fr...: AI1 directly ⓘ
AI1 scaling                          ▶
☐ Use start interlock 1
Back          16:00             Edit
```

Use the **HVAC quick setup** submenu to go through the most important settings (basic setup and basic operation) at start-up if you do not want to do it with the assistants.

The table below provides detailed information about the available setting items in the **HVAC quick setup** submenu.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Primary start/stop from: | Set where the start and stop comes in the Auto mode. | |
| Primary reference from: | Set where the reference comes in the Auto mode. | |
| AI scaling | Set the scaling of AI inputs. | |
| Use start interlock 1 | Selected/Unselected | |
| Start enabled when: | Start enabled when: DIx high | *20.41 Start interlock 1* |
| Use run permissive | Selected/Unselected | |
| Run enabled when: | Run enabled when: DIx high | *20.40 Run permissive* |
| Minimum speed: Minimum frequency: | | *30.13 Minimum speed* *30.11 Minimum frequency* |
| Acceleration time: | | *23.12 Acceleration time 1* *28.72 Freq acceleration time 1* |
| Deceleration time: | | *23.13 Deceleration time 1* *28.73 Freq deceleration time 1* |
| Stop mode: | | *21.03 Stop mode* |
| ⚒Motor nominal values | Enter the motor's nominal values from the motor's nameplate. | *99.03 Motor type … 99.12 Motor nominal torque* |
| Date & time | Set the time and date, and their formats. | |

### ■ Start, stop, reference

```
Off◇        ⌒ ACH480        0.0 Hz
Start, stop, reference ─────────
✕Basic operation setup
✕Basic control setup
Auto control selection:   Primary only
Primary auto control location        ▶
Interlocks/permissives               ▶
Back        16:01          Select
```
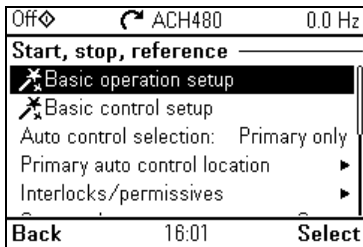
**4**

Use the **Start, stop, reference** submenu to set up start/stop commands, reference, and related features, such as constant speeds or run permissions.

The table below provides detailed information about the available setting items in the **Start, stop, reference** submenu.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| ✕Basic operation setup | Ramps<br>Limits<br>Start interlock signal<br>Run permissive signal<br>Naming the drive | |
| ✕Basic control setup | Direct control via I/O (HVAC default configuration)<br>• Reference (AI1) scaling<br>Direct control via fieldbus comm.<br>• BACnet MS/TP<br>• Modbus RTU<br>PID control, single motor<br>• Feedback (AI2) scaling<br>• Setpoint source<br>• Constant setpoint | |
| Primary auto control location | Settings for the primary remote control location, Ext1. Enabling Ext1 gives a second set of start/stop/reference sources for remote control. | *12.17 AI1 min*<br>*12.18 AI1 max* |
| Secondary auto control location | Settings for the secondary remote control location, Ext2. These settings include reference source, start, stop, direction and command sources for Ext2.<br>By default, Ext2 is set to **Off**. | *19.11 Ext1/Ext2 selection*<br>*28.15 Ext2 frequency ref1* or<br>*22.18 Ext2 speed ref1*<br>*12.17 AI1 min*<br>*12.18 AI1 max*<br>*12.27 AI2 min*<br>*12.28 AI2 max*<br>*20.06 Ext2 commands*<br>*20.08 Ext2 in1 source*<br>*20.09 Ext2 in2 source*<br>*20.10 Ext2 in3 source* |

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Interlock/permissives | Settings to prevent the drive from running or starting when a specific digital input is low.<br><br>You can enter a custom text to use instead of "Run permissive", "Start interlock 1", "Start interlock 2", "Start interlock 3" and "Start interlock 4".<br><br>See section *Interlocks* on page *105*. | *20.40 Run permissive20.41 Start interlock 1*<br>*20.42 Start interlock 2*<br>*20.43 Start interlock 3*<br>*20.44 Start interlock 4*<br>*20.45 Start interlock stop mode* |
| Stop mode: | Sets how the drive stops the motor. | *21.03 Stop mode* |
| Pump and fan control | Selects PFC or SPFC control.<br>Configures the PFC/SPFC I/O.<br>Configures PFC/SPFC control.<br>Configures Autochange.<br>See section *Single pump and fan control (PFC)* on page *145*. | *76.21 PFC configuration*<br>*76.25 Number of motors*<br>*76.27 Max number of motors allowed*<br>*76.59 PFC contactor delay*<br>*10.24 RO1 source*<br>*10.27 RO2 source*<br>*10.30 RO3 source*<br>*76.81 PFC 1 interlock*<br>*76.82 PFC 2 interlock*<br>*76.83 PFC 3 interlock*<br>*76.84 PFC 4 interlock*<br>*76.30 Start point 1*<br>*76.31 Start point 2*<br>*76.32 Start point 3*<br>*76.41 Stop point 1*<br>*76.42 Stop point 2*<br>*76.43 Stop point 3*<br>*76.55 Start delay*<br>*76.56 Stop delay*<br><br>*76.70 Autochange*<br>*76.71 Autochange interval*<br>*76.72 Maximum wear imbalance*<br>*76.73 Autochange level* |
| Constant speeds / Constant frequencies | These settings are for using a constant value as the reference. By default, this is set to **On**<br>See section *Constant speeds/frequencies* on page *116*. | *28.21 Constant frequency function* or *22.21 Constant speed function*<br>*28.26 Constant frequency 1*<br>*28.27 Constant frequency 2*<br>*28.28 Constant frequency 3*<br>*22.26 Constant speed 1*<br>*22.27 Constant speed 2*<br>*22.28 Constant speed 3* |
| Start mode: | Sets how the drive starts the motor. | *21.01 Start mode*<br>*21.02 Magnetization time* |
| Start delay: | Sets how the drive starts the motor. | *21.22 Start delay* |

**4**

| Menu item | Description | Corresponding parameter |
|-----------|-------------|-------------------------|
| Critical speeds/frequencies | Prevents running in critical ranges (speeds or frequencies).<br>See section *Critical speeds/frequencies* on page *117*. | Vector control:<br>*22.51 Critical speed function*<br>*22.52 Critical speed 1 low*<br>*22.53 Critical speed 1 high*<br>*22.54 Critical speed 2 low*<br>*22.55 Critical speed 2 high*<br>*22.56 Critical speed 3 low*<br>*22.57 Critical speed 3 high*<br>Scalar control:<br>*28.51 Critical frequency function*…<br>*28.57 Critical frequency 3 high* |

◼ **Motor**



Use the **Motor** submenu to adjust motor-related settings, such as nominal values, control mode or thermal protection.

Note that settings that are visible depend on other selections, for example, vector or scalar control mode, used motor type or selected start mode.

Three assistants are available: Control mode, Nominal value and ID run (for vector control mode only).

The table below provides detailed information about the available setting items in the **Motor** submenu.

| Menu item | Description | Corresponding parameter |
|-----------|-------------|-------------------------|
| Nominal values | Enter the motor's nominal values from the motor's nameplate. | *99.03 Motor type* …<br>*99.12 Motor nominal torque* |

| Menu item | Description | Corresponding parameter |
|---|---|---|
| ⚙Control mode | Selects whether to use scalar or vector control mode.<br>For information on scalar control mode, see section *Scalar motor control* on page *120*.<br>For information on vector control mode, see section *Vector control* on page *132*. | *99.04 Motor control mode* |
| Start mode: | Sets how the drive starts the motor (for example, pre-magnetize or not). For more information, see section *Start methods – DC magnetization* on page *123*. | *21 Start/stop mode* |
| Phase order: | If the motor turns in the wrong direction, change this setting to fix the direction instead of changing the phase order on the motor cable. | *99.16 Motor phase order* |
| Switching frequency | Sets the highest and the lowest allowed switching frequencies. For more information, see section *Switching frequency* on page *125*. | *97.01 Switching frequency reference 97.02 Minimum switching frequency* |
| U/f ratio: | The form of voltage to frequency ratio below field weakening point. For more information, see section *U/f ratio* on page *121*. | *97.20 U/F ratio* |
| IR compensation: | Sets how much to boost voltage at zero speed. Increase this for higher break-away torque. For more information, see section *IR compensation for scalar motor control* on page *121*. | *97.13 IR compensation* |
| Pre-heating | Turns pre-heating on or off. The drive can prevent condensation in a stopped motor by feeding it a fixed current (% of motor nominal current). Use in humid or cold conditions to prevent condensation. For more information, see section *Start methods – DC magnetization* on page *123*. | *21.14 Pre-heating input source 21.16 Pre-heating current* |
| Thermal protection estimated | The settings in this submenu are meant to protect the motor from overheating by automatically triggering a fault or warning above a certain temperature.<br>By default, motor thermal estimate protection is on. We recommend checking the values for the protection to function properly.<br>For more information, see section *Motor thermal protection* on page *126*. | *35 Motor thermal protection* |
| Thermal protection measured | The settings in this submenu are meant to protect the motor with a thermal measurement from overheating by automatically triggering a fault or warning above a certain temperature.<br>For more information, see section *Motor thermal protection* on page *126*. | *35 Motor thermal protection* |

4

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Flux braking: | Sets how much current to use for braking, ie, how the motor is magnetized before starting. For more information, see section *Flux braking* on page *122*. | *97.05 Flux braking* |
| Stall protection | The settings in this submenu are meant to protect the motor in a stall situation. You can adjust the supervision limits (current, frequency and time) and choose how the drive reacts to a motor stall condition. For more information, see section *Stall protection (parameters 31.24…31.28)* on page *177*. | *31.24 Stall function*<br>*31.25 Stall current limit*<br>*31.26 Stall speed limit*<br>*31.27 Stall frequency limit*<br>*31.28 Stall time* |

**4**

■ **Ramps**



```
Off◇          ⟳ ACH480        0.0 Hz
Ramps ─────────────────────────
 Acceleration time:        30.000 s
 Deceleration time:        30.000 s
 Stop mode:                  Coast
 Ramp time target frequency: 50.00 Hz
 ☐ Use two ramp sets
Back          16:01           Edit
```

Use the **Ramps** submenu to set up acceleration and deceleration settings.

See also section *Ramps* on page *112*.

**Note:** To set ramps, you also have to specify parameter *46.01 Speed scaling* (in speed control mode) or *46.02 Frequency scaling* (in frequency control mode).

The table below provides detailed information about the available setting items in the **Ramps** submenu.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Acceleration time: | This is the time between standstill and "scaling speed" when using the default ramps (set 1). | *23.12 Acceleration time 1*<br>*28.72 Freq acceleration time 1* |
| Deceleration time: | This is the time between standstill and "scaling speed" when using the default ramps (set 1). | *23.13 Deceleration time 1*<br>*28.73 Freq deceleration time 1* |
| Stop mode: | Sets how the drive stops the motor. | *21.03 Stop mode* |
| Ramp time target frequency: | Sets the maximum frequency for acceleration = the initial frequency for deceleration. For scalar control mode. | *46.02 Frequency scaling* |
| Ramp time target speed: | Sets the maximum speed for acceleration = the initial speed for deceleration. For vector control mode | *46.01 Speed scaling* |

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Use two ramp sets | Sets the use of a second acceleration/deceleration ramp set. If unselected, only one ramp set is used.<br><br>Note that if this selection is not enabled, the selections below are not available. | |
| Activate ramp set 2 | To switch ramp sets, you can either:<br>• use a digital input (low = set 1; high = set 2), or<br>• automatically switch to set 2 above a certain frequency/speed. | *23.11 Ramp set selection*<br>*28.71 Freq ramp set selection* |
| Acceleration time 2 | Sets the time between standstill and "scaling speed" when using ramp set 2. | *23.14 Acceleration time 2*<br>*28.74 Freq acceleration time 2* |
| Deceleration time 2 | Sets the time between standstill and "scaling speed" when using ramp set 2. | *23.15 Deceleration time 2*<br>*28.75 Freq deceleration time 2* |

**4**

■ **Limits**



Use the **Limits** submenu to set the allowed operating range. This function is intended to protect the motor, connected hardware and mechanics. The drive stays within these limits, no matter what reference value it gets.

See also section *Limits* on page *115*.

**Note:** To set ramps, you also have to specify parameter *46.01 Speed scaling* (in speed control mode) or *46.02 Frequency scaling* (in frequency control mode) in the *Ramps* menu, see page *54*; these limit parameters have no effect on ramps.

The table below provides detailed information about the available setting items in the **Limits** submenu.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Minimum frequency: | Sets the minimum operating frequency. Affects scalar control only. | *30.13 Minimum frequency* |
| Maximum frequency: | Sets the maximum operating frequency. Affects scalar control only. | *30.14 Maximum frequency* |

| Menu item | Description | Corresponding parameter |
|-----------|-------------|-------------------------|
| Minimum speed: | Sets the minimum operating speed. Affects vector control only. | *30.11 Minimum speed* |
| Maximum speed: | Sets the maximum operating speed. Affects vector control only. | *30.12 Maximum speed* |
| Minimum torque: | Sets the minimum operating torque. Affects vector control only. | *30.19 Minimum torque 1* |
| Maximum torque: | Sets the maximum operating torque. Affects vector control only. | *30.20 Maximum torque 1* |
| Maximum current: | Sets the maximum output current. | *30.17 Maximum current* |

**4**

■ **Communication**

```
Off◇        ⟳ ACH480        0.0 rpm
Communication ─────────────
 Embedded fieldbus          Off ►
 Fieldbus adapter      Not used ►



Back         16:02          Select
```

Use the **Communication** menu to set up and view communication through embedded fieldbus or fieldbus adapter.

**Embedded fieldbus**

| Off◇ | C⌐ ACH480 | 0.0 rpm |
|---|---|---|

**Embedded fieldbus** ─────

| Communication setup | ▶ |
|---|---|

| **Back** | 16:02 | **Select** |
|---|---|---|

| Off◇ | C⌐ ACH480 | 0.0 Hz |
|---|---|---|

**Communication setup** ─────

| EFB selection: | Not selected |
|---|---|

| **Back** | 16:02 | **Edit** |
|---|---|---|

| Off◇ | C⌐ ACH480 | 50.0 Hz |
|---|---|---|

**EFB selection:**

Not selected
**BACnet MS/TP**
Modbus RTU

| **Cancel** | 09:36 | **Save** |
|---|---|---|

Use the settings in the **Embedded fieldbus** submenu to use the drive with the following protocols:

- Modbus RTU
- BACnet MS/TP

You can also configure all the embedded fieldbus related settings via the parameters (parameter group *58 Embedded fieldbus*), but the purpose of the **Embedded fieldbus** submenu is to make the protocol configurations easier.

For N2 protocol, you have to do the configuration through parameters (parameter group *58 Embedded fieldbus*).

See also chapters

- *Modbus RTU control through the embedded fieldbus interface (EFB)* on page *209*
- *BACnet MS/TP control through the embedded fieldbus interface (EFB)* on page *239*
- *N2 control through the embedded fieldbus interface (EFB)* on page *271*.

The table below provides detailed information about the available setting items in the **Embedded fieldbus** submenu. Note that some of the items only become active once you have enabled embedded fieldbus.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| EFB selection | Select the protocol you want to use. | *58.01 Protocol enable* |

**4**

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Communication setup | To set up communication between the drive and the fieldbus master, define these settings and then select **Apply settings to embedded fieldbus module**. | *58 Embedded fieldbus*<br>*58.03 Node address* (Station ID)<br>*58.04 Baud rate*<br>*58.40 Device object ID*<br>*58.41 Max master*<br>*58.42 Max info frames*<br>*58.43 Max APDU retries*<br>*58.14 Communication loss action*<br>*58.15 Communication loss mode*<br>*58.16 Communication loss time*<br>*58.06 Communication control* |
| Pass through I/O -> Drive control setup | After applying the settings, press **Back** twice to see **Pass through I/O** on the **Communication** menu.Select it to go to the **Drive control setup** menu.<br><br>For relay output control, select **Relay outputs** and set the source of appropriate relays to EFB.<br>For analog output control, select **Analog outputs** configure the appropriate analog outputs. | *19.11 Ext1/Ext2 selection*<br><br>*20.01 Ext1 commands*<br>*22.11 Ext1 speed ref1*<br>*28.11 Ext1 frequency ref1*<br>*22.41 Speed ref safe*<br>*28.41 Frequency ref safe*<br><br>*46.01 Speed scaling*<br>*46.02 Frequency scaling*<br>*23.12 Acceleration time 1*<br>*23.13 Deceleration time 1*<br>*28.72 Freq acceleration time 1*<br>*28.73 Freq deceleration time 1* |
| Diagnostics | • Actual status:<br>• Status value:<br>• EFB data from client<br>  View what the drive EFB receives from the fieldbus master (PLC) / BACnet client (eg BMS).<br>• EFB data to client<br>  View what the drive EFB sends to the fieldbus master (PLC) / BACnet client (eg BMS). | *58.07 Communication diagnostics*<br><br>*58.08 Received packets*<br>*58.11 UART errors*<br>*58.12 CRC errors*<br>*58.13 Token counter58.18 EFB control word*<br>*03.09 EFB reference 1*<br><br>*58.09 Transmitted packets*<br>*58.19 EFB status word* |

**Fieldbus adapter**

```
Off◇          ⌒ ACH480        0.0 Hz
Fieldbus adapter ─────────────
☑ FBA enable
Communication setup              ▶



Back          16:04        Unselect
```
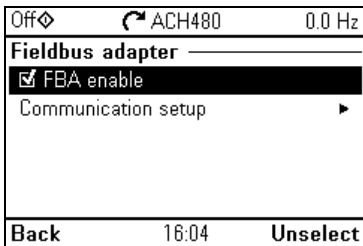
Use the settings in the **Fieldbus adapter** submenu to use the drive with the following fieldbus protocols, shown with the optional fieldbus adapter module required:

- BACnet/IP: FBIP-21 adapter
- CANopen: FCAN-01 adapter
- ControlNet: FCNA-01 adapter
- DeviceNet: FDNA-01 adapter
- EtherCAT: FECA-01 adapter
- Ethernet/IP: FEIP-21, FENA-11/-21 adapter
- ETH Pwrlink (Ethernet Powerlink): FEPL-02 adapter
- ModbusTCP: FMBT-21 adapter, FENA-11/-21 adapter
- PROFIBUS-DB: FBPA-01 adapter
- PROFINET IO: FPNO-21, FENA-11/-21 adapter
- Ethernet/IP: FENA-11/-21 adapter

You can also configure all the fieldbus related settings via the parameters (parameter groups *50 Fieldbus adapter (FBA)*, *51 FBA A settings*, *52 FBA A data in*, *53 FBA A data out*, *58 Embedded fieldbus*, but the purpose of the **Fieldbus adapter** submenu is to make the protocol configurations easier.

See also chapter *Fieldbus control through a fieldbus adapter* on page *285*.

The table below provides detailed information about the available setting items in the **Fieldbus adapter** submenu. Note that some of the items only became active once you have enabled fieldbus.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Fieldbus adapter | FBA enable: Select this if you want to use the drive with a fieldbus adapter. | *50.01 FBA A enable* |

**4**

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Communication setup | Select the module (protocol).<br>To set up communication between the drive and the fieldbus master, define these settings and then select **Apply settings to fieldbus module**. | *51.01 FBA A type*<br>*58.01 Protocol enable*<br>*51 FBA A settings*<br>*51.01 FBA A type*<br>*51.02 FBA A Par2*<br>*51.27 FBA A par refresh*<br>*51.31 D2FBA A comm status*<br>*50.13 FBA A control word*<br>*50.16 FBA A status word* |
| Drive control setup | Sets how a fieldbus master can control this drive, and how the drive reacts if the fieldbus communication fails. | *20.01 Ext1 commands*<br>*19.11 Ext1/Ext2 selection*<br>*22.11 Ext1 speed ref1*<br>*28.11 Ext1 frequency ref1*<br>*22.41 Speed ref safe*<br>*28.41 Frequency ref safe*<br>*50.03 FBA A comm loss t out*<br>*46.01 Speed scaling*<br>*46.02 Frequency scaling*<br>*23.12 Acceleration time 1*<br>*23.13 Deceleration time 1*<br>*28.72 Freq acceleration time 1*<br>*28.73 Freq deceleration time 1*<br>*51.27 FBA A par refresh* |
| Received data from master | Sets what the drive's fieldbus module expects to receive from the fieldbus master (PLC). After changing these settings, select **Apply settings to fieldbus module**. | *50.13 FBA A control word*<br>*53 FBA A data out*<br>*51.27 FBA A par refresh* |
| Send data to master | Sets what the drive's fieldbus module sends to the fieldbus master (PLC). After changing these settings, select **Apply settings to fieldbus module**. | *50.16 FBA A status word*<br>*52 FBA A data in*<br>*51.27 FBA A par refresh* |
| Apply settings to fieldbus module | Applies modified settings to the fieldbus module. | *51.27 FBA A par refresh* |

### ■ PID control

```
Off◇          ⌒ ACH480        0.0 Hz
PID control ─────────────
⚒PID assistant
☑ Use PID control
Activate PID control f...: Always acti...
Start/stop/dir from:      Not selected
Unit:                      PID unit 1
Feedback:                 0.00 PID unit 1
Back          16:01          Select
```

The **PID** submenu contains settings and actual values for the process PID controller. PID is only used in remote control.

See also section .

The table below provides detailed information about the available setting items in the **PID** submenu.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| ⚒PID assistant | Configures secondary control location to use PID control.<br>Feedback: AI2. Adjust the scaling of AI2 signal for feedback, if required.<br>Setpoint: Select a constant value, control panel or AI1. If you selected AI2, adjust the scaling of AI1 signal for setpoint.<br>Start/stop: DI | |
| Use PID control: | Select if PID control is used or not. | *40.07 Process PID operation mode* |
| Activate PID control from | Sets where the drive gets the signal to switch between control locations (Ext1 and Ext2) | *19.11 Ext1/Ext2 selection* |
| Start/stop/dir from: | Selects the source for start, stop and direction. | *20.01 Ext1 commands*<br>*20.02 Ext1 start trigger type*<br>*20.03 Ext1 in1 source*<br>*20.04 Ext1 in2 source*<br>*20.05 Ext1 in3 source*<br>*20.06 Ext2 commands*<br>*20.07 Ext2 start trigger type*<br>*20.08 Ext2 in1 source*<br>*20.09 Ext2 in2 source*<br>*20.10 Ext2 in3 source* |
| Unit: | PID unit 1 (PID customer unit). Sets the text shown as the unit for setpoint, feedback and deviation. | |
| PID status: | View process PID status. | *40.06 Process PID status word* |

**4**

**4**

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Feedback: | View or configure process PID feedback, ie, the measured value. | *40.02 Process PID feedback actual*<br>*40.08 Set 1 feedback 1 source*<br>*40.11 Set 1 feedback filter time* |
| Setpoint: | View or configure the process PID setpoint, ie, the target process value.<br>You can also use a constant setpoint value instead of (or in addition to) an external setpoint source. When a constant setpoint is active, it overrides the normal setpoint. | *40.03 Process PID setpoint actual*<br>*40.16 Set 1 setpoint 1 source*<br>*40.26 Set 1 setpoint min*<br>*40.27 Set 1 setpoint max* |
| Tuning | The **Tuning** submenu contains settings for gain, integration time and derivation time.<br>1. Make sure it is safe to start the motor and run the actual process.<br>2. Start the motor in remote control.<br>3. Change setpoint by a small amount.<br>4. Watch how feedback reacts.<br>5. Adjust gain/integration/derivation.<br>6. Repeat steps 3-5 until feedback reacts as desired. | *40.04 Process PID deviation actual*<br>*40.32 Set 1 gain*<br>*40.33 Set 1 integration time*<br>*40.34 Set 1 derivation time*<br>*40.35 Set 1 derivation filter time* |
| Increase output: | Select whether deviation means "feedback minus setpoint" or "setpoint minus feedback":<br>• Feedback < Setpoint: Drive increases motor speed when feedback signal is below setpoint. Examples: Supply fan or pump.<br>• Feedback > Setpoint: Drive increases motor speed when feedback signal is greater than setpoint. Example: Cooling tower. | *40.04 Process PID deviation actual*<br>*40.31 Set 1 deviation inversion* |
| Output | View the process PID output or set its range. | *40.01 Process PID output actual*<br>*40.36 Set 1 output min*<br>*40.37 Set 1 output max* |
| Sleep function | The sleep function can be used to save energy by stopping the motor during low demand. By default, sleep function is disabled. If enabled, the motor automatically stops when demand is low, and starts again when deviation grows too large. This saves energy when rotating the motor at low speeds would be useless.<br>See section *Sleep and boost functions for process PID control* on page *142*. | *40.43 Set 1 sleep level*<br>*40.44 Set 1 sleep delay*<br>*40.45 Set 1 sleep boost time*<br>*40.46 Set 1 sleep boost step*<br>*40.47 Set 1 wake-up deviation*<br>*40.48 Set 1 wake-up delay* |

■ **Override**

```
Off◇        ⌒ ACH480        0.0 Hz
Override
Override mode:              Disabled
Activate override from:     Not used
Reference from:   Override frequency
Override frequency:          0.0 Hz
Direction selection:        Forward
Back           16:01           Edit
```

The **Override** submenu contains settings the override function

See also section *Override* on page *94*.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| | Override mode<br>Activate override from:<br>Reference from:<br>Override frequency:<br>Direction selection:<br>Override safeties: | *70.02 Override enable*<br>*70.02 Override activation source*<br>*70.04 Override reference source*<br>*70.06 Override frequency*<br>*70.05 Override direction*<br>*70.10 Override enables selection* |
| | Use autoreset for critical faults<br>Wait between reset attempts:<br>Max attempts: | *70.20 Override fault handling*<br>*70.22 Override auto reset time*<br>*70.21 Override auto reset trials* |

**4**

■ **Fault functions**

| Off◇ | ⟲ ACH480 | 0.0 Hz |
|---|---|---|
| **Fault functions** | | |
| Autoreset faults | | On ▶ |
| ☑ Additional fault reset | | |
| Reset from keypad and | | DI3 ⓘ |
| ☐ Enable AI2 low detection | | |
| If any cable failure detected | | Custom |
| If EFB communication fails | | |
| **Back** | 16:01 | **Unselect** |

**4**

The **Fault functions** submenu contains settings for resetting faults automatically or manually.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Autoreset faults | Reset faults automatically. For more information, see section *Sleep and boost functions for process PID control* on page *142*. | *31.12 Autoreset selection* *31.14 Number of trials* *31.15 Total trials time* *31.16 Delay time* |
| Additional fault reset | You can reset an active fault via I/O: a rising pulse in the selected input means reset. A fault can be reset from the fieldbus even if **Reset faults manually** is unselected. | *31.11 Fault reset selection* |
| Reset from keypad and... | Define from where you want to reset faults manually. Note that this submenu is active only if you have selected to reset faults manually. | *31.11 Fault reset selection* |
| Enable AI2 low detection | Enable AI2 minimum limit supervision AI2 < MIN. | *12.04 AI supervision selection*, bit 2 |
| If any cable failure detected | Define action to be taken when AI2 low detection is enabled and AI2 is less than the minimum limit (AI2 < MIN). | *12.03 AI supervision function* |
| If EFB communication fails: | Define action to be taken if EFB communication fails. | *58.14 Communication loss action* |
| If EFB communication under monitoring: | Define which message types reset the timeout counter for detecting an EFB communication loss. | *58.15 Communication loss mode* |
| Ignore EFB failures shorter than: | Define a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified in *If EFB communication fails:* is taken. | *58.16 Communication loss time* |

■ **Security**

```
Off◇        ⌒ ACH480        0.0 Hz
┌─────────────────────────────────────┐
│ ❶ Security                           │
│ Security menu allows you to prevent  │
│ unauthorized tampering of drive      │
│ configuration. PLEASE NOTE! If you   │
│ select "Disable file download" and   │
│ forget password there is no way to   │
│ reset security settings.             │
├─────────────────────────────────────┤
│ Back         16:01          Next     │
└─────────────────────────────────────┘
```

The **Security** submenu is a protected menu that you can open with the user pass code. The menu lets you prevent actions and functionalities with the user lock. You can also change the user lock pass code.

See also section *User lock* on page *183*.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Unlock this menu / Lock this menu | You have to enter the user passcode to unlock the menu. The default passcode is "10000000". While you have the user lock open, warning *A6B0 User lock is open* is active.<br><br>After making your changes in the menu, select row Lock this menu and press **Select**. | *96.02 Pass code* |
| Lock all parameters<br>Lock override settings<br>Disable backup and restore<br>Disable OEM access level<br>Disable ABB access level<br>Disable file download | | *96.102 User lock functionality* |
| ⚒Change security passcode | **Note:** You must change the default user pass code to maintain a high level of cybersecurity. <u>Store the code in a safe place – the protection cannot be disabled even by ABB if the code is lost.</u><br>Enter first the new passcode and then re-enter the new passcode to confirm it. | *96.02 Pass code*<br>*96.100 Change user pass code*<br>*96.101 Confirm user pass code* |

■ **Advanced functions**

```
Off◇        ⟳ ACH480      0.0 Hz
Advanced functions ─────────
External events              ▶
Supervision                  ▶
Timed functions       Enabled ▶
User sets                    ▶
⚒First start assistant
Back          16:01      Select
```

**4**

The **Advanced functions** submenu contains settings for advanced functions, such as triggering or resetting custom faults via I/O, signal supervision, using the drive with timed functions, or switching between several entire sets of settings. In addition you can run the First start assistant from this submenu.

The table below provides detailed information about the available setting items in the **Advanced functions** submenu.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| External events | Enables you to define custom faults or warnings you can trigger via digital input. The texts of these messages are customizable.<br><br>For more information, see section *External events* on page *116*. | *31.01 External event 1 source*<br>*31.02 External event 1 type*<br>*31.03 External event 2 source*<br>*31.04 External event 2 type*<br>*31.05 External event 3 source*<br>*31.06 External event 3 type* |

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Supervision | You can select three signals to be supervised. If a signal is outside predefined limits a fault or warning is generated. For complete settings, see group *32 Supervision* on page *432*.<br><br>For more information, see section *Signal supervision* on page *139*. | *32.01 Supervision status*<br>*32.05 Supervision 1 function*<br>*32.06 Supervision 1 action*<br>*32.07 Supervision 1 signal*<br>*32.09 Supervision 1 low*<br>*32.10 Supervision 1 high*<br>*32.11 Supervision 1 hysteresis*…<br>*32.25 Supervision 3 function*<br>*32.26 Supervision 3 action*<br>*32.27 Supervision 3 signal*<br>*32.29 Supervision 3 low*<br>*32.30 Supervision 3 high*<br>*32.31 Supervision 3 hysteresis* |
| Timed functions | Enables using the drive with timed functions. For complete settings, see group *34 Timed functions* on page *439*.<br><br>For more information, see section *Timed functions* on page *118*. | *34.100 Timed function 1*<br>*34.101 Timed function 2*<br>*34.102 Timed function 3*<br>*34.11 Timer 1 configuration*<br>*34.12 Timer 1 start time*<br>*34.13 Timer 1 duration*<br>…<br>*34.44 Timer 12 configuration*<br>*34.45 Timer 12 start time*<br>*34.46 Timer 12 duration*<br>*34.111 Boost time activation source*<br>*34.112 Boost time duration* |
| User sets | This submenu enables you to save four sets of settings for easy switching.<br><br>For more information about user sets, see section *Data storage parameters* on page *181*. | *96.11 User set save/load*<br>*96.10 User set status*<br>*96.12 User set I/O mode in1*<br>*96.13 User set I/O mode in2* |

**4**

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Confirmation for HAND/OFF | Selects if you have to press Hand and Off buttons twice within five seconds to operate. The panel shows a message about pressing twice after the first press. | |
| | This selection can be used to prevent accidental Hand and Off button presses. | |
| | If Hand and/or Off buttons are disabled with parameters *19.18 HAND/OFF disable source* and *19.19 HAND/OFF disable action*, this setting has no effect. | |
| ⚒First start assistant | Runs the same First start assistant that is used to commission the drive. | |

■ **Clock, region, display**

```
Off◇      ⤴ ACH480      50.0 Hz
Clock, region, display ─────
Select drive                ▶
Language                    ▶
Date & time                 ▶
Units                       ▶
Drive name              ACH480
─────────────────────────────
Back          09:55      Select
```
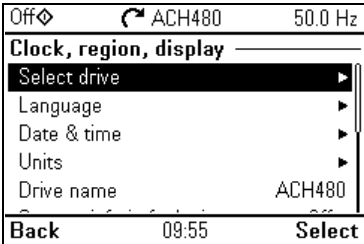
The **Clock, region, display** submenu contains settings for language, date and time, display (such as brightness) and settings for changing how information is displayed on screen.

The table below provides detailed information about the available setting items in the **Clock, region, display** submenu.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Select drive | | |
| Language | Change the language used on the control panel screen. Note that the language is loaded from the drive so this takes some time. | *96.01 Language* |
| Date & time | Set the time and date, and their formats. | |
| Units | Select the units used for power, temperature, torque and currency. | *96.16 Unit selection* |
| Drive name | The drive name defined in this setting is shown in the status bar at the top of the screen while using the drive. If more than one drives are connected to the control panel, the drive names make it easy to identify each drive. It also identifies any backups you create for this drive. | |

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Contact info in fault view | Define a fixed text that is shown during any fault (for example, who to contact in case of a fault). If a fault occurs, this information appears on the panel screen (in addition to the fault-specific information). | |
| Display settings | Adjust the brightness, contrast and display power save delay of the panel screen or to invert white and black. | |
| Show in lists | Show or hide the numeric IDs of:<br>• parameters and groups<br>• option list items<br>• bits<br>• devices in **Options** > **Select drive** | |
| Edit Home view | Select the parameters displayed in the Home view, with display style, decimals, name, unit, minimum and maximum. | |
| Show inhibit pop-up | Enables or disables pop-up views showing information on inhibits, for example, when you try to start the drive but it is prevented. | |

■ **Reset to defaults**



```
Off◇        ⟳ ACH480      0.0 Hz
Reset to defaults ──────────
⮌Reset fault and event logs
⮌Reset home view layout
⮌Reset non-HW parameters
⮌Reset all fieldbus settings
⮌Reset motor data and ID run resu...
Back         16:01        Select
```
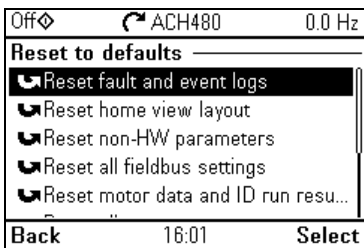
The **Reset to defaults** submenu enables you to reset parameters and other settings.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Reset fault and event logs | Clears all events from the drive's fault and event logs. | *96.51 Clear fault and event logger* |
| Reset home view layout | Restores the home view layout back to show the values of the default parameters defined by the control macro in use. | *96.06 Parameter restore*, selection *Reset home view* |

**4**

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Reset non-HW parameters | Restores all editable parameter values to default values, except<br><br>• motor data and ID run results<br>• I/O extension module settings<br>• end user texts, such as customized warnings and faults, and the drive name<br>• control panel/PC communication settings<br>• fieldbus adapter settings<br>• parameter *95.01 Supply voltage*<br>• differentiated defaults implemented by parameters *95.20 HW options word 1* and *95.21 HW options word 2*<br>• user lock configuration parameters *96.100…96.102*. | *96.06 Parameter restore*, selection *Restore defaults* |
| Reset all fieldbus settings | Restores all fieldbus and communication related settings to default values.<br><br>**Note:** Fieldbus, control panel and PC tool communication are interrupted during the restore. | *96.06 Parameter restore*, selection *Reset all fieldbus settings* |
| Reset motor data and ID run results | Restores all motor nominal values and motor ID run results to default values. | *96.06 Parameter restore*, selection *Reset motor data* |
| Reset all parameters | Restores all editable parameter values to default values, except<br><br>• end user texts, such as customized warnings and faults, and the drive name<br>• control panel/PC communication settings<br>• parameter *95.01 Supply voltage*<br>• differentiated defaults implemented by parameters *95.20 HW options word 1* and *95.21 HW options word 2*<br>• user lock configuration parameters *96.100…96.102*<br>• group *49 Panel port communication* parameters. | *96.06 Parameter restore*, selection *Clear all* |
| Reset end user texts | Restores all end user texts to default values, including the drive name, contact info, customized fault and warning texts, PID unit and currency unit. | *96.06 Parameter restore*, selection *Reset end user texts* |
| Reset first start assistant | Resets first start assistant to the initial state. | |
| Reset all to factory defaults | Restores all drive parameters and settings back to initial factory values, except<br><br>• differentiated defaults implemented by parameters *95.20 HW options word 1* and *95.21 HW options word 2*. | *96.06 Parameter restore*, selection *All to factory defaults* |

## I/O menu

```
Off◇          ↻ ACH480         0.0 Hz
 I/O ──────────────────────────────
 DI1: 0                  Start/stop ▸
 DI2: 0                    Not used ▸
 DI3: 0      Used in several places ▸
 DI4: 1        Start interlock 1 high ▸
 DI5: 0                    Not used ▸
 ─────────────────────────────────
 Back          16:02          Select
```

To go the **I/O** menu from the Home view, select **Menu > I/O**.

Use the **I/O** menu to make sure that the actual I/O wiring matches the I/O use in the control program. It answers the questions:

- What is each input being used for?
- What is the meaning of each output?

You can also add and remove use of inputs and outputs.

In the **I/O** menu, each row provides the following information:

- Terminal name and number
- Electrical status
- Logical meaning of the drive

Each row also provides a submenu that provides further information on the menu item and lets you make changes to the I/O connections.

The table below provides detailed information about the contents of the different submenus available in the **I/O** menu.

| Menu item | Description |
|-----------|-------------|
| DI1 | This submenu lists the functions that use DI1 as input. |
| DI2 | This submenu lists the functions that use DI2 as input. |
| DI3 | This submenu lists the functions that use DI3 as input. |
| DI4 | This submenu lists the functions that use DI4 as input. |
| DI5 | This submenu lists the functions that use DI5 as input. |
| DI6 | This submenu lists the functions that use DI6 or FI as input. The connector can be used as either digital input or frequency input. |
| AI1 | This submenu lists the functions that use AI1 as input. |
| AI2 | This submenu lists the functions that use AI2 as input. |
| RO1 | This submenu lists what information goes into relay output 1. |
| RO2 | This submenu lists what information goes into relay output 2. |
| RO3 | This submenu lists what information goes into relay output 3. |
| AO1 | This submenu lists what information goes into AO1. |
| AO2 | This submenu lists what information goes into AO2. |

# Diagnostics menu

```
Off◇          ⊗ ACH480        0.0 Hz
Diagnostics ─────────────────────
Drive actual values              ▶
Active faults                    ▶
Active warning ACH480
Active inhibits                  ▶
Fault & event log                ▶
Back          16:03         Select
```
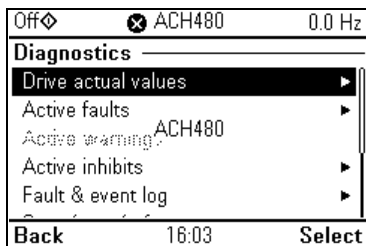
To go the **Diagnostics** menu from the Home view, select **Menu > Diagnostics**.

The **Diagnostics** menu provides you with diagnostic information, such as faults and warnings, and helps you to resolve potential problems. Use the menu to make sure that the drive setup is functioning correctly.

To clear the fault and event logger, select **Menu > Primary settings > Reset to defaults > Reset fault and event logs**, or set parameter *96.51 Clear fault and event logger* to value *Reset*.

The table below provides detailed information about the contents of the different views available in the **Diagnostics** menu.

| Menu item | Description |
|---|---|
| Drive actual values | Shows actual values: *01.01 Motor speed used*, *01.06 Output frequency*, *01.07 Motor current*, *01.10 Motor torque*, *01.11 DC voltage*, *01.13 Output voltage*, *01.14 Output power*, *06.01 Main control word*, *06.11 Main status word*, *06.22 HVAC status word*, *19.01 Actual operation mode*, *05.01 On-time counter*, *05.02 Run-time counter*, *05.04 Fan on-time counter*, *05.10 Control board temperature*, *05.11 Inverter temperature*, *35.01 Motor estimated temperature*, *35.02 Measured temperature 1*, *35.03 Measured temperature 2*, *40.01 Process PID feedback actual*, *40.02 Process PID feedback actual*, *40.03 Process PID setpoint actual*, *40.04 Process PID deviation actual*, *40.07 Process PID operation mode*. |
| Active faults | This view shows the currently active faults and provides instructions on how to fix and reset them. |
| Active warnings | This view shows the currently active warnings and provides instructions on how to fix them. |
| Active inhibits | This view shows up to five simultaneous active start inhibits and how to fix them. |
| Fault & event log | This view lists the faults, warnings and other events that have occurred in the drive. |
|  | Press **Details** to see, for each stored fault, the fault code, time and values of nine parameters (actual signals and status words) stored at the time of the fault. The values of the parameters for the latest fault are in parameters *05.80…05.89*. |

| Menu item | Description |
|---|---|
| Start, stop, reference summary | This view shows where the drive is currently taking its start and stop commands and reference. The view is updated in real time. |
| | If the drive is not starting or stopping as expected, or runs at an undesired speed, use this view to find out where the control comes from. |
| Limit status | This view describes any limits currently affecting operation. |
| | If the drive is running at undesired speed, use this view to find out if any limitations are active. |
| Communication status | This view provides status information and sent and received data from fieldbus for troubleshooting. |
| Motor summary | This view provides motor information: nominal values, control mode and whether ID run has been completed. |

**4**

# System info menu

```
Off◇         ⌐ ACH480        0.0 Hz
System info ─────────────
Drive                              ▶
Control panel                      ▶
QR code                            ▶


Back          16:03         Select
```

To go the **System info** menu from the Home view, select **Menu > System info**.

The **System info** menu shows information of the drive and the control panel. In problem situations you can also request the drive to generate a QR code for ABB service, so they can better assist you.

The table below provides detailed information about the available setting items in the **System info** menu.

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Drive | Panel bus id:<br>Product id:<br>Product type:<br>FW version:<br>LP version:<br>Backup version: | *07.05 Firmware version*<br>*07.07 Loading package version* |
| Control panel | Product type:<br>HW version:<br>FW version:<br>Serial number:<br>Manufacturing date: | |

| Menu item | Description | Corresponding parameter |
|-----------|-------------|-------------------------|
| QR code | The drive generates a QR code (or a series of QR codes), which contains drive identification data, information on the latest events, and values of status and counter parameters. You can read the QR code with a mobile device containing the ABB service application, which then sends the QR code to ABB for analysis. | |

# Energy efficiency menu

**4**

```
Off◇         ⌒ ACH480        0.0 Hz
Energy efficiency ─────────
Total energy saved        0.0 kWh ▶
Used, last hour          0.00 kWh ▶
Used, last day           0.00 kWh ▶
Used, last month         0.00 kWh ▶
Used, total               0.0 kWh ▶
Back          16:03        Select
```

To go the **Energy efficiency** menu from the Home view, select **Menu > Energy efficiency**.

Use the **Energy efficiency** menu to view energy and power values, view and change settings of the load analyzer (= amplitude and peak value loggers), for example, view graphical representation of the two amplitude loggers, as well as and change energy calculation settings.

See also sections *Energy efficiency* on page *172* and *Load analyzer* on page *173*.

The table below provides detailed information about the available setting items in the **Energy efficiency** menu.

| Menu item | Description | Corresponding parameter |
|-----------|-------------|-------------------------|
| Total energy saved | Energy saved in kWh compared to direct-on-line motor connection.<br>Corresponding money saved.<br>Corresponding $CO_2$ saved. | *45.04 Saved energy*<br>*45.07 Saved amount*<br>*45.10 Total saved CO2* |
| Used, last hour | Energy used during the last hour (the last 60 minutes).<br>Average power during the last hour (value of *45.26* divided by one hour). | *45.26 Hourly total energy (resettable)* |
| Used, last day | Energy used during the previous day (between midnight of the previous day and midnight of the present day).<br>Average power during the last day (value of *45.30* divided by 24 hours). | *45.30 Last day total energy* |

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Used, last month | Energy used during the previous month (between midnight of the first day or the previous month and midnight of the first day of the present month).<br><br>Average power during the last month (value of *45.30* divided by 732 hours). | *45.35 Last month total energy* |
| Used, total | All-time total used energy<br><br>Resettable total used energy | *01.54 Cumulative inverter energy*<br>*01.58 Cumulative inverter energy (resettable)* |
| Peak power | Hourly peak power (during the last 60 minutes)<br>Time of the hourly peak time<br>Daily peak power (during the previous day)<br>Time of the daily peak time<br>Monthly peak power (during the previous month)<br>Time of the monthly peak time<br>Date of the monthly peak time<br>All-time peak power<br>Time of all time peak power<br>Date of all time peak power | *45.24 Hourly peak power value*<br>*45.25 Hourly peak power time*<br>*45.27 Daily peak power value (resettable)*<br>*45.28 Daily peak power time*<br>*45.31 Monthly peak power value (resettable)*<br>*45.33 Monthly peak power time*<br>*45.32 Monthly peak power date*<br>*45.36 Lifetime peak power value*<br>*45.38 Lifetime peak power time*<br>*45.37 Lifetime peak power time* |
| Load profile | Amplitude logger 1 (graphical representation)<br>Amplitude logger 2 (graphical representation)<br>Amplitude loggers show load distribution diagrams: how much of the drive's running time was spent at each load level.<br>Load profile configuration<br><br>Peak value logger<br>The peak value logger lists maximum momentary load levels. | *36.06 AL2 signal source*<br>*36.07 AL2 signal scaling*<br>*36.09 Reset loggers*<br>*36.01 PVL signal source*<br>*36.02 PVL filter time*<br>*36.10 PVL peak value*<br>*36.11 PVL peak date*<br>*36.12 PVL peak time*<br>*36.13 PVL current at peak*<br>*36.14 PVL DC voltage at peak*<br>*36.15 PVL speed at peak*<br>*36.16 PVL reset date*<br>*36.17 PVL reset time* |

**4**

| Menu item | Description | Corresponding parameter |
|---|---|---|
| Calculation settings | Energy optimizer<br>Energy tariff 1<br>Energy tariff 2<br>Tariff selection<br>$CO_2$ conversion<br>Comparison power<br>Reset saved energy counters<br>Reset total used counter | *45.11 Energy optimizer* (Disable or Enable)<br>*45.12 Energy tariff 1*<br>*45.13 Energy tariff 2*<br>*45.14 Tariff selection*<br>*45.18 CO2 conversion factor*<br>*45.19 Comparison power*<br>*45.21 Energy calculations reset*<br>Enter 0 to *01.58 Inverter kWh counter (resettable)* |

**4**

## Backups menu



To go to the **Backups** menu from the Home view, select **Backups**.

For backups and restores, see section *Backup and restore* on *180* page.

5

# Default I/O configuration

## Contents of this chapter

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

You select default configurations in the **Primary settings** menu.

To get to the **Primary settings** menu from the Home view, first select **Menu** to go the **Main** menu, and then select **Primary settings**. Select **Start, stop, reference**, and **How do you control?** then shows the default configurations (Direct control via I/O means the HVAC default configuration.)
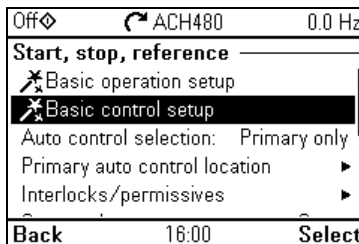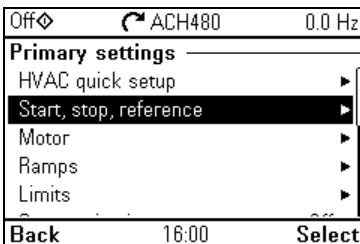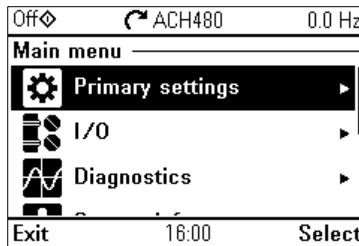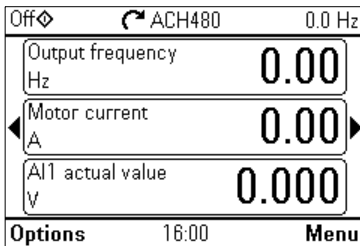
## HVAC default



This is the default configuration for HVAC (factory default). The HVAC default direct 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 (operator keypad).

**Note:** You select default configurations in the **Primary settings** menu, not with parameter *96.04 Macro select*. This parameter is only used for Drive customizer support



HVAC default



HVAC default

**Input signals**
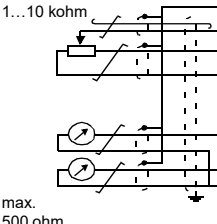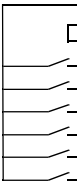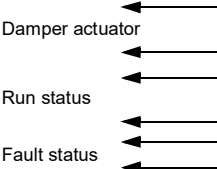
- Analog frequency/speed reference (AI1)
- Start/stop selection (DI1)
- Constant speed/frequency selection (DI3)
- Start interlock 1 (DI4)

**Output signals**

- Analog output AO1: Output frequency
- Analog output AO2: Motor current
- Relay output 1: Damper control
- Relay output 2: Running
- Relay output 3: Fault (-1)

**5**

## Default control connections for the HVAC default

For the standard I/O configuration (drive base unit and RIIO-01 I/O module). The fixed terminals of the base unit are marked in the table:

| Terminal | | Description | | Fixed |
|---|---|---|---|---|
| | | **Reference voltage and analog I/O** | | |
| 1…10 kohm | SCR | Signal cable shield (screen) | | |
| | AI1 | Output frequency/speed reference: 0...10 V | | |
| | AGND | Analog input circuit common | | |
| | +10 V | Reference voltage 10 V DC | | |
| | AI2 | Actual feedback: 0...20 mA | | |
| | AGND | Analog input circuit common | | |
| | AO1 | Output frequency: 0...20 mA | | |
| | AO2 | Output current: 0...20 mA | | |
| max. 500 ohm | AGND | Analog output circuit common | | |
| | | **Aux. voltage output and programmable digital inputs** | | |
| | +24 V | Aux. voltage output +24 V DC, max. 200 mA | | X |
| | DGND | Aux. voltage output common | | X |
| | DCOM | Digital input common for all | | X |
| | DI1 | Stop (0)/Start (1) | | X |
| | DI2 | Not configured | | X |
| | DI3 | Constant frequency/speed selection | | |
| | DI4 | Start interlock 1 (1 = allow start) | | |
| | DI5 | Not configured | | |
| | DI6 | Not configured | | |
| | | **Relay outputs** | | |
| Damper actuator | RO1C | Damper control 250 V AC/30 V DC, 2 A | Energize damper RO1C connected to RO1B | X |
| | RO1A | | | X |
| | RO1B | | | X |
| Run status | RO2C | Running 250 V AC/30 V DC, 2 A | Running RO2C connected to RO2B | |
| | RO2A | | | |
| | RO2B | | | |
| Fault status | RO3C | Fault (-1) 250 V AC/30 V DC, 2 A | Fault condition RO3C connected to RO3A | |
| | RO3A | | | |
| | RO3B | | | |
| | | **Embedded fieldbus** | | |
| | B+ | Embedded fieldbus, EFB (EIA-485) | | |
| | A- | | | |
| | DGND | | | |
| | TERM&BIA | Termination switch and bias resistor switch | | |
| | | **Safe torque off** | | |
| | SGND | Safe torque off. Factory connection. Both circuits must be closed for the drive to start. | | X |
| | IN1 | | | X |
| | IN2 | | | X |
| | OUT1 | | | X |
| | | | | |
| | +24V | Auxiliary voltage output. The alternative terminals have the same supply as the base unit. | | |
| | DGND | | | |
| | DCOM | | | |

Terminal sizes: 0.14…1.5 mm$^2$ (26…16 AWG)
Tightening torques: 0.5…0.6 N·m (4.4…5.3 lbf·in)

# PID control, single motor

This configuration offers quick setup of PID control for keeping flow or pressure constant. It requires a measurement feedback from the process, and the feedback signal must be connected to the analog input 2 (AI2). You can specify the setpoint to come from analog input 1 (AI1) or from the control panel (operator keypad) in the Auto mode, or you can set a constant setpoint.

In the Hand/Off mode, the speed reference and start command are given through the control panel. In the Hand mode the speed reference is the direct speed reference and a PID setpoint value.

After you have commissioned the drive to use the PID control operation, single motor, you can adjust Process PI(D) in the **PID control** submenu of the **Primary settings** menu (see page *61*).

**Note:** You select default configurations in the **Primary settings** menu, not with parameter *96.04 Macro select*. This parameter is only used for Drive customizer support

| | |
|---|---|
| Off◇   C ACH480   0.0 Hz | Off◇   C ACH480   0.0 Hz |
| **How do you control?** ▭ | **PID control** |
| Press [?] for help. | ⚒PID assistant |
| Direct control via I/O | ☑ Use PID control |
| **PID control, single motor** | Activate PID control f...: Always acti... |
| | Start/stop/dir from:   Not selected |
| | Unit:   PID unit 1 |
| **Back**   16:00   **Next** | **Back**   16:01   **Select** |
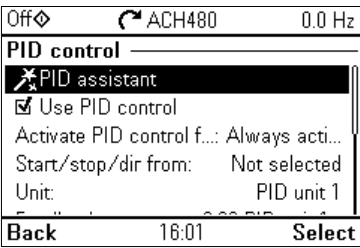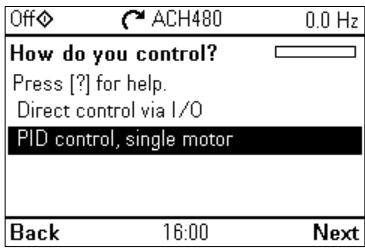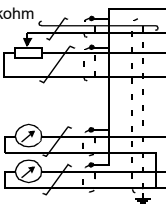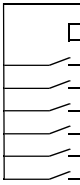
### Input signals

- Setpoint selected from: control panel setpoint/ constant setpoint / analog input (AI1)
- PID feedback (AI2)
- Start/stop selection (DI1)
- Constant speed/frequency selection (DI3)
- Start interlock 1 (DI4)

### Output signals

- Analog output AO1: Output frequency
- Analog output AO2: Motor current
- Relay output 1: Damper control
- Relay output 2: Running
- Relay output 3: Fault (-1)

## Default control connections for the PID control, single motor

For the standard I/O configuration (drive base unit and RIIO-01 I/O module). The fixed terminals of the base unit are marked in the table:

| Terminal | | Description | | Fixed |
|---|---|---|---|---|
| | | **Reference voltage and analog I/O** | | |
| 1…10 kohm | SCR | Signal cable shield (screen) | | |
| | AI1 | Panel setpoint ref/ Constant setpoint: 0…10 V | | |
| | AGND | Analog input circuit common | | |
| | +10 V | Reference voltage 10 V DC | | |
| | AI2 | PID feedback: 0…20 mA | | |
| | AGND | Analog input circuit common | | |
| | AO1 | Output frequency: 0...20 mA | | |
| | AO2 | Output current: 0...20 mA | | |
| max. 500 ohm | AGND | Analog output circuit common | | |
| | | **Aux. voltage output and programmable digital inputs** | | |
| | +24 V | Aux. voltage output +24 V DC, max. 200 mA | | X |
| | DGND | Aux. voltage output common | | X |
| | DCOM | Digital input common for all | | X |
| | DI1 | Stop (0)/Start (1) | | X |
| | DI2 | Not configured | | X |
| | DI3 | Constant frequency/speed selection | | |
| | DI4 | Start interlock 1 (1 = allow start) | | |
| | DI5 | Not configured | | |
| | DI6 | Not configured | | |
| | | **Relay outputs** | | |
| Damper actuator | RO1C | Damper control 250 V AC/30 V DC, 2 A | Energize damper RO1C connected to RO1B | X |
| | RO1A | | | X |
| | RO1B | | | X |
| Run status | RO2C | Running 250 V AC/30 V DC, 2 A | Running RO2C connected to RO2B | |
| | RO2A | | | |
| | RO2B | | | |
| Fault status | RO3C | Fault (-1) 250 V AC/30 V DC, 2 A | Fault condition 25 connected to 26 | |
| | RO3A | | | |
| | RO3B | | | |
| | | **Embedded fieldbus** | | |
| | B+ | Embedded fieldbus, EFB (EIA-485) | | |
| | A- | | | |
| | DGND | | | |
| | TERM&BIA | Termination switch and bias resistor switch | | |
| | | **Safe torque off** | | |
| | SGND | Safe torque off. Factory connection. Both circuits must be closed for the drive to start. | | X |
| | IN1 | | | X |
| | IN2 | | | X |
| | OUT1 | | | X |
| | | | | |
| | +24V | Auxiliary voltage output. The alternative terminals have the same supply as the base unit. | | |
| | DGND | | | |
| | DCOM | | | |

Terminal sizes: 0.14…1.5 mm$^2$ (26…16 AWG)
Tightening torques: 0.5…0.6 N·m (4.4…5.3 lbf·in)

**5**

# 6

# Program features

## What this chapter contains

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

## Local control vs. external control

The ACH480 has two main control locations: external and local. In local control there are additionally three different modes: Off, Hand and Auto modes.

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 diagram shows the state transitions when you press the Hand, Off or Auto button:
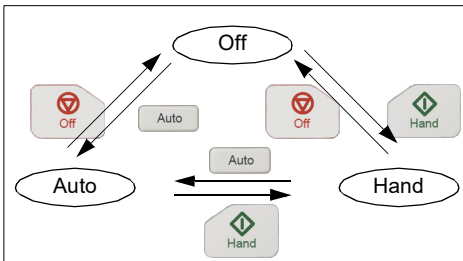


The control location can also be selected in the PC tool.

**Note:** When you restart the drive while fault *7081 Control panel loss* is active, the mode changes from Hand or Off to Auto.

**Note:** Override function overrides the actual running mode.

1) Extra inputs/outputs can be added by installing an optional I/O extension module (RIIO-01, BIO-01) in drive slot.

**6**
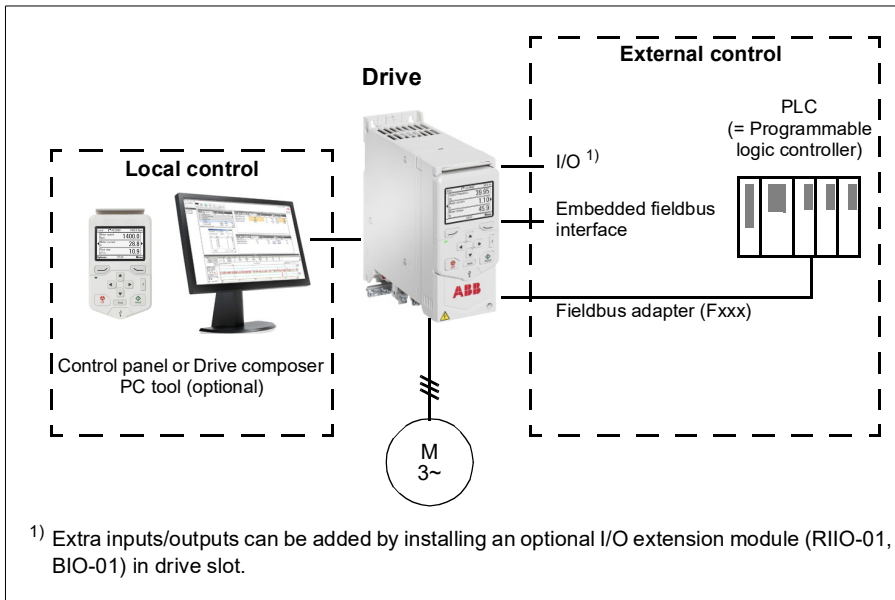
## ■ Local control

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

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

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

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

The user can select with parameter *49.05 Communication loss action* how the drive reacts to a control panel or PC tool communication 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), or optional I/O extension modules
- the fieldbus interface (via the embedded fieldbus interface or an optional fieldbus adapter module).

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

**Communication fail functionality**

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

**6**

**Block diagram: EXT1/EXT2 selection for speed control**



**6**
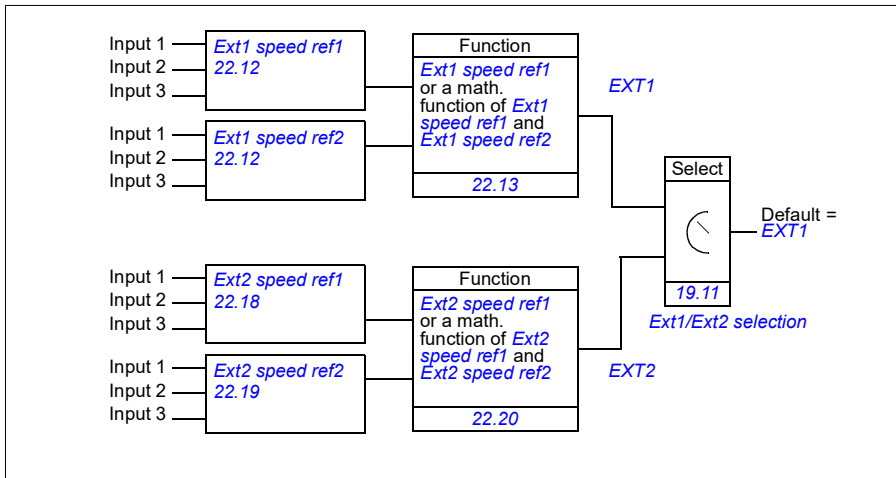
**Block diagram: EXT1/EXT2 selection for frequency control**
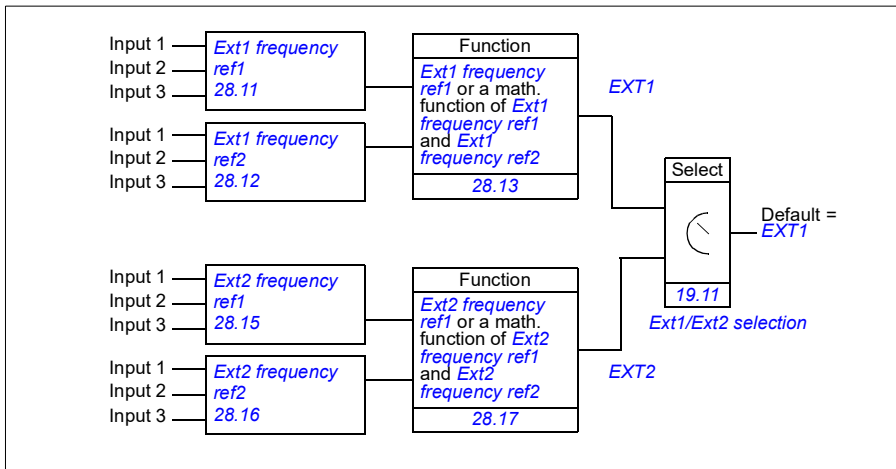


**Settings**

- Parameters *19.11 Ext1/Ext2 selection* (page *370*); *20.01 Ext1 commands*…*20.10 Ext2 in3 source* (page *372*)
- 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*. An overview of the different reference types
and control chains is shown below.



**6**
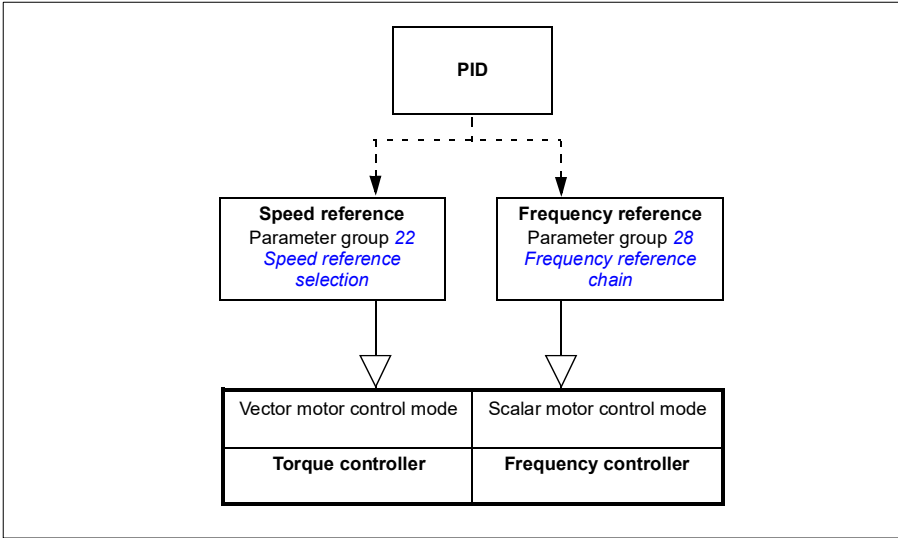
# Drive configuration and programming

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.
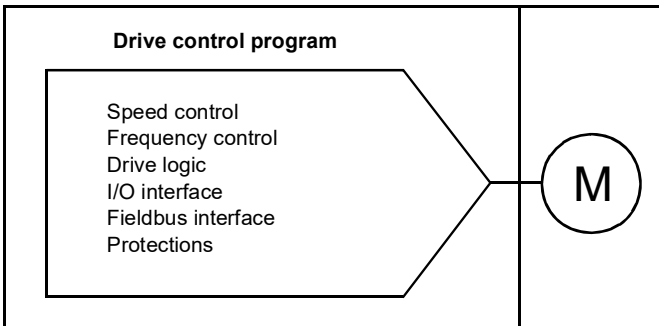


## ■ Configuring via default configurations

Default configurations are predefined I/O configurations. See chapter *Default I/O configuration* (page *77*).

## ■ Configuring via menus

The drive can be configured using the **Primary settings** and other menus on the control panel. They effectively change parameters but they guide you with assistants, and you do not have to know the parameter names and numbers. See chapter *Settings, I/O and diagnostics on the control panel* (page *47*).

## ■ Configuring via parameters

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

- the control panel, as described in chapter *Control panel* (see page *39*)
- the Drive composer PC tool, as described in *Drive composer user's manual* (3AUA0000094606 [English]), or
- the fieldbus interface, as described in chapters *Modbus RTU control through the embedded fieldbus interface (EFB)* (see page *209*) and *Fieldbus control through a fieldbus adapter* (see page *285*).

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

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

■ **Adaptive programming**

Conventionally, 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 pro PC tool (version 1.10 or later, available separately) has an Adaptive programming feature with a graphical user interface for building the custom program. The function blocks include the usual arithmetic and logical functions, as well as, for example, selection, comparison and timer blocks.

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 *96.70 Disable adaptive program*.

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

| Inputs available to the adaptive program | |
|---|---|
| *Input* | *Source* |
| *I/O* | |
| DI1 | *10.02 DI delayed status,* bit 0 |
| DI2 | *10.02 DI delayed status*, bit 1 |
| DI3 | *10.02 DI delayed status*, bit 2 |
| DI4 | *10.02 DI delayed status*, bit 3 |
| DI5 | *10.02 DI delayed status*, bit 4 |
| DI6 | *10.02 DI delayed status*, bit 5 |
| AI1 | *12.11 AI1 actual value* |
| AI2 | *12.21 AI2 actual value* |
| *Actual signals* | |
| Motor speed | *01.01 Motor speed used* |
| Output frequency | *01.06 Output frequency* |
| Motor current | *01.07 Motor current* |
| Motor torque | *01.10 Motor torque* |
| Motor shaft power | *01.17 Motor shaft power* |

| Inputs available to the adaptive program | |
|---|---|
| *Input* | *Source* |
| *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* |
| *I/O* | |
| RO1 | *10.24 RO1 source* |
| RO2 | *10.27 RO2 source* |
| RO3 | *10.30 RO3 source* |
| AO1 | *13.12 AO1 source* |
| AO2 | *13.22 AO2 source* |
| *Start control* | |
| Ext1/Ext2 selection | *19.11 Ext1/Ext2 selection* |
| Ext1 in1 cmd | *20.03 Ext1 in1 source* |
| Ext1 in2 cmd | *20.04 Ext2 in2 source* |
| Ext1 in3 cmd | *20.05 Ext1 in3 source* |
| Ext2 in1 cmd | *20.08 Ext2 in1 source* |
| Ext2 in2 cmd | *20.09 Ext2 in2 source* |
| Ext2 in3 cmd | *20.10 Ext2 in3 source* |
| Fault reset | *31.11 Fault reset selection* |
| *Speed control* | |
| Ext1 speed reference | *22.11 Ext1 speed ref1* |
| Speed proportional gain | *25.02 Speed proportional gain* |
| Speed integration time | *25.03 Speed integration time* |
| Acceleration time 1 | *23.12 Acceleration time 1* |
| Deceleration time 1 | *23.13 Deceleration time 1* |
| *Frequency control* | |
| Ext1 frequency reference | *28.11 Ext1 frequency ref1* |
| *Limit function* | |
| Minimum torque 2 | *30.21 Min torque 2 source* |
| Maximum torque 2 | *30.22 Max torque 2 source* |
| *Events* | |
| External event 1 | *31.01 External event 1 source* |
| External event 2 | *31.03 External event 2 source* |
| External event 3 | *31.05 External event 3 source* |
| External event 4 | *31.07 External event 4 source* |

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| Outputs available to the adaptive program | |
|---|---|
| *Output* | *Target* |
| 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* on page *202*.

**Sequence program**

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

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

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

# Control interfaces

## ◼ Programmable analog inputs

The control unit with standard I/O extension RIIO-01 module has two programmable analog inputs. Each of the inputs can be independently set as a voltage (0/2…10 V) or current (0/4…20 mA) input with parameters. Each input can be filtered, inverted and scaled.

**Settings**

• Parameter group *12 Standard AI* (page *360*).

## ◼ Programmable analog outputs

The control unit with standard I/O extension RIIO-01 module has two current (0…20 mA) analog outputs. Analog output 1 can be set as a voltage (0/2…10 V) or current (0/4…20 mA) output with a parameter. Analog output 2 always uses current. Each output can be filtered, inverted and scaled.

**Settings**

• Parameter group *13 Standard AO* (page *365*).

## ◼ Programmable digital inputs and outputs

The control unit with standard I/O extension RIIO-01 module has six digital inputs.

Digital input DI5 can be used as a frequency input.

**Settings**

• Parameter groups *10 Standard DI, RO* (page *342*) and *11 Standard DIO, FI, FO* (page *352*).

## ◼ Programmable frequency input and output

Digital input DI5 can be configured as a frequency input.

**Settings**

• Parameter groups *10 Standard DI, RO* (page *342*) and *11 Standard DIO, FI, FO* (page *352*).

## ◼ Programmable relay outputs

The control unit with standard I/O extension RIIO-01 module has three relay outputs. The signal to be indicated by the outputs can be selected by parameters.

**Settings**

• Parameter group *10 Standard DI, RO* (page *342*).

### ■ Programmable I/O extensions

Inputs and outputs can be added to the base unit either by using a standard I/O extension RIIO-01 module or a BIO-01 reduced I/O extension module. The I/O extension module is mounted on option slot of the control unit.

The table below shows the number of I/O on the base unit, on the standard I/O extension RIIO-01 module as well as optional BIO-01 module with reduced number of I/Os. The base unit with the standard I/O extension RIIO-01 module is called the standard unit.

| Location | Digital inputs (DI) | Digital outputs (DO) | Digital I/Os (DIO) | Analog inputs (AI) | Analog outputs (AO) | Relay outputs (RO) |
|---|---|---|---|---|---|---|
| Base unit | 2 | - | - | - | - | 1 |
| RIIO-01 | 4 | - | - | 2 | 2 | 2 |
| BIO-01 | 3 | 1 | - | 1 | - | - |

**Note:** The configuration parameter group contains parameters that display the values of the inputs on the extension module. These parameters are the only way of utilizing the inputs on an I/O extension module as signal sources.

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### Settings

•  Parameter groups *10 Standard DI, RO* (page *342*) and *11 Standard DIO, FI, FO* (page *352*).

### ■ Fieldbus control

The drive can be connected to several different automation systems through its fieldbus interfaces. See chapters *Modbus RTU control through the embedded fieldbus interface (EFB)* (page *209*) and *Fieldbus control through a fieldbus adapter* (page *285*).

### Settings

•  Parameter groups *50 Fieldbus adapter (FBA)* (page *494*), *51 FBA A settings* (page *498*), *52 FBA A data in* (page *499*), and *53 FBA A data out* (page *500*) and *58 Embedded fieldbus* (page *500*).

# 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 *120*).

## ◼ Activating the Override mode

When override is activated, the drive follows the programmed functionality defined in the parameter group *70 Override*, using the settings defined in the **Menu > Primary settings > Override** menu. The override mode is activated through an assigned digital input in the drive, which you select in the **Primary settings > Override > Activate override from:** menu. The digital input also acts as the start command for the drive in override mode

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| Off◇ | ⟲ ACH480 | 0.0 Hz |
|---|---|---|
| **Override** | | |
| Override mode: | | Normal |
| Activate override from: | | DI6 high |
| Reference from: Constant frequencies | | |
| Constant frequencies | | ► |
| Direction selection: | | Forward |
| **Back** | 16:02 | **Edit** |
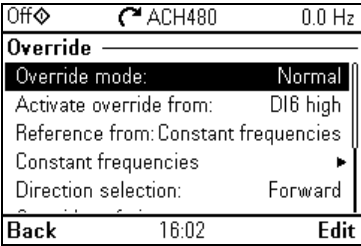
Select Normal or Critical override mode in **Menu > Primary settings > Override > Override mode:**.

To lock the override settings, select **Menu > Primary settings > Security**. Unlock the **Security** menu by entering the user pass code. Then select **Lock override settings**. Lock the menu at the end.

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 speed/frequency

You can configure the drive to run in seven different override mode types by selecting the reference for override speed/frequency in the **Reference from:** menu.

```
Off◇          ⌒ ACH480        0.0 Hz
Reference from:
Constant frequencies
AI1 directly
AI2 directly
Override frequency
Floating point
Cancel         16:02          Save
```
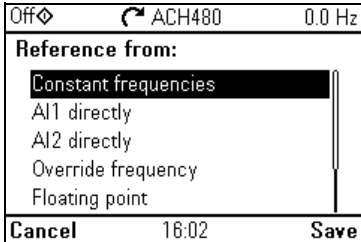
- **Constant frequencies** allows you to select multiple, constant frequencies based on multiple digital inputs.
- **AI1 directly** or **AI2 directly** is the speed reference in the override mode.
- **Override frequency** commands the drive frequency to a single preprogrammed value.
- **Floating point** uses two defined digital inputs to increase or decrease the drive frequency. Initial values can be configured, as well as, minimum and maximum values and ramp times.
- **Force stop** stops the drive following the defined stop mode.
- **PID, set1** controls the drive frequency using the output value of the process PID controller for PID parameter set 1.

### ◼ Override mode features

When placed into the override mode, the drive shows the following features and behavior.

- Once in override, the drive ignores all fieldbus communication commands for start/stop and speed reference.
- In the override mode the drive ignores all commands from the control panel: for example, Hand/Off/Auto requests and any parameters changes that would affect override are ignored. If a DriveWare tool is connected via the USB port, it will be ignored.
- Activating the override mode also initiates a start command. There is no need for a secondary start command while in the override mode.

- The run permissive signal and the signal source for the start interlock(s) that will be followed during the override mode can be set up from the **Primary settings > Override > Override safeties** menu.

```
Off◇          ⟲ ACH480        0.0 Hz
Override safeties ─────────────
☑ Use run permissive signal
☑ Use start interlock 1
☑ Use start interlock 2
☐ Use start interlock 3
☐ Use start interlock 4
Back          16:03        Unselect
```

- When override is enabled, the drive ignores all inputs with the exception of the override activation/deactivation input, the digital inputs selecting the constant frequency or frequencies and the safeties selected to be effective in the override mode. Selecting which ones remain active is done in the **Override safeties** menu and they can be the run permissive signal and/or up to four start interlock(s).

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- When the override mode is active, the drive displays warning message **Override active**.

```
OVERRIDE    ⟲ ACH480        0.0 Hz
  ⚠   Warning AFFE
       Aux code: 0000 0000
Override active              16:03:07
Drive is in override mode


Hide          16:03       How to fix
```

- 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 *509*) for fault handling. The following is a list of the high priority faults:

| | |
|---|---|
| *2310 Overcurrent* | *4982 External temperature 2* |
| *2330 Earth leakage* | *5090 STO hardware failure* |
| *2340 Short circuit* | *5091 Safe torque off* |
| *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 (☑ **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.
- The override configuration is able to be locked through the drive's access level security. See parameter group *96 System* (page *528*) for pass code and access level settings.
- The AI supervision function still operates for any override modes that utilize an analog input. Thus if an analog input signal is lost, the drive will operate based on parameter group *12 Standard AI* (page *360*) 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**

- **Menu > Primary settings > Override**
- Parameter group *70 Override* (page *509*)
- Parameter group *12 Standard AI* (page *360*)
- Parameter group *96 System* (page *528*).

■ **Application example 1: 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:

• A start/stop command from the building automation system (BAS) for Normal mode operation
• A 0…10 V DC analog speed command signal from the BAS for Normal mode operation
• A Freezestat safety configured as a low priority safety interlock that will be ignored in the override mode
• A duct high static pressure safety (Overpressure) configured as a high priority safety interlock that will operate in normal and override modes
• 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
• Override mode is enabled by relay output from the fire alarm system to the drive
• A run/stop status feedback from the drive to the BAS
• A fault/not-faulted status feedback from the drive to the BAS.

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## Wiring diagram

| X1 | | Reference voltage and analog inputs and outputs | |
|---|---|---|---|
| 1 | SCR | Signal cable shield (screen) | |
| 2 | AI1 | **Output frequency/speed reference**: 0…10 V | |
| 3 | AGND | Analog input circuit common | |
| 4 | +10V | Reference voltage 10 V DC | |
| 5 | AI2 | **Actual feedback:** 0…20 mA | |
| 6 | AGND | Analog input circuit common | |
| 7 | AO1 | **Output frequency:** 0…10 V | |
| 8 | AO2 | **Motor current:** 0…20 mA | |
| 9 | AGND | Analog output circuit common | |
| **X2 & X3** | | Aux. voltage output and programmable digital inputs | |
| 10 | +24V | Aux. voltage output +24 V DC, max. 200 mA | |
| 11 | DGND | Aux. voltage output common | |
| 12 | DCOM | Digital input common for all | |
| 13 | DI1 | **Stop (0) / Start (1)** | |
| 14 | DI2 | Not configured | |
| 15 | DI3 | **Start interlock 3 (1 = allow start)** | |
| 16 | DI4 | **Start interlock 1 (1 = allow start)** | |
| 17 | DI5 | **Start interlock 2 (1 = allow start)** | |
| 18 | DI6 | **Override** | |
| **X6, X7, X8** | | Relay outputs | |
| 19 | RO1C | **Damper control** | Energize damper |
| 20 | RO1A | 250 V AC / 30 V DC | 19 connected to 21 |
| 21 | RO1B | 2 A | |
| 22 | RO2C | **Running** | Running |
| 23 | RO2A | 250 V AC / 30 V DC | 22 connected to 24 |
| 24 | RO2B | 2 A | |
| 25 | RO3C | **Fault (-1)** | Fault condition |
| 26 | RO3A | 250 V AC / 30 V DC | 25 connected to 26 |
| 27 | RO3B | 2 A | |

0…10 V DC speed reference signal
+
-

Start/stop signal
Freezestat safety
High static safety (Overpressure)
Supply air smoke detector safety
Fire alarm override

Run status
Fault status

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**Quick steps – Programming summary**

Unless otherwise noted, the settings listed below are changed relative to the drive's factory defaults to meet the application requirements. The settings identified below are specific to the configuration of override mode and configuration of the Interlock text, and do not review the complete normal mode configuration.

**Menu > Primary settings > Override**

- Edit **Override mode:** *Critical*
- Edit **Activate override from:** *DI6 high*
- Edit **Reference from:** *Override frequency*
- Edit **Override frequency:** *48.0 Hz*
- Edit **Direction selection:** *Forward* (default)
- Select **Override safeties**
  - ☑ **Use start interlock 1**
  - ☑ **Use start interlock 2**
- Select ☑ **Use autoreset for critical faults**
- Edit **Wait between reset attempts:** *5.0 s* (default)
- Edit **Max attempts:** *5* (default)

**Menu > Primary settings > Start, stop, reference > Interlocks/permissives**

- ☑ **Use start interlock 1**
  - Edit **Description text:** *Overpressure*
- Select ☑ **Use start interlock 2**
  - Edit **Start enabled when:** *DI5 high*
  - Edit **Description text:** *Smoke alarm*
- Select ☑ **Use start interlock 3**
  - Edit **Start enabled when:** *DI3 high*
  - Edit **Description text:** *Freezestat*

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### ■ Application example 2: Override for PID control

In the application example 1, 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 application example 2 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
- An analog differential pressure sensor measuring the pressure differential between the stairwell and the occupied space
- An override input (Run) from the fire alarm system to start the drive and place it in the override mode
- A dedicated "shutdown" command from the fire alarm system
- 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.)
- A High pressure static safety (Overpressure)
- Resetting of high priority faults is Normal with two resets. (This is not "run to destruction".)
- A run/stop status feedback from the drive to the building automation system (BAS)
- A fault/not-faulted status feedback from the drive to the BAS.

## Wiring diagram

| X1 | | Reference voltage and analog inputs and outputs |
|---|---|---|
| 1 | SCR | Signal cable shield (screen) |
| 2 | AI1 | **Output frequency/speed reference**: 0…10 V |
| 3 | AGND | Analog input circuit common |
| 4 | +10V | Reference voltage 10 V DC |
| 5 | AI2 | **Actual feedback: 4…20 mA** |
| 6 | AGND | Analog input circuit common |
| 7 | AO1 | **Output frequency:** 0…10 V |
| 8 | AO2 | **Motor current:** 0…20 mA |
| 9 | AGND | Analog output circuit common |

4…20 mA pressure feedback signal → + / −

| X2 & X3 | | Aux. voltage output and programmable digital inputs |
|---|---|---|
| 10 | +24V | Aux. voltage output +24 V DC, max. 200 mA |
| 11 | DGND | Aux. voltage output common |
| 12 | DCOM | Digital input common for all |
| 13 | DI1 | **Stop (0) / Start (1)** |
| 14 | DI2 | **Run permissive (1 = allow start)** |
| 15 | DI3 | Not configured |
| 16 | DI4 | **Start interlock 1 (1 = allow start)** |
| 17 | DI5 | **Start interlock 2 (1 = allow start)** |
| 18 | DI6 | **Override** |

Damper end switch
High static safety (Overpressure)
Fire alarm "shutdown")
Fire alarm override/run

| X6, X7, X8 | | Relay outputs | | |
|---|---|---|---|---|
| 19 | RO1C | **Damper control** | Energize damper |
| 20 | RO1A | 250 V AC / 30 V DC | 19 connected to 21 |
| 21 | RO1B | 2 A | |
| 22 | RO2C | **Running** | Running |
| 23 | RO2A | 250 V AC / 30 V DC | 22 connected to 24 |
| 24 | RO2B | 2 A | |
| 25 | RO3C | **Fault (-1)** | Fault condition |
| 26 | RO3A | 250 V AC / 30 V DC | 25 connected to 26 |
| 27 | RO3B | 2 A | |

Damper actuator
Run status
Fault status

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**Quick steps – Programming summary**

Unless otherwise noted, the settings listed below are changed relative to the drive's factory defaults to meet the application requirements. The settings identified below are specific to configuration of the Override mode and configuration of the Interlock text, and do not review the complete setup of the PID configuration.

**Primary settings > Override**

- Edit **Override mode:** *Normal*
- Edit **Activate override from:** *DI6 high*
- Edit **Reference from:** *PID, set 1*
- Edit **Direction selection:** *Forward* (default)
- Select **Override safeties**
  - Select ☑ **Run permissive signal**
  - Select ☑ **Start interlock 1**
  - Select ☑ **Start interlock 2**
- Select ☑ **Use autoreset for critical faults**
  - Edit **Wait between reset attempts:** *5.0 s* (default)
  - Edit **Max attempts:** *2*

**Primary settings > Start, stop, reference > Interlocks/permissives**

- Select ☑ **Run permissive signal**
  - Edit **Description text:** *Damper end switch*
- Select ☑ **Use start interlock 1**
  - Edit **Description text:** *Overpressure*
- Select ☑ **Use start interlock 2**
  - Edit **Start enabled when:** *DI5 high*
  - Edit **Description text:** *Smoke alarm*

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# Interlocks

## ◼ Overview

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

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

You can configure interlocks either in the **Primary settings** menu, or via parameter group *20 Start/stop/direction* in the **Parameters** menu. ABB recommends configuration via the **Primary settings** menu (**Menu > Primary settings > Start, stop, reference > Interlocks/permissives**).

Interlocks are configurable for normally open or normally closed functionality.

- For example, in the **Primary settings**, 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 panel display via a flashing green LED light, and a flashing warning on the display. You can set up the drive to indicate an unsatisfied interlock in one of two methods (**Menu > Primary settings > Start, stop, reference > Interlocks/permissives > Interlock warning condition**). This setting applies to all the interlocks.

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

You can configure the drive for either coast or ramp to a stop, when the interlock changes to an unsatisfied state (**Menu > Primary settings > Start, stop, reference > Interlocks/permissives > Interlock stop mode**).

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.

• Prevent operation in the Hand mode. For example, one or more interlocks are wired to a separate BAS controller that then provides a single interlock to the drive. If the BAS controller has failed, the drive will not be receiving the interlock status from BAS controller, thus not allowing it to run in the Hand mode.

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

You configure the predefined descriptive text in **Menu > Primary settings > Start, stop, reference > Interlocks/Permissives > Descriptive text**. You configure the Label text in **Menu > Primary settings > Start, stop, reference > Interlocks/Permissives > Label text**.

**Settings**

• **Menu > Primary settings > Start, stop, reference > Interlocks/Permissives**

• Parameter *20.41 Start interlock 1* (page *378*)

■ **Application examples of interlocks**

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

1. **Overpressure.** This interlock is typically used with air handlers for air duct protection. This interlock stops operation when the measured pressure exceeds a threshold, to prevent damage to ductwork. For integration examples, see *Application example 2: Supply fan, basic speed follower with interlock and status* (page *156*) and *Application example 3: Supply fan, speed follower complete integration* (page *158*).

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

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event to fault the drive. This can be done in **Menu > Primary Settings > Advanced functions > External events**.

For integration examples, see *Application example 5: Cooling tower fan, speed follower* (page *162*) and *Application example 6: Cooling tower, PID* (page *164*).

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 3: Supply fan, speed follower complete integration* (page *158*).

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 4: Supply fan, PID control* (page *160*).

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

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

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

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

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

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

12. **Label text.** Provides up to 35 characters of free/custom text describing the interlock. This text will appear on the drive control panel when the interlock is no longer satisfied. This text can be used to better describe the interlock itself or its physical location. This text can also be used to enter a phone number for the local

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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."

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# Run permissives

## ◼ Overview

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

Run permissive is different from start interlock:

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

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

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## ◼ Configuration

You can configure run permissive either in the **Primary settings** menu, or via parameter group *20 Start/stop/direction* in the **Parameters** menu. ABB recommends configuration via the **Primary settings** menu (**Menu > Primary settings > Start, stop, reference > Interlocks/permissives**). 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.
- Prevent operation in the Hand mode. For example, a permissive is wired to a separate BAS controller that then reproduces a permissive to the drive. If the BAS controller were to fail, the drive will not be receiving the permissive status from the BAS controller, thus not allowing it to run in the Hand mode.

■ **Functionality**

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

- You configure (select) the predefined descriptive text in **Menu > Primary settings > Start, stop, reference > Interlocks/Permissives > Descriptive text.**
- You configure (edit) the label text is configured in **Menu > Primary settings > Start, stop, reference > Interlocks/Permissives > Label text.**

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 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**

- **Menu > Primary settings > Start, stop, reference > Interlocks/permissives**
- Parameter *20.40 Run permissive* (page *378*).

### ■ Application example 1: Damper end switch

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

1. Drive receives start command, either via Hand or Auto source.

2. Drive verifies safeties are satisfied and end switch has not yet been satisfied.

3. Drive activates a relay output that was programmed to Damper control. This relay allows power to the actuator.

4. Once the damper end switch closes, run permissive is satisfied and the drive outputs to the motor.

See the figure on page *349* and *Application example 3: Supply fan, speed follower complete integration* (page *158*).

### ■ Application example 2: Valve opening

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

1. Drive receives start command, either via Hand or Auto source.

2. Drive verifies safeties are satisfied and valve position has not yet been satisfied.

3. Drive activates a relay output that was programmed to Valve opening (could have also been programmed to Started or Running). This relay allows power to the actuator.

4. Once the valve is opened, run permissive is satisfied and the drive outputs to the motor.

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# 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.

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 Ramp time target frequency setting is located under **Menu > Primary Settings > Ramps.**

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

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



90-second acceleration and no deceleration ramp curve
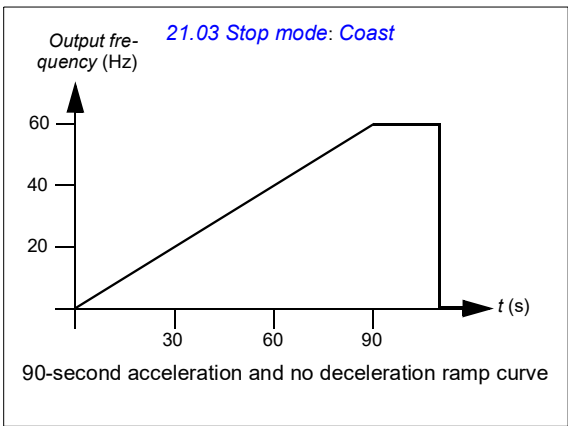
In pump applications, the stop mode is typically set to ramp and the deceleration ramp is used while stopping. Ramping a pump motor to a stop helps prevent issues

such as water hammer and assist in closing the check valve. The figure below shows a ramp curve for 30-second acceleration and deceleration.



30-second acceleration and deceleration ramp curve
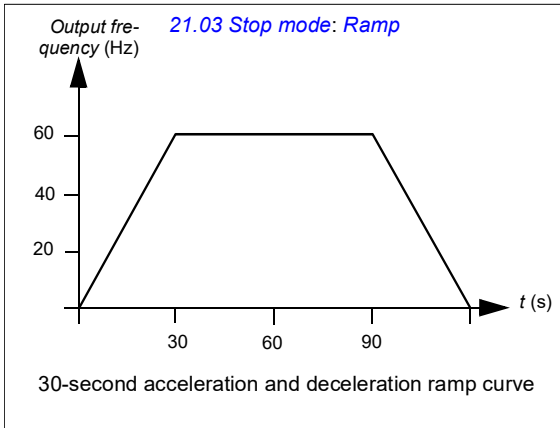
If the acceleration time is too short, the drive may trip out on overcurrent. If the deceleration ramp is set to stop too quickly, the drive may trip out on overvoltage. These scenarios are unlikely in most applications due to the internal current and voltage limiting features built into the drive.

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. This feature is configured with **Menu > Primary settings > Ramps > Use two ramp sets.**

**Settings**

- **Menu > Primary settings > Ramps**
- Speed reference ramping: Parameters *23.11…23.15* and *46.01* (pages *398* and *489*)
- Frequency reference ramping: Parameters *28.71…28.75* and *46.02* (pages *412* and *489*)
- Floating point control (Motor potentiometer): Parameter *22.75* (page *396*)
- Emergency stop ("Off3" mode): Parameter *23.23 Emergency stop time* (page *399*)

■ **Application examples**

Referring to *Application example 7: Chilled water pump* (page *168*) and *Application example 8: Condenser water pump* (page *170*), the drive is programmed to have the drive ramp the motor to a stop to prevent water hammer. All of the fan application examples are set up to coast to stop.

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

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

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# 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**

- **Menu > Primary Settings > Limits**
- Parameter group *30 Limits*.

## ■ Application examples

Referring to *Application example 5: Cooling tower fan, speed follower* (page *162*) and *Application example 6: Cooling tower, PID* (page *164*), the minimum frequency is set based on limitations on the lubrication requirements of the fan's gearbox. In this case, the limit was is based on information provided by the equipment manufacturer.

While the other examples on pages *154…170* 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.

# Application control

## ■ 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**

- **Menu > Primary settings > Advanced functions > Autoreset faults**
- Parameters *31.12*…*31.16* (page *426*).

## ■ 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 by selecting **Menu > Primary settings > Advanced functions > External events**.

**Settings**

- **Menu > Primary settings > Advanced functions > External events**
- Parameters *31.01*…*31.10* (page *423*).

## ■ 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**

- **Menu > Primary settings > Start, stop, reference > Constant speeds**
- **Menu > Primary settings > Start, stop, reference > Constant frequencies**
- Parameter groups *22 Speed reference selection* (page *388*) and *28 Frequency reference chain* (page *405*).

### ■ Critical speeds/frequencies

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

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

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

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

**Example for critical speeds:**

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

• enable the critical speeds function by turning on bit 0 of parameter *22.51 Critical speed function*, and

• set the critical speed ranges as in the figure below.



*22.01 Speed ref unlimited* (rpm)
(output of function)

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

1560
1380
690
540

1  2  3  4

*22.87 Speed reference act 7* (rpm)
(input of function)
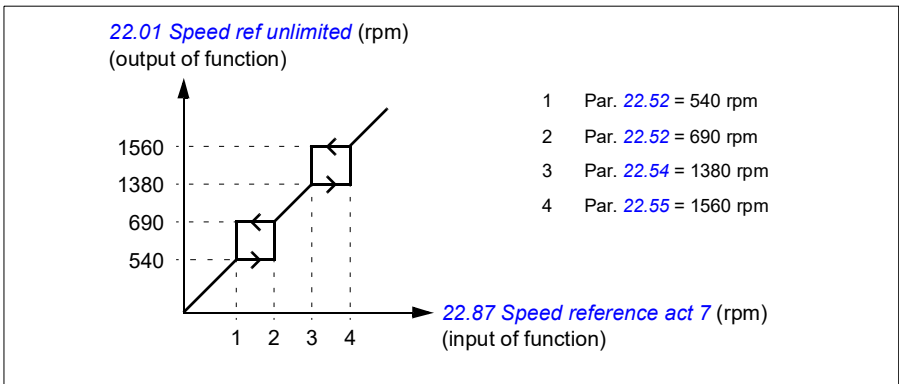
**Example for critical frequencies:**

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 speed frequencies as in the figure below.



*28.97 Frequency ref unlimited* (Hz)
(output of function)
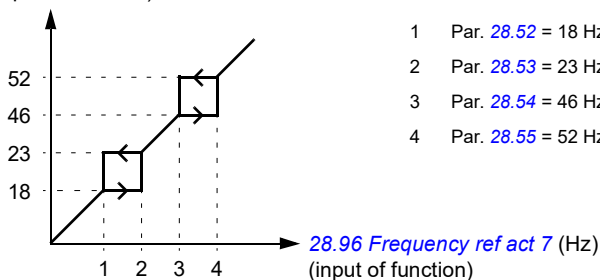
| | | |
|---|---|---|
| 1 | Par. *28.52* | = 18 Hz |
| 2 | Par. *28.53* | = 23 Hz |
| 3 | Par. *28.54* | = 46 Hz |
| 4 | Par. *28.55* | = 52 Hz |

*28.96 Frequency ref act 7* (Hz)
(input of function)

**Settings**

- **Menu > Primary settings > Start, stop, reference > Constant speeds**
- **Menu > Primary settings > Start, stop, reference > Constant frequencies**
- Critical speeds: parameters *22.51…22.57* (page *394*)
- Critical frequencies: parameters *28.51…28.57* (page *412*).

■ **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 exceptional days (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 exceptional days.

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 or pump 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.
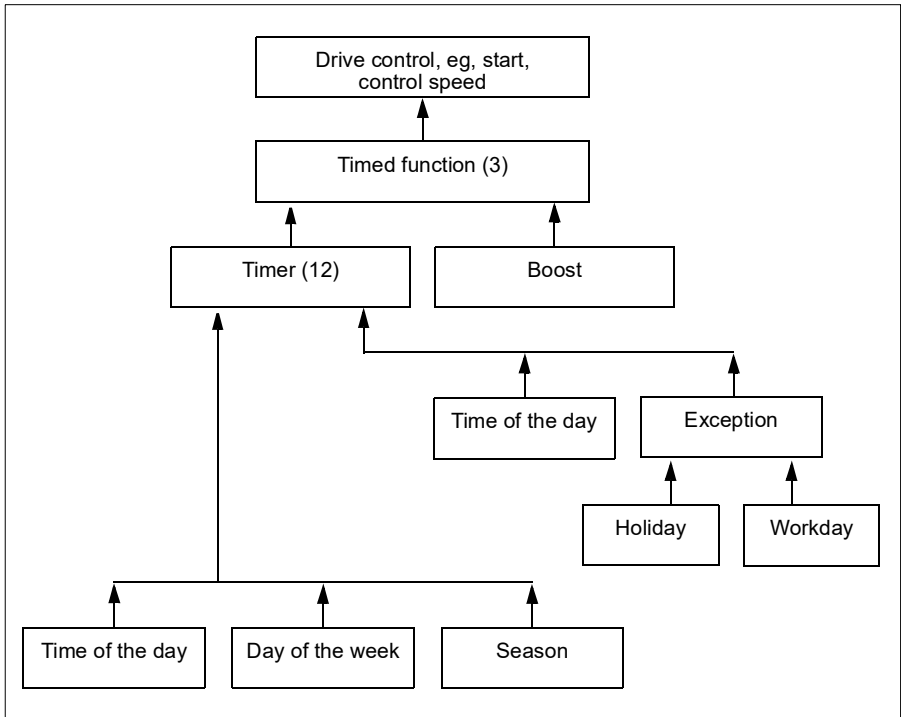


**Settings**

- **Menu > Primary settings > Advanced functions > Timed functions**
- Parameter group *34 Timed functions* (page *439*).

# Motor control

## ◼ Speed control mode

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

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

Speed control uses speed reference chain. Select speed reference with parameters in group *22 Speed reference selection* on page *388*.

## ◼ Frequency control mode

The motor follows a frequency reference given to the drive. Frequency control is available in both local and external control. It is supported in scalar motor control only.

Frequency control uses frequency reference chain. Select frequency reference with parameters in group *28 Frequency reference chain* on page *405*.

## ◼ Motor types

The drive supports asynchronous AC induction, permanent magnet (PM) and synchronous reluctance motors (SynRM).

## ◼ Motor identification

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

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

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

**Settings**

• **Menu > Primary settings > Motor > Control mode > Vector control**
• Parameter *99.13 ID run requested* (page *546*).

## ◼ 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 runs a medium-voltage motor through a step-up transformer
- 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 *87*).

**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.
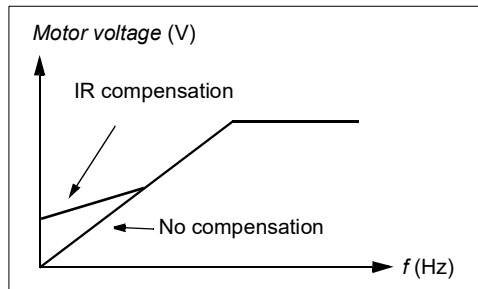


In vector control, no IR compensation is possible or needed as it is applied automatically.

**Settings**

- **Menu > Primary settings > Motor > IR compensation**
- Parameters *97.13 IR compensation* (page *540*), *97.94 IR comp max frequency* (page *541*) and *99.04 Motor control mode* (page *543*)
- Parameter group *28 Frequency reference chain* (page *405*).

■ *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**

- **Menu > Primary settings > Motor > U/f ratio**
- Parameter *97.20 U/F ratio* (page *540*).

### ◼ **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.
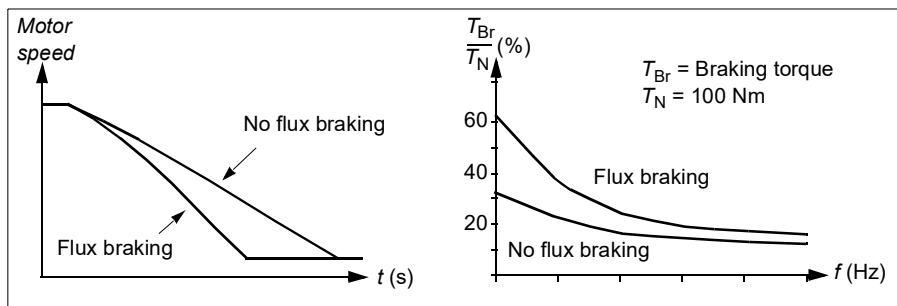


The drive monitors the motor status continuously, also during flux braking. Therefore, flux braking can be used both for stopping the motor and for changing the speed. The other benefits of flux braking are:

- 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**

- **Menu > Primary settings > Motor > Flux braking**
- Parameter *97.05 Flux braking* (page *539*).

■ **Start methods – DC magnetization**

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

**Pre-heating (Motor heating)**

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

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

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

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

**Notes:**

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

**Settings**

- **Menu > Primary settings > Motor > Pre-heating**
- Parameters *21.14 Pre-heating input source*, *21.15 Pre-heating time delay* and *21.16 Pre-heating current* (page *384*).

**6**

**Pre-magnetization**

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

**Settings**

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

**DC hold**

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

reference exceeds parameter *21.09 DC hold speed*, normal drive operation continues.
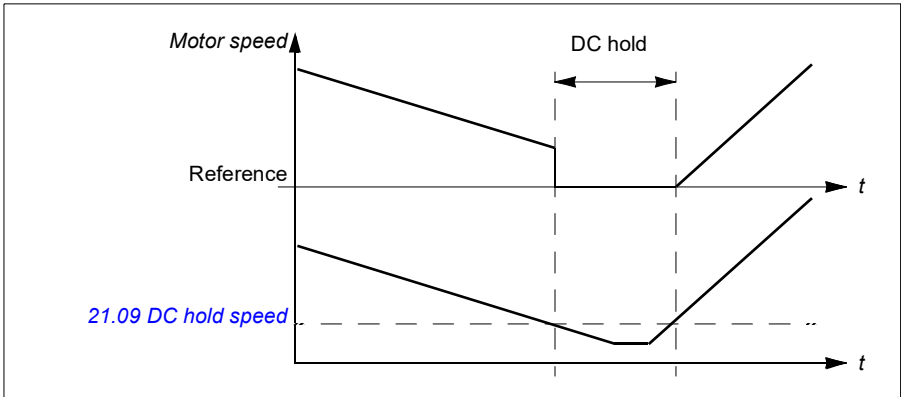


**Settings**

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

**Post-magnetization**

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

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

**Settings**

• Parameters *21.03 Stop mode* (page *381*), *21.08 DC current control* and *21.11 Post magnetization time*.

## ■ Switching frequency

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

For derating, see chapter *Technical data*, section *Switching frequency derating* in the *Hardware manual* of the drive.

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

**Example 2:** If the reference switching frequency is set to 8 kHz and the minimum switching frequency is set to the smallest available value, the drive maintains the highest possible switching frequency to reduce motor noise and only when the drive heats it will decrease the switching frequency. This is useful, for example, in applications where low noise is necessary but higher noise can be tolerated when the full output current is needed.

**Settings**

• **Menu > Primary settings > Motor > Switching frequency**

• Parameters *97.01 Switching frequency reference* and *97.02 Minimum switching frequency* (page *525*).

### ■ Motor thermal protection

**6**

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 inverter.

**Insulation**

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

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

• Separate the thermistor from live parts of the motor with double reinforced insulation.

• Protect all circuits connected to the drive's digital and analog inputs. Protect against contact, and insulate from other low voltage circuits with basic insulation (rated for the same voltage level as the drive's main circuit).

• Use an external thermistor relay. The relay insulation must be rated for the same voltage level as the drive's main circuit.

**Temperature monitoring using Pt100 sensors**

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

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

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

See section *Insulation* on page *127*.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs* on page *130*.

**Temperature monitoring using Pt1000 sensors**

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

The analog output feeds a constant excitation current of 0.1 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

See section *Insulation* on page *127*.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs* on page *130*.

**Temperature monitoring using Ni1000 sensors**

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

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

See section *Insulation* on page *127*.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs* on page *130*.

**Temperature monitoring using KTY84 sensors**

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

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

The figure and table on page *129* show typical KTY84 sensor resistance values as a function of the motor operating temperature.

See section *Insulation* on page *127*.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs* on page *130*.

**Temperature monitoring using KTY83 sensors**

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

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

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



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

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

See section *Insulation* on page *127*.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs* on page *130*.

**6**

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

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



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

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

**Temperature monitoring using thermistor relays**

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

See section *Insulation* on page *127*.
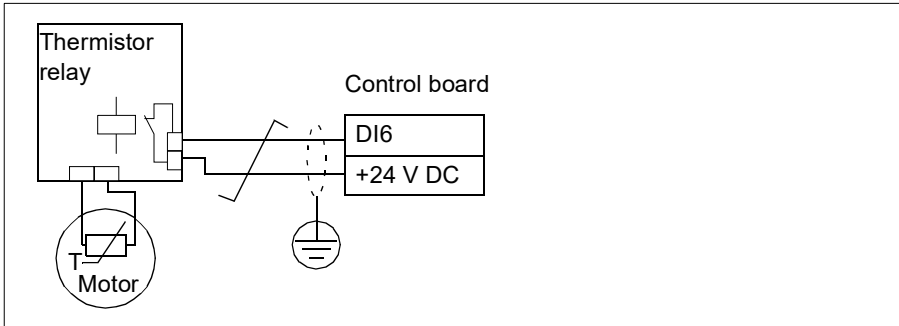


**Settings**

• **Menu > Primary settings > Motor > Thermal protection estimated**

• **Menu > Primary settings > Motor > Thermal protection measured**

• Parameter group *35 Motor thermal protection* (page *447*).

### ◼ Motor overload protection

This section describes motor overload protection without using motor thermal protection model, either with estimated or measured temperature. For protection with the motor thermal protection model, see section *Motor thermal protection* on page *126*.

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 to as I$^2$t protection. The accumulated value is shown with parameter *35.05 Motor overload level*.

You can define with parameter *35.56 Motor overload action* that when *35.05 Motor overload level* reaches 88%, a motor overload warning will be 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 as well as specify the overload tripping level.

**Settings**

- Parameters common to motor thermal protection and motor overload protection: *35.51 Motor load curve* (page *454*), *35.52 Zero speed load* (page *455*) and *35.53 Break point* (page *455*).

- Parameters specific to motor overload protection: *35.05 Motor overload level* (page *448*), *35.56 Motor overload action* (page *456*) and *35.57 Motor overload class* (page *456*).

### ■ Vector control

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

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

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

**Settings**

- **Menu > Primary settings > Motor > Control mode**
- Parameters *99.04 Motor control mode* (page *543*) and *99.13 ID run requested* (page *546*).

### ■ 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
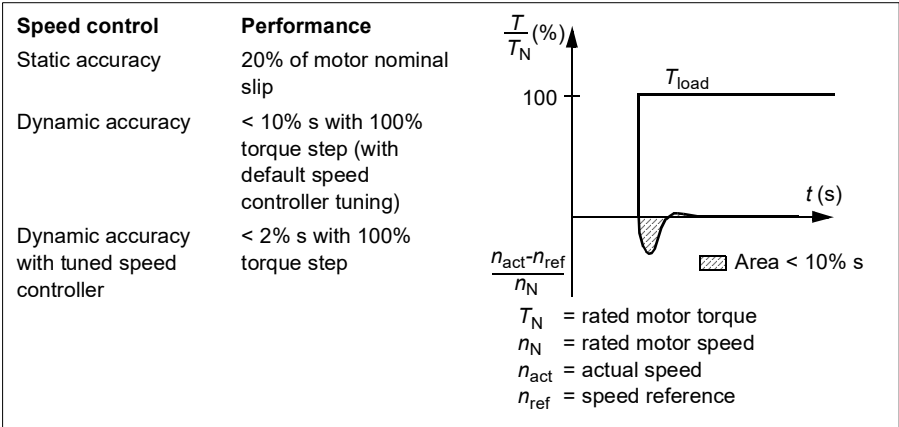
### ■ Floating point control (Motor potentiometer)

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

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

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

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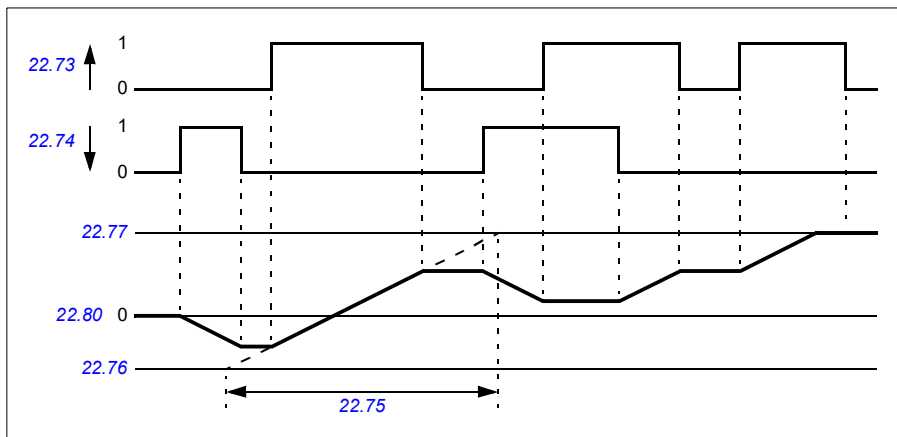


**6**

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



\* Output speed or frequency has reached the reference value.
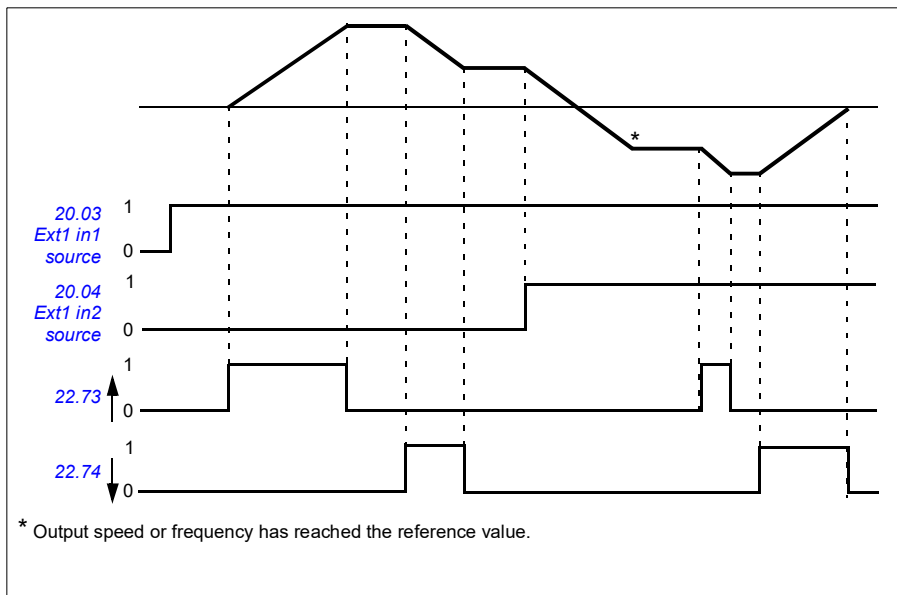
**Settings**

• Parameters *22.71…22.80* (page *395*).

# DC voltage control

## ◼ Overvoltage control

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

## ◼ Undervoltage control (power loss ride-through)

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

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

**6**



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

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

**Implementing the undervoltage control (power loss ride-through)**

Implement the undervoltage control function as follows:

- Check that the undervoltage control function of the drive is enabled with parameter *30.31 Undervoltage control*.

- Parameter *21.01 Start mode* must be set to *Automatic* (in vector mode) or parameter *21.19 Scalar start mode* to *Automatic* (in scalar mode) to make flying start (starting into a rotating motor) possible.

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

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

**Automatic restart**

**6**

It is possible to restart the drive automatically after a short (max. 10 seconds) power supply failure by using the Automatic restart function, provided that the drive is allowed to run for 10 seconds without the cooling fans operating.

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

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

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

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

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

■ **Voltage control and trip limits**

The control and trip limits of the intermediate DC voltage regulator are relative to the supply voltage as well as drive/inverter type. The DC voltage ($U_{DC}$) is approximately

1.35 times the line-to-line supply voltage, and is displayed by parameter *01.11 DC voltage*.

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

| | DC voltage level [V] | |
|---|---|---|
| See *95.01 Supply voltage*. | AC supply voltage range [V] 380…415 | AC supply voltage range [V] 440…480 |
| Overvoltage fault limit | 840 | 840 |
| Overvoltage control limit | 780 | 780 |
| Internal brake chopper start limit | 780 | 780 |
| Internal brake chopper stop limit | 760 | 760 |
| Overvoltage warning limit | 745 | 745 |
| Undervoltage warning limit | 0.85×1.41×par *95.03* value [1] <br> 0.85×1.41×380 = 455 [2] | 0.85×1.41×par *95.03* value [1] <br> 0.85×1.41×440 = 527 [2] |
| Undervoltage control limit | 0.75×1.41×par *95.03* value [1] <br> 0.75×1.41×380 = 402 [2] | 0.75×1.41×par *95.03* value [1] <br> 0.75×1.41×440 = 465 [2] |
| Charging relay closing limit | 0.75×1.41×par *95.03* value [1] <br> 0.75×1.41×380 = 402 [2] | 0.75×1.41×par *95.03* value [1] <br> 0.75×1.41×440 = 465 [2] |
| Charging relay opening limit | 0.65×1.41×par *95.03* value [1] <br> 0.65×1.41×380 = 348 [2] | 0.65×1.41 ×par *95.03* value [1] <br> 0.65×1.41×440 = 403 [2] |
| DC voltage at upper bound of supply voltage range ($U_{DCmax}$) | 560 | 648 |
| DC voltage at lower bound of supply voltage range ($U_{DCmin}$) | 513 | 594 |
| Charging activation/standby limit [3] | 0.65×1.41×par *95.03* value [1] <br> 0.65×1.41×380 = 348 [2] | 0.65×1.41×par *95.03* value [1] <br> 0.65×1.41×440 = 403 [2] |
| Undervoltage fault limit | 0.45×1.41×par *95.03* value [1] <br> 0.45×1.41×380 = 241 [2] | 0.45×1.41×par *95.03* value [1] <br> 0.45×1.41×440 = 279 [2] |

[1] *95.01 Supply voltage* is set to *Automatic / not selected* and *95.02 Adaptive voltage limits* is set to *Enable*, the value of parameter *95.03 Estimated AC supply voltage* is used,
[2] otherwise the lower limit of the range selected with parameter *95.01 Supply voltage* is used.
[3] When standby is activated, drive modulation is stopped, the fan is stopped and the pre-charge circuit is activated. If the voltage exceeds this level again, the drive has to complete charging before it will automatically continue operation.

**Settings**

• Parameters *01.11 DC voltage* (page *325*), *30.30 Overvoltage control* (page *421*), *30.31 Undervoltage control* (page *422*), *95.01 Supply voltage* (page *525*) and *95.02 Adaptive voltage limits* (page *526*).

■ **Brake chopper**

A brake chopper can be used to handle the energy generated by a decelerating motor. When the DC voltage rises high enough, the chopper connects the DC circuit

to an external brake resistor. The chopper operates on the pulse width modulation principle.

The internal brake choppers in the drive start conducting when the DC link voltage reaches approximately 1.15 × $U_{DCmax}$. 100% maximum pulse width is reached at approximately 1.2 × $U_{DCmax}$. ($U_{DCmax}$ is the DC voltage corresponding to the maximum of the AC supply voltage range.) For information on external brake choppers, refer to their documentation.

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

**Settings**

- Parameter *01.11 DC voltage* (page *325*); parameter group *43 Brake chopper* (page *482*).

**6**

# 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 *432*).

## ■ Application example 1: Dirty filter

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

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

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

## ■ Application example 2: High current

The supervisory function can be used to monitor motor current for increasing or excessive loading. This increase in loading may be due to mechanical failure/wear. A single "high current" threshold may be used with the supervisory function. Alternately, parameter group *37 User load curve* (page *460*) can be used to detect this scenario throughout the entire speed range, as shown under *User load curve* (page *140*).

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.

**6**



1 = Overload curve (five points)
2 = Nominal process load curve
3 = Underload curve (five points)
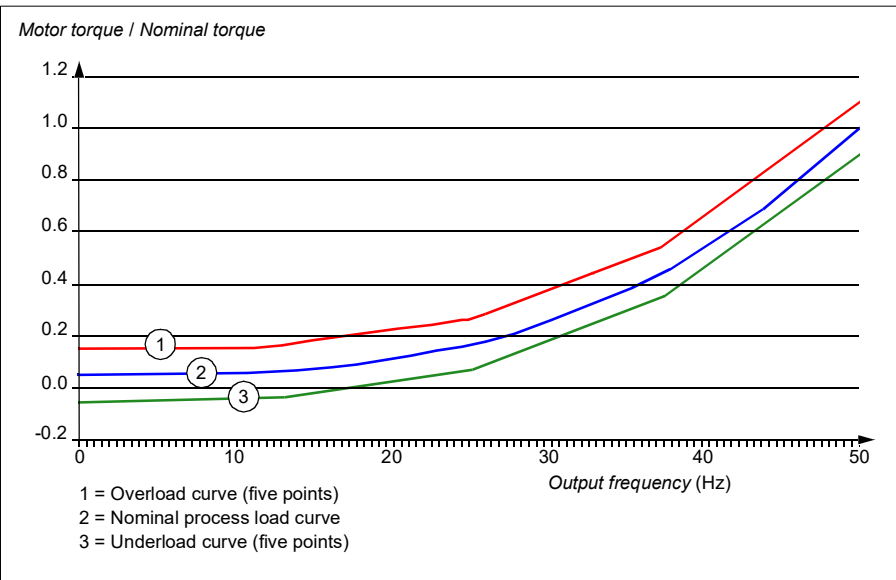
An overload warning and/or fault can be set to occur if the monitored signal stays continuously over the overload curve for a defined time. An underload warning and/or fault can be set to occur if the monitored signal stays continuously under the underload for a defined time.

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

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

**Settings**

• Parameter group *37 User load curve* (page *460*).

**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 panel is capable of displaying the motor torque. See parameter *01.10 Motor torque* (page *325*). 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.

**6**

# Process PID control

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

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

The simplified block diagram below illustrates the process PID control. For more detailed block diagrams, see pages *314* and *316*.
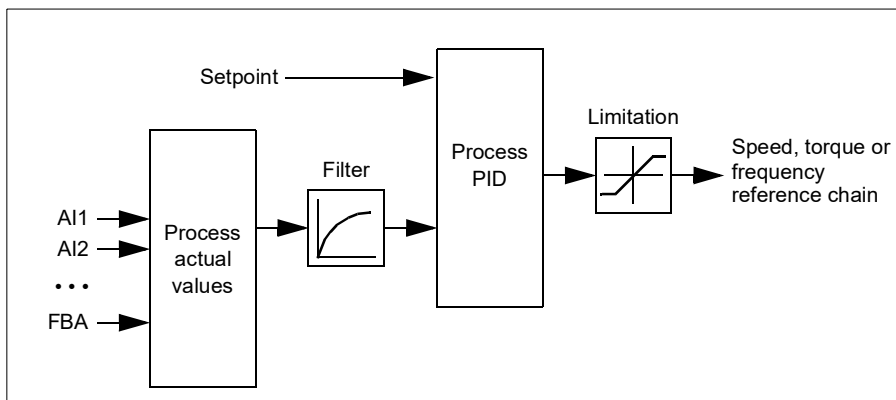


The drive contains two complete sets of process PID controller settings that can be alternated whenever necessary; see parameter *40.57 PID set1/set2 selection*.

**Note:** Process PID control is only available in external control location EXT2; see section *Local control vs. external control* (page *83*).

### Sleep and boost functions for process PID control

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

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

resumes when the pressure falls under the predefined minimum level and the wake-up delay has passed.

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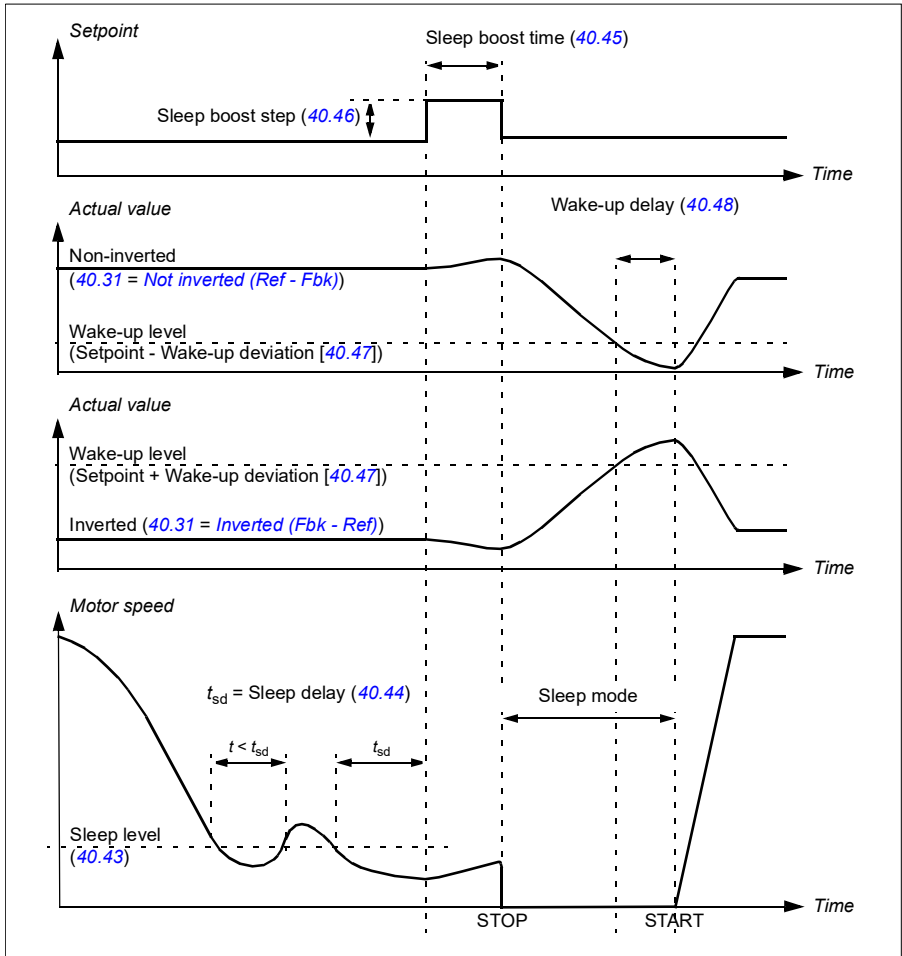


### Tracking

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

**Settings**

• Parameter groups *40 Process PID set 1* (page *463*) and *41 Process PID set 2* (page *480*).

**6**

# Multipump control

## ■ Single pump and fan control (PFC)

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

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

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

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

**6**

**Example:** Three-pump constant pressure water supply application



**Main supply**

VSD motor     Aux. motor 1     Aux. motor 2     Aux. motor 3

**Pump 1** is connected to **VSD motor** (drive controlled motor).
**Pump 2** is connected to **auxiliary motor 1**.
**Pump 3** is connected to **auxiliary motor 2**.
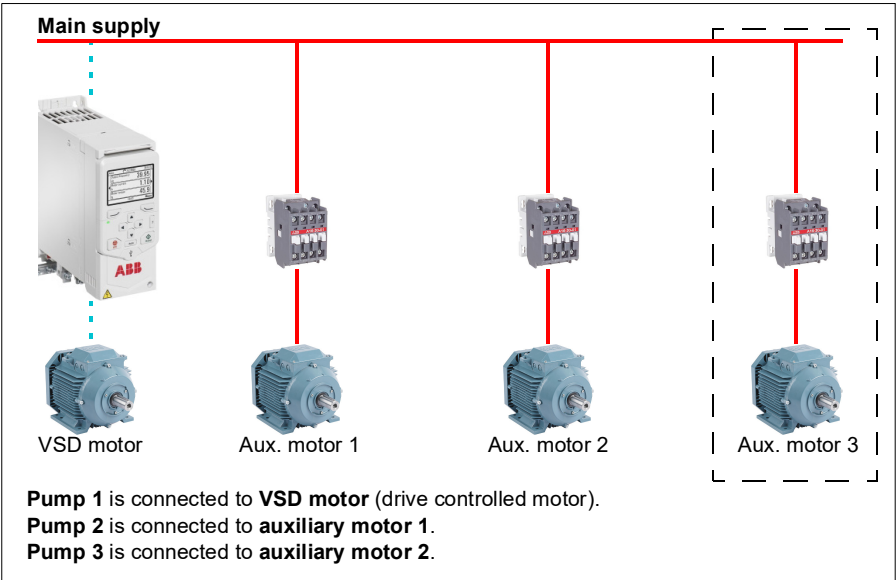
| Flow consumption vs. pump status | | | |
|---|---|---|---|
| Consumption | Pump 1 | Pump 2 | Pump 2 |
| Low | **VSD** | **Off** | **Off** |
| ↓ | **VSD** | **DOL** | **Off** |
| High | **VSD** | **DOL** | **DOL** |
| ↓ | **VSD** | **DOL** | **Off** |
| Low | **VSD** | **Off** | **Off** |

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

**Soft pump and fan control (SPFC)**

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

The main difference between traditional PFC and SPFC logic is how the SPFC logic connects auxiliary motors on-line. When the criteria for starting a new motor is fulfilled (see above) the SPFC logic connects the drive controlled motor to the supply network in a flying start, that is, while the motor is still coasting. The drive then connects to the

next pump/fan unit to be started and starts controlling the speed of that one, while the previously controlled unit is now connected directly on line through a contactor.

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

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

**Example:** Three-pump constant pressure water supply application



**Main supply**

Motor 1    Motor 2    Motor 3

**Pump 1** is connected to **Motor 1**.
**Pump 2** is connected to **Motor 2**.
**Pump 3** is connected to **Motor 3**.
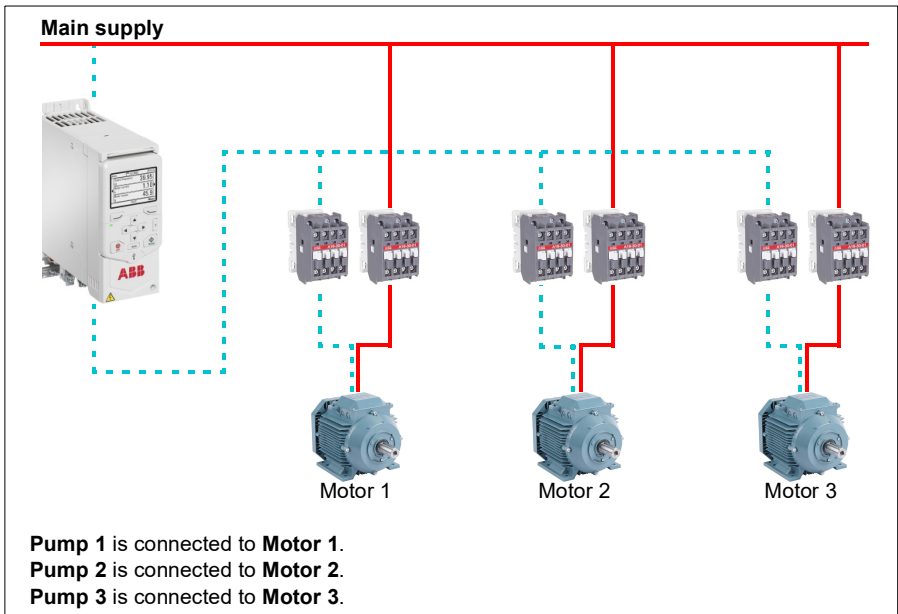
| Flow consumption and pump status | | | |
|---|---|---|---|
| Consumption | Pump 1 | Pump 2 | Pump 2 |
| Low | **VSD** | **Off** | **Off** |
| ↓ | **DOL** | **VSD** | **Off** |
| High | **DOL** | **DOL** | **VSD** |
| ↓ | **DOL** | **Off** | **VSD** |
| Low | **Off** | **Off** | **VSD** |
| ↓ | **VSD** | **Off** | **DOL** |
| High | **DOL** | **VSD** | **DOL** |
| ↓ | **DOL** | **VSD** | **Off** |
| Low | **Off** | **VSD** | **Off** |
| ↓ | **VSD** | **DOL** | **Off** |
| High | **DOL** | **DOL** | **VSD** |

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

**6**

### Autochange

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

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

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

### 1. Autochange PFC with auxiliary motors only

**Example:** Three-pump constant pressure water supply application.

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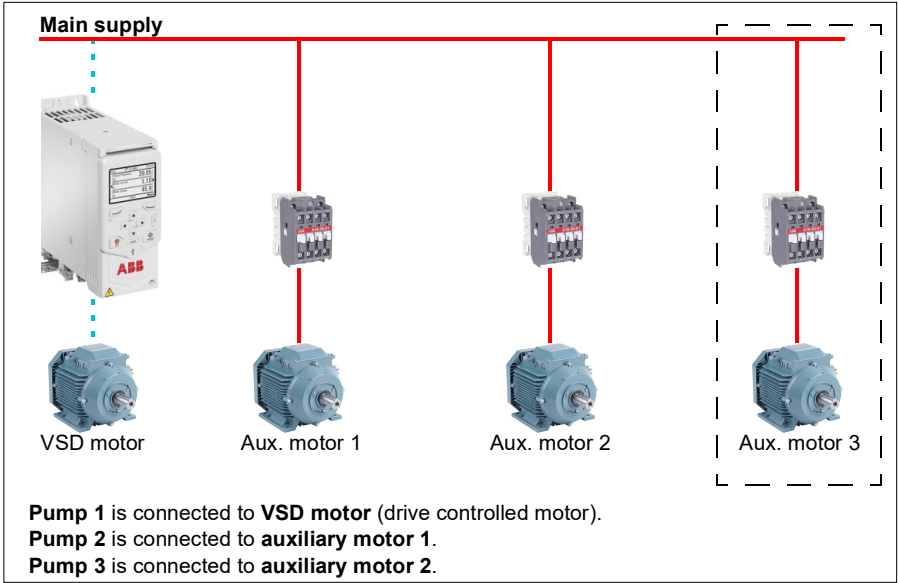


**Pump 1** is connected to **VSD motor** (drive controlled motor).
**Pump 2** is connected to **auxiliary motor 1**.
**Pump 3** is connected to **auxiliary motor 2**.

| Flow consumption and pump status | | | |
|---|---|---|---|
| Consumption | Pump 1 | Pump 2 | Pump 2 |
| Low | VSD | Off | Off |
| Normal | VSD | DOL | Off |
| ↓ | VSD | Off | DOL |
| ↓ | VSD | DOL | Off |
| Normal | VSD | Off | DOL |

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

**2. Autochange PFC with all motors**

**Example:** Three-pump constant pressure water supply application

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

In this mode, the VSD motor will move to the next pump one by one, but the auxiliary motor will always be put on-line in DOL mode. However, three pumps are shifted overall.
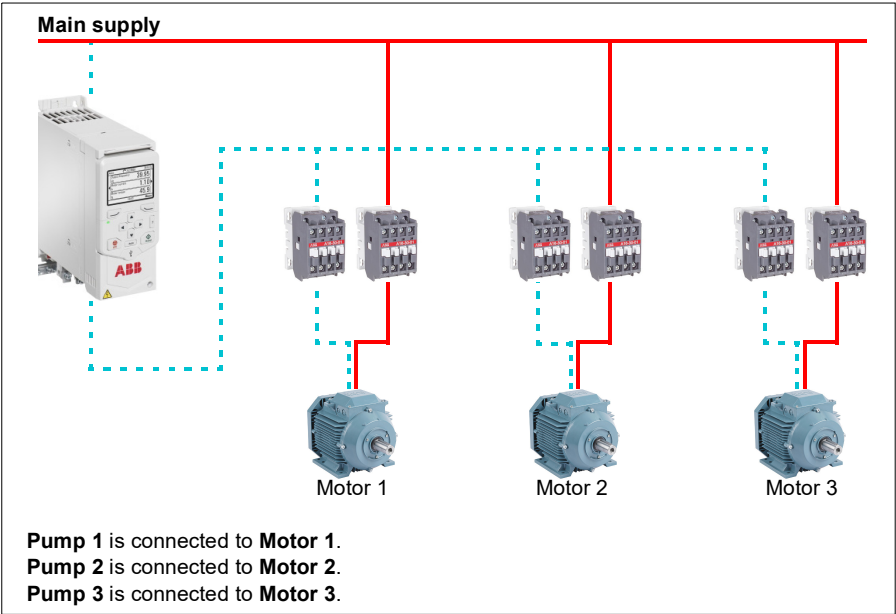
**6**



**Main supply**

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

| Flow consumption and pump status | | | |
|---|---|---|---|
| Consumption | Pump 1 | Pump 2 | Pump 2 |
| Low | VSD | Off | Off |
| Normal | VSD | DOL | Off |
| ↓ | Off | VSD | DOL |
| ↓ | DOL | Off | VSD |
| Normal | VSD | DOL | Off |

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

### 3. Autochange with SPFC

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

**Example:** Three-pump constant pressure water supply application

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

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

**Main supply**



**Pump 1** is connected to **Motor 1**.
**Pump 2** is connected to **Motor 2**.
**Pump 3** is connected to **Motor 3**.
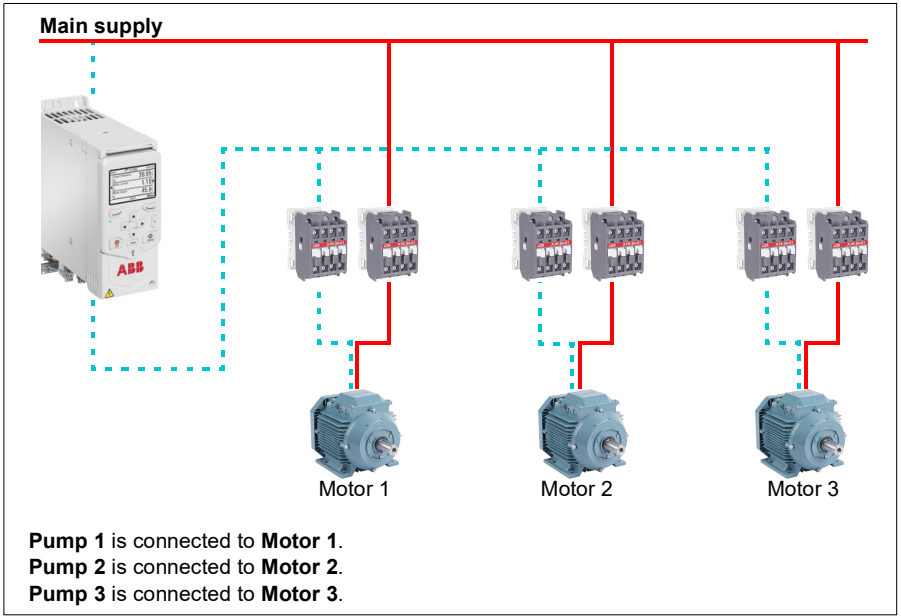
| Flow consumption and pump status | | | |
|---|---|---|---|
| Consumption | Pump 1 | Pump 2 | Pump 2 |
| Low | **VSD** | **Off** | **Off** |
| Normal | **DOL** | **VSD** | **Off** |
| ↓ | **Off** | **DOL** | **VSD** |
| ↓ | **VSD** | **Off** | **DOL** |
| Normal | **DOL** | **VSD** | **Off** |

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

**Interlock**

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

**Settings**

- Parameter group *10 Standard DI, RO* (page *342*)
- Parameter group *40 Process PID set 1* (page *463*)
- Parameter groups *76 PFC configuration* (page *516*) and *77 PFC maintenance and monitoring* (page *523*).

**6**

**6**

## ◼ Application example 1: 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:

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

**Wiring diagram**

| **X1** | | Reference voltage and analog inputs and outputs | |
|---|---|---|---|
| 1 | SCR | Signal cable shield (screen) | |
| 2 | AI1 | **Output frequency/speed reference**: 0…10 V | |
| 3 | AGND | Analog input circuit common | |
| 4 | +10V | Reference voltage 10 V DC | |
| 5 | AI2 | **Actual feedback:** 0…20 mA | |
| 6 | AGND | Analog input circuit common | |
| 7 | AO1 | **Output frequency:** 0…10 V | |
| 8 | AO2 | **Motor current:** 0…20 mA | |
| 9 | AGND | Analog output circuit common | |
| **X2 & X3** | | Aux. voltage output and programmable digital inputs | |
| 10 | +24V | Aux. voltage output +24 V DC, max. 200 mA | |
| 11 | DGND | Aux. voltage output common | |
| 12 | DCOM | Digital input common for all | |
| 13 | DI1 | **Stop (0) / Start (1)** | |
| 14 | DI2 | Not configured | |
| 15 | DI3 | **Constant frequency/speed selection** | |
| 16 | DI4 | Not configured | |
| 17 | DI5 | Not configured | |
| 18 | DI6 | Not configured | |
| **X6, X7, X8** | | Relay outputs | |
| 19 | RO1C | **Damper control** | Energize damper |
| 20 | RO1A | 250 V AC / 30 V DC | 19 connected to 21 |
| 21 | RO1B | 2 A | |
| 22 | RO2C | **Running** | Running |
| 23 | RO2A | 250 V AC / 30 V DC | 22 connected to 24 |
| 24 | RO2B | 2 A | |
| 25 | RO3C | **Fault (-1)** | Fault condition |
| 26 | RO3A | 250 V AC / 30 V DC | 25 connected to 26 |
| 27 | RO3B | 2 A | |

0…10 V DC speed reference signal → + / − (to AI1)

Start/stop signal → (to DI1)

**6**

**Quick steps – Programming summary**

Settings listed below are changed relative to the drive's factory defaults to meet the application requirements:

**Menu > Primary settings > Start, stop, reference > Interlocks/permissives**

- Unselect ☐ **Use start interlock 1**

**6**

### ■ Application example 2: 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:

- Start/stop contact closure from the building automation system (BAS)
- A 0…10 V DC analog speed command signal from the BAS
- A duct high static pressure safety (Overpressure) contact wired to the drive
- A run/stop status feedback from the drive to the BAS
- A fault/not-faulted status feedback from the drive to the BAS.

**Wiring diagram**

| | X1 | Reference voltage and analog inputs and outputs | |
|---|---|---|---|
| | **1** | SCR | Signal cable shield (screen) |
| 0…10 V DC speed reference signal | **2** | AI1 | **Output frequency/speed reference**: 0…10 V |
| | **3** | AGND | Analog input circuit common |
| | **4** | +10V | Reference voltage 10 V DC |
| | **5** | AI2 | **Actual feedback:** 0…20 mA |
| | **6** | AGND | Analog input circuit common |
| | **7** | AO1 | **Output frequency:** 0…10 V |
| | **8** | AO2 | **Motor current:** 0…20 mA |
| | **9** | AGND | Analog output circuit common |
| | X2 & X3 | Aux. voltage output and programmable digital inputs | |
| | **10** | +24V | Aux. voltage output +24 V DC, max. 200 mA |
| | **11** | DGND | Aux. voltage output common |
| | **12** | DCOM | Digital input common for all |
| Start/stop signal | **13** | DI1 | **Stop (0) / Start (1)** |
| | **14** | DI2 | Not configured |
| | **15** | DI3 | **Constant frequency/speed selection** |
| High static safety (Overpressure) | **16** | DI4 | **Start interlock 1 (1 = allow start)** |
| | **17** | DI5 | Not configured |
| | **18** | DI6 | Not configured |
| | X6, X7, X8 | Relay outputs | |

| | | | | |
|---|---|---|---|---|
| | **19** | RO1C | **Damper control** | Energize damper |
| | **20** | RO1A | 250 V AC / 30 V DC | 19 connected to 21 |
| | **21** | RO1B | 2 A | |
| Run status | **22** | RO2C | **Running** | Running |
| | **23** | RO2A | 250 V AC / 30 V DC | 22 connected to 24 |
| | **24** | RO2B | 2 A | |
| Fault status | **25** | RO3C | **Fault (-1)** | Fault condition |
| | **26** | RO3A | 250 V AC / 30 V DC | 25 connected to 26 |
| | **27** | RO3B | 2 A | |

**Quick steps** – **Programming summary**

Settings listed below are changed relative to the drive's factory defaults to meet the application requirements:

**Menu > Primary settings > Start, stop, reference > Interlocks/permissives**

- ☑ **Use start interlock 1**
    - Edit **Description text:** *Overpressure*

**6**

## Application example 3: 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:

- Start/stop contact closure from the building automation system (BAS)
- A 0…10 V DC analog speed command signal from the BAS
- A damper end-switch contact closure to the drive, to indicate the damper open/closed status
- A duct high static pressure safety (Overpressure) contact wired to the drive
- A supply air Smoke alarm safety contact wired to the drive
- A run/stop status feedback from the drive to the BAS
- A fault/not-faulted status feedback from the drive to the BAS
- A relay output to the external, actuator control circuit to open an isolation damper
- A 0…10 V DC analog output signal from the drive, to indicate drive output frequency, to the BAS.

**6**

### Wiring diagram

| X1 | | Reference voltage and analog inputs and outputs | |
|---|---|---|---|
| 1 | SCR | Signal cable shield (screen) | |
| 2 | AI1 | **Output frequency/speed reference**: 0…10 V | |
| 3 | AGND | Analog input circuit common | |
| 4 | +10V | Reference voltage 10 V DC | |
| 5 | AI2 | **Actual feedback:** 0…20 mA | |
| 6 | AGND | Analog input circuit common | |
| 7 | AO1 | **Output frequency:** 0…10 V | |
| 8 | AO2 | **Motor current:** 0…20 mA | |
| 9 | AGND | Analog output circuit common | |

0…10 V DC speed reference signal → 2, 3 (+/−)
0…10 V DC output frequency ← 7, 8 (+/−)

| X2 & X3 | | Aux. voltage output and programmable digital inputs | |
|---|---|---|---|
| 10 | +24V | Aux. voltage output +24 V DC, max. 200 mA | |
| 11 | DGND | Aux. voltage output common | |
| 12 | DCOM | Digital input common for all | |
| 13 | DI1 | **Stop (0) / Start (1)** | |
| 14 | DI2 | **Run permissive (1 = allow start)** | |
| 15 | DI3 | **Constant frequency/speed selection** | |
| 16 | DI4 | **Start interlock 1 (1 = allow start)** | |
| 17 | DI5 | **Start interlock 2 (1 = allow start)** | |
| 18 | DI6 | Not configured | |

Start/stop signal → 13
Damper end switch → 14
High static safety (Overpressure) → 16
Smoke alarm safety → 17

| X6, X7, X8 | | Relay outputs | |
|---|---|---|---|
| 19 | RO1C | **Damper control** | Energize damper |
| 20 | RO1A | 250 V AC / 30 V DC | 19 connected to 21 |
| 21 | RO1B | 2 A | |
| 22 | RO2C | **Running** | Running |
| 23 | RO2A | 250 V AC / 30 V DC | 22 connected to 24 |
| 24 | RO2B | 2 A | |
| 25 | RO3C | **Fault (-1)** | Fault condition |
| 26 | RO3A | 250 V AC / 30 V DC | 25 connected to 26 |
| 27 | RO3B | 2 A | |

Damper actuator ← 19, 21
Run status ← 22, 24
Fault status ← 25, 26

**Quick steps – Programming summary**

Settings listed below are changed relative to the drive's factory defaults to meet the application requirements:

**Primary settings > Start, stop, reference > Interlocks/permissives**

- Select ☑ **Use run permissive signal**
    - Edit **Run enabled when:** *DI2 high*
    - Edit **Description text:** *Damper end switch*
- ☑ **Use start interlock 1**
    - Edit **Description text:** *Overpressure*
- Select ☑ **Use start interlock 2.**
    - Edit **Start enabled when:** *DI5 high*
    - Edit **Description text:** *Smoke alarm*

**6**

## Application example 4: 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:

- Start/stop contact closure from the building automation system (BAS)
- 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)
- 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)
- A duct high static pressure safety (Overpressure) contact wired to the drive
- A Freezestat safety contact wired to the drive
- A run/stop status feedback from the drive to the BAS
- A fault/not-faulted status feedback from the drive to the BAS.

### Wiring diagram

| X1 | | Reference voltage and analog inputs and outputs | |
|---|---|---|---|
| 1 | SCR | Signal cable shield (screen) | |
| 2 | AI1 | **Speed reference**: 4…20 mA | |
| 3 | AGND | Analog input circuit common | |
| 4 | +10V | Reference voltage 10 V DC | |
| 5 | AI2 | **Actual feedback:** 4…20 mA | |
| 6 | AGND | Analog input circuit common | |
| 7 | AO1 | **Output frequency:** 0…10 V | |
| 8 | AO2 | **Motor current:** 0…20 mA | |
| 9 | AGND | Analog output circuit common | |
| **X2 & X3** | | Aux. voltage output and programmable digital inputs | |
| 10 | +24V | Aux. voltage output +24 V DC, max. 200 mA | |
| 11 | DGND | Aux. voltage output common | |
| 12 | DCOM | Digital input common for all | |
| 13 | DI1 | **Stop (0) / Start (1)** | |
| 14 | DI2 | Not configured | |
| 15 | DI3 | **Constant frequency/speed selection** | |
| 16 | DI4 | **Start interlock 1 (1 = allow start)** | |
| 17 | DI5 | **Start interlock 2 (1 = allow start)** | |
| 18 | DI6 | Not configured | |
| **X6, X7, X8** | | Relay outputs | |
| 19 | RO1C | **Damper control** | Energize damper |
| 20 | RO1A | 250 V AC / 30 V DC | 19 connected to 21 |
| 21 | RO1B | 2 A | |
| 22 | RO2C | **Running** | Running |
| 23 | RO2A | 250 V AC / 30 V DC | 22 connected to 24 |
| 24 | RO2B | 2 A | |
| 25 | RO3C | **Fault (-1)** | Fault condition |
| 26 | RO3A | 250 V AC / 30 V DC | 25 connected to 26 |
| 27 | RO3B | 2 A | |

4…20 mA pressure command signal — + / -

4…20 mA pressure feedback signal — + / -

Start/stop signal

High static safety (Overpressure)

Freezestat safety

Run status

Fault status

**Quick steps – Programming summary**

Settings listed below are changed relative to the drive's factory defaults to meet the application requirements:

**Menu > Primary settings > Start, stop, reference > Interlocks/permissives**

- ☑ **Use start interlock 1**
  - Edit **Description text:** *Overpressure*
- Select ☑ **Use start interlock 2**
  - Edit **Description text:** *Freezestat*

**Menu > Primary settings > PID control**

- Select ☑ **Use PID control**
- Edit **Start/stop/dir from:** *DI1 start/stop*
- Edit ☑ **Unit:** *kPa* (or *inWC*)

**Menu > Primary settings > PID control > Feedback**

- Edit **Source:** *AI2 Scaled*

**Menu > Primary settings > PID control > Feedback > AI2 Scaling**

- Edit **Range:** *4…20 mA*
- Edit **Scaled min:** *0 kPa* (or *0 inWC*)
- Edit **Scaled max:** *1.25 kPa* (or *5.0 inWC*)

**Menu > Primary settings > PID control > Setpoint**

- Edit **Source:** *AI1 scaled*

**Menu > Primary settings > PID control > Setpoint > AI1 Scaling**

- Edit **Range:** *4…20 mA*
- Edit **Scaled min:** *0.0 kPa* (or *0.0 inWC*)
- Edit **Scaled max:** *0.5 kPa* (or *2.0 inWC*)

**Menu > Primary settings > PID control**

- **Tuning** (adjust the gain and integration time of the PID, as needed for the application)

### ■ Application example 5: 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:

- Start/stop contact closure from the building automation system (BAS)
- A 4…20 mA analog speed command signal from the BAS
- A vibration safety switch contact wired to the drive
- A run/stop status feedback from the drive to the BAS
- A fault/not-faulted status feedback from the drive to the BAS
- Minimum frequency programmed to 30 Hz due to lubrication needs of this particular fan's right angle gear box.

**Wiring diagram**

| X1 | | Reference voltage and analog inputs and outputs | |
|---|---|---|---|
| 1 | SCR | Signal cable shield (screen) | |
| 2 | AI1 | **Output frequency/speed reference**: 4…20 mA | |
| 3 | AGND | Analog input circuit common | |
| 4 | +10V | Reference voltage 10 V DC | |
| 5 | AI2 | **Actual feedback:** 0…20 mA | |
| 6 | AGND | Analog input circuit common | |
| 7 | AO1 | **Output frequency:** 0…10 V | |
| 8 | AO2 | **Motor current:** 0…20 mA | |
| 9 | AGND | Analog output circuit common | |
| **X2 & X3** | | Aux. voltage output and programmable digital inputs | |
| 10 | +24V | Aux. voltage output +24 V DC, max. 200 mA | |
| 11 | DGND | Aux. voltage output common | |
| 12 | DCOM | Digital input common for all | |
| 13 | DI1 | **Stop (0) / Start (1)** | |
| 14 | DI2 | Not configured | |
| 15 | DI3 | **Constant frequency/speed selection** | |
| 16 | DI4 | **Start interlock 1 (1 = allow start)** | |
| 17 | DI5 | Not configured | |
| 18 | DI6 | Not configured | |
| **X6, X7, X8** | | Relay outputs | |
| 19 | RO1C | **Damper control** | Energize damper |
| 20 | RO1A | 250 V AC / 30 V DC | 19 connected to 21 |
| 21 | RO1B | 2 A | |
| 22 | RO2C | **Running** | Running |
| 23 | RO2A | 250 V AC / 30 V DC | 22 connected to 24 |
| 24 | RO2B | 2 A | |
| 25 | RO3C | **Fault (-1)** | Fault condition |
| 26 | RO3A | 250 V AC / 30 V DC | 25 connected to 26 |
| 27 | RO3B | 2 A | |

4…20 mA speed command signal → + / −

Start/stop signal

Vibration switch

Run status

Fault status

**6**

**Quick steps – Programming summary**

Settings listed below are changed relative to the drive's factory defaults to meet the application requirements:

**Menu > Primary settings > Start, stop, reference > Primary auto control location > AI1 scaling**

• Edit **Range**: *4…20 mA*

**Primary settings > Start, stop, reference > Interlocks/permissives**

• ☑ **Use start interlock 1**
    • Edit **Description text:** *Vibration switch*

**Primary setting > Limits**

• Edit **Minimum frequency:** *30.00 Hz*

**6**

■ **Application example 6: 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:

- 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
- 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)
- A vibration safety switch contact wired to the drive
- A run/stop status feedback from the drive to the BAS
- A fault/not-faulted 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)

**6**

## Wiring diagram

| X1 | | | Reference voltage and analog inputs and outputs | |
|---|---|---|---|---|
| 1 | | SCR | Signal cable shield (screen) | |
| 2 | | AI1 | **Output frequency/speed reference**: 0…10 V | |
| 3 | | AGND | Analog input circuit common | |
| 4 | | +10V | Reference voltage 10 V DC | |
| 5 | | AI2 | **Actual feedback: 4…20 mA** | |
| 6 | | AGND | Analog input circuit common | |
| 7 | | AO1 | **Output frequency:** 0…10 V | |
| 8 | | AO2 | **Motor current:** 0…20 mA | |
| 9 | | AGND | Analog output circuit common | |
| **X2 & X3** | | | Aux. voltage output and programmable digital inputs | |
| 10 | | +24V | Aux. voltage output +24 V DC, max. 200 mA | |
| 11 | | DGND | Aux. voltage output common | |
| 12 | | DCOM | Digital input common for all | |
| 13 | | DI1 | **Stop (0) / Start (1)** | |
| 14 | | DI2 | Not configured | |
| 15 | | DI3 | **Constant frequency/speed selection** | |
| 16 | | DI4 | **Start interlock 1 (1 = allow start)** | |
| 17 | | DI5 | Not configured | |
| 18 | | DI6 | Not configured | |
| **X6, X7, X8** | | | Relay outputs | |
| 19 | | RO1C | **Damper control** | Energize damper |
| 20 | | RO1A | 250 V AC / 30 V DC | 19 connected to 21 |
| 21 | | RO1B | 2 A | |
| 22 | | RO2C | **Running** | Running |
| 23 | | RO2A | 250 V AC / 30 V DC | 22 connected to 24 |
| 24 | | RO2B | 2 A | |
| 25 | | RO3C | **Fault (-1)** | Fault condition |
| 26 | | RO3A | 250 V AC / 30 V DC | 25 connected to 26 |
| 27 | | RO3B | 2 A | |

4…20 mA temp. + / feedback signal - → (to AI2, terminals 5/6)

Start/stop signal → (DI1, terminal 13)

Vibration switch → (DI4, terminal 16)

Run status ← (RO2)

Fault status ← (RO3)

**6**

**Quick steps – Programming summary**

Settings listed below are changed relative to the drive's factory defaults to meet the application requirements:

**Menu > Primary settings > Start, stop, reference > Interlocks/permissives**

- ☑ **Use Start interlock 1**
  - Edit **Description text:** *Vibration switch*

**Menu > Primary settings > Limits**

- Edit **Minimum frequency:** *20 Hz*

**Menu > Primary settings > PID control**

- Select ☑ **Use PID control**
- Edit **Start/stop/dir from:** *DI1 start/stop*
- Edit **Unit:** *°C* (or *°F*)

**Menu > Primary Settings > PID control > Feedback**

- Edit **Source:** *AI2 Scaled*

**6**

**Menu > Primary Settings > PID control > Feedback > AI2 Scaling**

- Edit **Range:** *4…20 mA*
- Edit **Scaled min:** *-30.0°C* (or *-22°F*)
- Edit **Scaled max:** *50.0°C* (or *122°F*)

**Menu > Primary Settings > PID control > Setpoint**

- Edit **Source:** *Constant setpoint*
- Edit **Constant setpoint 1:** *24.0°C* (or *75.0°F*)

**Menu > Primary Settings > PID control >**

- **Tuning** (adjust the gain and integration time of the PID, as needed for the application)
- Edit **Increase output:** *Feedback > setpoint*

**Menu > Primary Settings > PID control > Sleep function**

- Select ☑ **Use sleep function**
- Edit **Activation level:** *25 Hz*
- Edit **Delay:** *30.0 s*
- Edit **Wake-up deviation:** *2 °C* (or *4 °F*)

**6**

## ■ Application example 7: 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:

• Start/stop contact closure from the building automation system (BAS)

• A 0…10 V DC analog speed command signal from the BAS

• A run/stop status feedback from the drive to the BAS

• A fault/not-faulted status feedback from the drive to the BAS

• A 4…20 mA analog output signal from the drive, to indicate drive output current, to the BAS

• When a stop command is received, the drive shall ramp the motor to a stop to prevent water hammer.

**Wiring diagram**

| | X1 | | Reference voltage and analog inputs and outputs | |
|---|---|---|---|---|
| | 1 | SCR | Signal cable shield (screen) | |
| 0…10 V DC speed reference signal | 2 | AI1 | **Output frequency/speed reference**: 0…10 V | |
| | 3 | AGND | Analog input circuit common | |
| | 4 | +10V | Reference voltage 10 V DC | |
| | 5 | AI2 | **Actual feedback:** 0…20 mA | |
| | 6 | AGND | Analog input circuit common | |
| | 7 | AO1 | **Output frequency:** 0…10 V | |
| 4…20 mA output current | 8 | AO2 | **Motor current:** 4…20 mA | |
| | 9 | AGND | Analog output circuit common | |
| | X2 & X3 | | Aux. voltage output and programmable digital inputs | |
| | 10 | +24V | Aux. voltage output +24 V DC, max. 200 mA | |
| | 11 | DGND | Aux. voltage output common | |
| | 12 | DCOM | Digital input common for all | |
| Start/stop signal | 13 | DI1 | **Stop (0) / Start (1)** | |
| | 14 | DI2 | Not configured | |
| | 15 | DI3 | **Constant frequency/speed selection** | |
| | 16 | DI4 | Not configured | |
| | 17 | DI5 | Not configured | |
| | 18 | DI6 | Not configured | |
| | X6, X7, X8 | | Relay outputs | |
| | 19 | RO1C | **Damper control** | Energize damper |
| | 20 | RO1A | 250 V AC / 30 V DC | 19 connected to 21 |
| | 21 | RO1B | 2 A | |
| | 22 | RO2C | **Running** | Running |
| Run status | 23 | RO2A | 250 V AC / 30 V DC | 22 connected to 24 |
| | 24 | RO2B | 2 A | |
| Fault status | 25 | RO3C | **Fault (-1)** | Fault condition |
| | 26 | RO3A | 250 V AC / 30 V DC | 25 connected to 26 |
| | 27 | RO3B | 2 A | |

**Quick steps – Programming summary**

Settings listed below are changed relative to the drive's factory defaults to meet the application requirements:

**Menu > I/O > AO2**

• Edit **Range:** *4…20 mA*

**Menu > Primary settings > Ramps**

• Edit **Stop mode:** *Ramp*

**Menu > Primary settings > Start, stop, reference > Interlocks/permissives**

• Unselect ☐ **Use start interlock 1**

**6**

## ■ Application example 8: 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:

- Start/stop contact closure from the building automation system (BAS)
- A 4…20 mA analog speed command signal from the BAS
- A run/stop status feedback from the drive to the BAS
- A fault/not-faulted 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**

| X1 | | Reference voltage and analog inputs and outputs | | |
|---|---|---|---|---|
| 1 | SCR | Signal cable shield (screen) | | |
| 2 | AI1 | **Output frequency/speed reference**: 4…20 mA | | |
| 3 | AGND | Analog input circuit common | | |
| 4 | +10V | Reference voltage 10 V DC | | |
| 5 | AI2 | **Actual feedback:** 0…20 mA | | |
| 6 | AGND | Analog input circuit common | | |
| 7 | AO1 | **Output frequency:** 0…10 V | | |
| 8 | AO2 | **Motor current:** 4…20 mA | | |
| 9 | AGND | Analog output circuit common | | |
| X2 & X3 | | Aux. voltage output and programmable digital inputs | | |
| 10 | +24V | Aux. voltage output +24 V DC, max. 200 mA | | |
| 11 | DGND | Aux. voltage output common | | |
| 12 | DCOM | Digital input common for all | | |
| 13 | DI1 | **Stop (0) / Start (1)** | | |
| 14 | DI2 | Not configured | | |
| 15 | DI3 | **Constant frequency/speed selection** | | |
| 16 | DI4 | Not configured | | |
| 17 | DI5 | Not configured | | |
| 18 | DI6 | Not configured | | |
| X6, X7, X8 | | Relay outputs | | |
| 19 | RO1C | **Damper control** | Energize damper | |
| 20 | RO1A | 250 V AC / 30 V DC | 19 connected to 21 | |
| 21 | RO1B | 2 A | | |
| 22 | RO2C | **Running** | Running | |
| 23 | RO2A | 250 V AC / 30 V DC | 22 connected to 24 | |
| 24 | RO2B | 2 A | | |
| 25 | RO3C | **Fault (-1)** | Fault condition | |
| 26 | RO3A | 250 V AC / 30 V DC | 25 connected to 26 | |
| 27 | RO3B | 2 A | | |

4…20 mA speed reference signal → + / −

Start/stop signal

Run status

Fault status

**Quick steps – Programming summary**

Settings listed below are changed relative to the drive's factory defaults to meet the application requirements:

**Menu > Primary settings > Start, stop, reference > Primary auto control location AI1 scaling**

- Edit **Range:** *4…20 mA*

**Menu > Primary settings > Start, stop, reference > Interlocks/permissives**

- Unselect ☐ **Use start interlock 1**

**Menu > Primary settings > Ramps**

- Edit **Stop mode:** *Ramp*

**Menu > Primary setting > Limits**

- Edit **Minimum frequency:** *20 Hz*

**6**

# 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**

- **Menu > Energy efficiency**
- Parameter *45.11 Energy optimizer* (page *486*).

## ■ Energy saving calculators

This feature consists of the following functionalities:

- An energy optimizer that adjusts the motor flux in such a way that the total system efficiency is maximized
- A counter that monitors used and saved energy by the motor and displays them in kWh, currency or volume of $CO_2$ emissions, and
- A load analyzer showing the load profile of the drive (see separate section on page *173*).

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**

- **Menu > Energy efficiency**
- Parameter group *45 Energy efficiency* (page *484*)
- Parameters *01.50 Current hour kWh*, *01.51 Previous hour kWh*, *01.52 Current day kWh* and *01.53 Previous day kWh* on page *326*
- 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 assistant panel or the Drive composer PC tool.

**6**



Amplitude ranges
(parameters *36.40…36.49*)
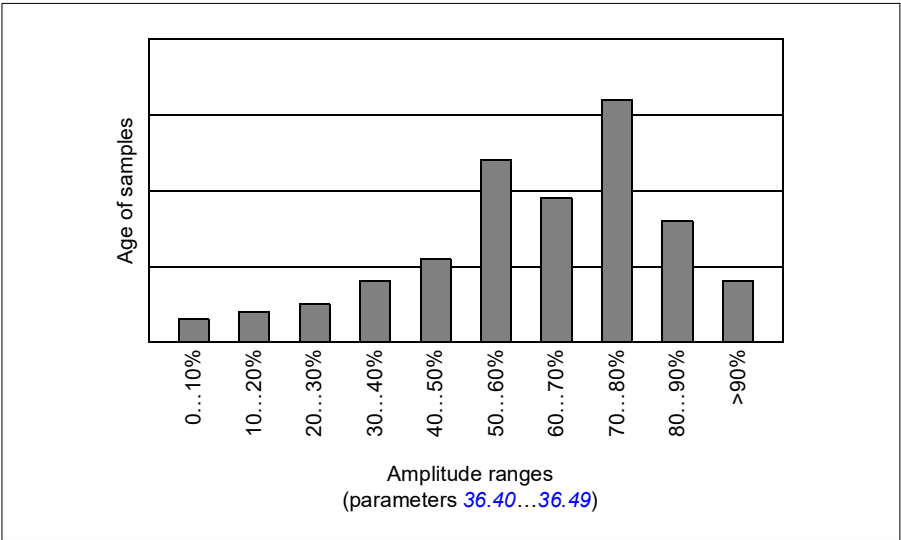
Amplitude logger 1 is fixed to monitor motor current, and cannot be reset. With amplitude logger 1, 100% corresponds to the maximum output current of the drive ($I_{max}$), which is listed in the *Hardware manual* of the drive. The measured current is logged continuously. The distribution of samples is shown by parameters *36.20…36.29*.

**Settings**

- **Menu > Diagnostics > Load profile**
- Parameter group *36 Load analyzer* (page *457*).

**6**

# Managing settings

## ◼ User parameter sets

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

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

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

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

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

Switching between sets is only possible with the drive stopped.

**Settings**

- **Menu > Primary settings > Advanced functions > User sets**
- Parameters *96.10*…*96.13* (page *532*).

# Safety and protections

## ■ Fixed/Standard protections

### Overcurrent

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

### DC overvoltage

See section *Overvoltage control* on page *135*.

### DC undervoltage

See section *Undervoltage control (power loss ride-through)* on page *135*.

### 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.

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

Note that

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

### Supply phase loss detection (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 (parameter *31.30…31.31*)**

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

**Local control loss detection (parameter *49.05*)**

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

**AI supervision (parameters *12.03…12.04*)**

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

### ■ 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*.
- Stop torque.

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

**Notes:**

• The installer of the equipment is responsible for installing the emergency stop devices and all additional devices needed for the emergency stop function to fulfill the required emergency stop categories. For more information, contact your local ABB representative.

• After an emergency stop signal is detected, the emergency stop function cannot be canceled even though the signal is canceled.

• If the minimum (or maximum) torque limit is set to 0%, the emergency stop function may not be able to stop the drive.

**Settings**

• Parameters *21.04 Emergency stop mode* (page *382*), *21.05 Emergency stop source* (page *382*), *23.23 Emergency stop time* (page *399*), *31.32 Emergency ramp supervision* (page *431*) and *31.33 Emergency ramp supervision delay* (page *432*).

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# Diagnostics

## ■ Diagnostics menu

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

```
Off◇        ⌐ ACH480        0.0 Hz
Diagnostics ─────────────
Drive actual values          ►
Active faults
Active warnings
Active inhibits
Fault & event log            ►
Back          16:03      Select
```
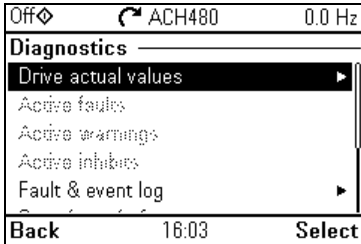
- **Drive actual values**
- **Active faults:** Use this view to see currently active faults and how to fix and reset them.
- **Active warnings:** Use this view to see currently active warnings and how to fix them.
- **Active inhibits:** Use this view to see the active inhibits and how to fix them. In addition, in the **Clock, region, display** menu you can disable (enabled by default) pop-up views showing information on inhibits when you try to start the drive but it is prevented.
- **Fault and event log:** Shows lists faults and other events.
- **Start/stop/reference summary:** Use this view to find out where the control comes from if the drive is not starting or stopping as expected, or runs at an undesired speed.
- **Limit status:** Use this view to find out whether any limitations are active if the drive is running at undesired speed.
- **Communication status:** Use this view to find out status information and sent and received data from fieldbus.
- **Motor summary:** Use this view to find out motor nominal values, control mode and whether ID run has been completed.

**Settings**

- **Menu > Diagnostics**
- **Menu > Primary settings > Clock, region, display > Show inhibit pop-up**.

# Miscellaneous

## ■ Backup and restore

You can make backups of the settings manually to the assistant panel. The assistant 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.

### Backup

<u>Manual backup</u>

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

Parameter changes from fieldbus interfaces are ignored unless you have forced parameter saving with parameter *96.07 Parameter save manually*.

<u>Automatic backup</u>

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

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

Parameter changes from fieldbus interfaces are ignored unless you have forced parameter saving with parameter *96.07 Parameter save manually*.

### Restore

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

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

**Note:** There is a risk of removing the **QR code** menu entry permanently if a backup from a drive with an old firmware or old panel firmware is restored to a drive with a new firmware from October 2014 or later.

| Off◇ | ⟳ ACH480 | 50.0 Hz |
|---|---|---|
| **Backups** | | |
| Create backup | | |
| A ACH480 11.10.2018 autobackup ▶ | | |
| ☐ ACH480 15.10.2018 | | ▶ |
| | | |
| **Back** | 10:03 | **Select** |

| Off◇ | ⟳ ACH480 | 50.0 Hz |
|---|---|---|
| **ACH480 11.10.2018 autobackup** — | | |
| 🖹 View back up contents | | ▶ |
| ↩ Restore all parameters | | |
| Select par restore group | | ▶ |
| Select user sets | | ▶ |
| Select prod. data items | | ▶ |
| **Back** | 10:03 | Select |
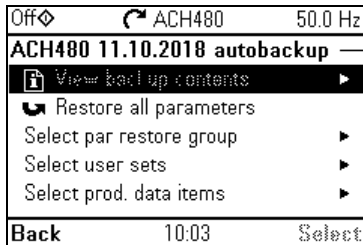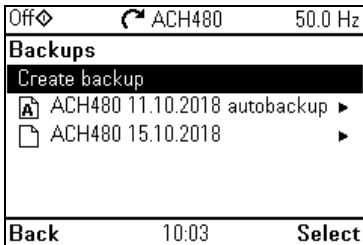
**Settings**

• **Menu > Backups**

• Parameter *96.07 Parameter save manually* (page *531*).

■ **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 *492*).

■ **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…13, 15, 19…25, 28, 30…32, 34…37, 40…41, 43, 45…46, 70…74, 76, 80, 94…99.

The set of parameters for checksum B does not include

• fieldbus settings

• motor data settings

• energy data settings.

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

**Settings**

• Parameters *96.54*…*96.69*, *96.71*…*96.72* (page *534*).

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## ◼ 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.

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

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- To activate the user lock for the first time:
- Enter the default pass code, 10000000, into *96.02 Pass code*. This will make parameters *96.100*…*96.102* visible.
- Enter a new pass code into *96.100 Change user pass code*. Always use eight digits; if using Drive composer PC tool, finish with Enter.
- Confirm the new pass code in *96.100 Change user pass code*.

---

⚠ **WARNING!** Store the pass code in a safe place – the user lock cannot be opened even by ABB if the pass code is lost.

---

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

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

**Settings**

- Parameters *96.02* (page *530*) and *96.100*…*96.102* (page *536*).

## ◼ Sine filter support

The control program has a setting that enables the use of ABB sine filters (available separately). With a sine filter connected to the output of the drive, bit 1 of *95.15 Special HW settings* must be switched on. The setting forces the drive to use the scalar motor control mode, and limits the switching and output frequencies to

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

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

**Settings**

• Parameter *95.15 Special HW settings* (page *525*).

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# Fault tracing

## What this chapter contains

The chapter lists the warning and fault messages including possible causes and corrective actions. The causes of most warnings and faults can be identified and corrected using the information in this chapter. If not, contact an ABB service representative. If you have a possibility to use the Drive composer PC tool, send the Support package created by the Drive composer to the ABB service representative.

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

## Safety

**WARNING!** Only qualified electricians are allowed to service the drive. Read the instructions in chapter *Safety instructions* at the beginning of the *Hardware manual* of the drive before working on the drive.

## Indications

### ◼ Warnings and faults

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

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

Faults latch inside the drive and cause the drive to trip, and the motor stops. After the cause of a fault has been removed, the fault can be reset from the panel or from a selectable source (parameter *31.11 Fault reset selection*) such as the digital inputs of the drive. Reseting the fault creates an event *64FF Fault reset*. After the reset, the drive can be restarted.

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

### ■ Pure events

In addition to warnings and faults, there are pure events that are only recorded in the event log of the drive. The codes of these events are included in the *Warning messages* table on page *188*.

### ■ Editable messages

For external events, the action (fault or warning), name and the message text can be edited. To specify external events, select **Menu > Primary settings > Advanced functions > External events**.

Contact information can also be included and the text edited. To specify contact information, select **Menu > Primary settings > Clock, region, display > Contact info view**.

## Warning/fault history

### ■ Event log

All indications are stored in the event log with a time stamp and other information. The event log stores information on

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

See section *Viewing warning/fault information* on page *187*.

To clear the fault and event logger, select **Menu > Primary settings > Reset to defaults > Reset fault and event logs**, or set parameter *96.51 Clear fault and event logger* to value Clear.

**Auxiliary codes**

Some events generate an auxiliary code that often helps in pinpointing the problem. On the control panel, the auxiliary code is stored as part of the details of the event; in the Drive composer PC tool, the auxiliary code is shown in the event listing.

■ **Viewing warning/fault information**

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

For each stored fault, the panel shows the fault code, time and values of nine parameters (actual signals and status words) stored at the time of the fault. The values of the parameters for the latest fault are in parameters *05.80* …*05.89*.

For active faults and warnings, see
• **Menu > Diagnostics > Active faults**
• **Menu > Diagnostics > Active warnings**
• parameters in group *04 Warnings and faults* (page *329*).

For previously occurred faults and warnings, see
• **Menu > Diagnostics > Fault & event log**
• parameters in group *04 Warnings and faults* (page *329*).

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

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A QR code (or a series of QR codes) can be generated by the drive for display on the 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.

To generate the QR code, select **Menu > System info > QR code**.

**Note:** If a control panel which does not support QR code generation (version older than v.6.4x) is used, the **QR code** menu entry will disappear totally and will not be available any longer either with control panels supporting the QR code generation.

**Note:** There is a risk of removing the **QR code** menu permanently if a backup from a drive with an old firmware or old panel firmware is restored to a drive with a new firmware from October 2014 or later.

# Warning messages

**Note:** The list also contains events that only appear in the Event log.

| Code (hex) | Warning / Aux. code | Cause | What to do |
|---|---|---|---|
| 64FF | Fault reset | A fault has been reset from the panel, Drive composer PC tool, fieldbus or I/O. | Event. Informative only. |
| A2B1 | Overcurrent | Output current has exceeded internal fault limit.<br>In addition to an actual overcurrent situation, this warning may also be caused by an earth fault or supply phase loss. | Check motor load.<br>Check acceleration times in parameter group *23 Speed reference ramp* (speed control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*.<br>Check motor and motor cable (including phasing and delta/star connection).<br>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.<br>Check there are no contactors opening and closing in motor cable.<br>Check that the start-up data in parameter group *99 Motor data* corresponds to the motor rating plate.<br>Check that there are no power factor correction capacitors or surge absorbers in motor cable. |
| A2B3 | Earth leakage | Drive has detected load unbalance typically due to earth fault in motor or motor cable. | Check there are no power factor correction capacitors or surge absorbers in motor cable.<br>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.<br>If no earth fault can be detected, contact your local ABB representative. |

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| Code (hex) | Warning / Aux. code | Cause | What to do |
|---|---|---|---|
| A2B4 | Short circuit | Short-circuit in motor cable(s) or motor. | Check motor and motor cable for cabling errors.<br>Check motor and motor cable (including phasing and delta/star connection).<br>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.<br>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.<br>Check ambient conditions.<br>Check air flow and fan operation.<br>Check heatsink fins for dust pick-up.<br>Check motor power against drive power. |
| A3A1 | DC link overvoltage | Intermediate circuit DC voltage too high (when the drive is stopped). | Check the supply voltage setting (parameter *95.01 Supply voltage*). Note that the wrong setting of the parameter may cause the motor to rush uncontrollably, or may overload the brake chopper or resistor. |
| A3A2 | DC link undervoltage | Intermediate circuit DC voltage too low (when the drive is stopped). | Check the supply voltage. |
| A3AA | DC not charged | The voltage of the intermediate DC circuit has not yet risen to operating level. | If the problem persists, contact your local ABB representative. |
| A490 | Incorrect temperature sensor setup | Temperature cannot be supervised due to incorrect adapter setup. | Check the settings of temperature source parameters *35.11* and *35.21*. |
| A491 | External temperature 1<br>(Editable message text) | Measured temperature 1 has exceeded warning limit. | Check the value of parameter *35.02 Measured temperature 1*.<br>Check the cooling of the motor (or other equipment whose temperature is being measured).<br>Check the value of *35.13 Temperature 1 warning limit*. |
| A492 | External temperature 2<br>(Editable message text) | Measured temperature 2 has exceeded warning limit. | Check the value of parameter *35.03 Measured temperature 2*.<br>Check the cooling of the motor (or other equipment whose temperature is being measured).<br>Check the value of *35.23 Temperature 2 warning limit*. |
| A4A0 | Control board temperature | Control board temperature is too high. | Check the auxiliary code. See actions for each code below. |
| | (none) | Temperature above warning limit | Check ambient conditions.<br>Check air flow and fan operation.<br>Check heatsink fins for dust pick-up. |
| | 1 | Thermistor broken | Contact an ABB service representative for control board replacement. |

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| Code (hex) | Warning / Aux. code | Cause | What to do |
|---|---|---|---|
| A4A1 | IGBT overtemperature | Estimated drive IGBT temperature is excessive. | Check ambient conditions.<br>Check air flow and fan operation.<br>Check heatsink fins for dust pick-up.<br>Check motor power against drive power. |
| A4A9 | Cooling | Drive module temperature is excessive. | Check ambient temperature. If it exceeds 50 °C /122 °F, ensure that load current does not exceed derated load capacity of drive.<br>Check drive module cooling air flow and fan operation.<br>Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary. |
| A4B0 | Excess temperature | Power unit module temperature is excessive. | Check ambient conditions.<br>Check air flow and fan operation.<br>Check heatsink fins for dust pick-up.<br>Check motor power against drive power. |
| A4B1 | Excess temperature difference | High temperature difference between the IGBTs of different phases. | Check the motor cabling.<br>Check cooling of drive module(s). |
| A4F6 | IGBT temperature | Drive IGBT temperature is excessive. | Check ambient conditions.<br>Check air flow and fan operation.<br>Check heatsink fins for dust pick-up.<br>Check motor power against drive power. |
| A581 | Fan | Cooling fan feedback missing. | Check the auxiliary code to identify the fan. Code **0** denotes main fan 1. Other codes (format XYZ): "X" specifies state code (**1:** ID run, **2:** normal). "Y" = 0, "Z" specifies the index of the fan (**1:** Main fan 1, **2:** Main fan 2, **3:** Main fan 3).<br>Check fan operation and connection.<br>Replace fan if faulty. |
| A5A0 | Safe torque off<br>Programmable warning:<br>*31.22 STO indication run/stop* | Safe torque off function is active, ie, safety circuit signal(s) connected to connector STO is lost. | Check safety circuit connections. For more information, chapter *The Safe torque off function* in the *Hardware manual* of the drive and description of parameter *31.22 STO indication run/stop* (page *427*).<br>Check the value of parameter *95.04 Control board supply*. |
| A5EA | Measurement circuit temperature | Problem with internal temperature measurement of the drive. | Contact your local ABB representative. |
| A5EB | PU board powerfail | Power unit power supply failure. | Contact your local ABB representative. |
| A5ED | Measurement circuit ADC | Measurement circuit fault. | Contact your local ABB representative. |
| A5EE | Measurement circuit DFF | Measurement circuit fault. | Contact your local ABB representative. |
| A5EF | PU state feedback | State feedback from output phases does not match control signals. | Contact your local ABB representative. |

| Code (hex) | Warning / Aux. code | Cause | What to do |
|---|---|---|---|
| A5F0 | Charging feedback | Charging feedback signal missing. | Check the feedback signal coming from the charging system. |
| A682 | Flash erase speed exceeded | The flash memory (in the memory unit) has been erased too frequently, compromising the lifetime of the memory. | Avoid forcing unnecessary parameter saves by parameter *96.07* or cyclic parameter writes (such as user logger triggering through parameters). Check the auxiliary code (format XYYY YZZZ). "X" specifies the source of warning (**1:** generic flash erase supervision). "ZZZ" specifies the flash subsector number that generated the warning. |
| A686 | Checksum mismatch<br>Programmable warning:<br>*96.54 Checksum action* | The calculated parameter checksum does not match any enabled reference checksum. | Check that all necessary approved (reference) checksums (*96.71…96.72*) are enabled in *96.55 Checksum control word*.<br>Check the parameter configuration. Using *96.55 Checksum control word*, enable a checksum parameter and copy the actual checksum into that parameter. |
| A687 | Checksum configuration | An action has been defined for a parameter checksum mismatch but the feature has not been configured. | Contact your local ABB representative for configuring the feature, or disable the feature in *96.54 Checksum action*. |
| A6A4 | Motor nominal value | The motor parameters are set incorrectly. | Check the auxiliary code. See actions for each code below. |
| | | The drive is not dimensioned correctly. | |
| | 0001 | Slip frequency is too small. | Check the settings of the motor configuration parameters in groups 98 and 99.<br>Check that the drive is sized correctly for the motor. |
| | 0002 | Synchronous and nominal speeds differ too much. | |
| | 0003 | Nominal speed is higher than synchronous speed with 1 pole pair. | |
| | 0004 | Nominal current is outside limits | |
| | 0005 | Nominal voltage is outside limits. | |
| | 0006 | Nominal power is higher than apparent power. | |
| | 0007 | Nominal power not consistent with nominal speed and torque. | |
| A6A5 | No motor data | Parameters in group 99 have not been set. | Check that all the required parameters in group 99 have been set.<br>**Note:** It is normal for this warning to appear during the start-up and continue until the motor data is entered. |
| A6A6 | Voltage category unselected | The voltage category has not been defined. | Set voltage category in parameter *95.01 Supply voltage*. |

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| Code (hex) | Warning / Aux. code | Cause | What to do |
|---|---|---|---|
| A6A7 | System time not set | System time is not set. Timed functions cannot be used and fault log dates are not correct. | Set the system time manually or connect the panel to the drive to synchronize the clock. If basic panel is used, synchronize the clock through the EFB or a fieldbus module.<br>Set parameter *34.10 Timed functions enable* to *Disabled* to disable the timed functions if they are not used. |
| A6B0 | User lock is open | The user lock is open, ie, user lock configuration parameters *96.100…96.102* are visible. | Close the user lock by entering an invalid pass code in parameter *96.02 Pass code*. See section *Parameter checksum calculation* (page *181*). |
| A6B1 | User pass code not confirmed | A new user pass code has been entered in parameter *96.100* but not confirmed in *96.101*. | Confirm the new pass code by entering the same code in *96.101*. To cancel, close the user lock without confirming the new code. See section *Parameter checksum calculation* (page *181*). |
| A6D1 | FBA A parameter conflict | The drive does not have a functionality requested by a PLC, or requested functionality has not been activated. | Check PLC programming.<br>Check settings of parameter groups *50 Fieldbus adapter (FBA)*. |
| A6E5 | AI parametrization | The current/voltage hardware setting of an analog input does not correspond to parameter settings. | Check the event log for an auxiliary code. The code identifies the analog input whose settings are in conflict.<br>Adjust either the hardware setting (on the drive control unit) or parameter *12.15/12.25*.<br>**Note:** Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings. |
| A6E6 | ULC configuration | User load curve configuration error. | Check the auxiliary code (format XXXX ZZZZ). "ZZZZ" indicates the problem (see actions for each code below). |
|  | 0000 | Speed points inconsistent. | Check that each speed point (parameters *37.11…37.15*) has a higher value than the previous point. |
|  | 0001 | Frequency points inconsistent. | Check that each frequency point (*37.20…37.16*) has a higher value than the previous point. |
|  | 0002 | Underload point above overload point. | Check that each overload point (*37.31…37.35*) has a higher value than the corresponding underload point (*37.21…37.25*). |
|  | 0003 | Overload point below underload point. | |
| A780 | Motor stall<br>Programmable warning:<br>*31.24 Stall function* | Motor is operating in stall region because of, for example, excessive load or insufficient motor power. | Check motor load and drive ratings.<br>Check fault function parameters. |
| A783 | Motor overload | Motor current is too high. | Check for overloaded motor.<br>Adjust the parameters used for the motor overload function (*35.51…35.53*) and *35.55…35.56*. |

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| Code (hex) | Warning / Aux. code | Cause | What to do |
|---|---|---|---|
| A793 | BR excess temperature | Brake resistor temperature has exceeded warning limit defined by parameter *43.12 Brake resistor warning limit*. | Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*. Check warning limit setting, parameter *43.12 Brake resistor warning limit*. Check that the resistor has been dimensioned correctly. Check that braking cycle meets allowed limits. |
| A794 | BR data | Brake resistor data has not been given. | One or more of the resistor data settings (parameters *43.08…43.10*) is incorrect. The parameter is specified by the auxiliary code. |
|  | 0000 0001 | Resistance value too low. | Check value of *43.10*. |
|  | 0000 0002 | Thermal time constant not given. | Check value of *43.08*. |
|  | 0000 0003 | Maximum continuous power not given. | Check value of *43.09*. |
| A79C | BC IGBT excess temperature | Brake chopper IGBT temperature has exceeded internal warning limit. | Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameters *43.06…43.10*). Check minimum allowed resistor value for the chopper being used. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive. |
| A7C1 | FBA A communication Programmable warning: *50.02 FBA A comm loss func* | Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost. | Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups *50 Fieldbus adapter (FBA)*, *51 FBA A settings*, *52 FBA A data in* and *53 FBA A data out*. Check cable connections. Check if communication master is able to communicate. |
| A7CE | EFB comm loss Programmable warning: *58.14 Communication loss action* | Communication break in embedded fieldbus (EFB) communication. | Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the EIA-485/X5 terminals 29, 30 and 31 on the control unit. |

| Code (hex) | Warning / Aux. code | Cause | What to do |
|---|---|---|---|
| A7EE | Panel loss<br>Programmable warning:<br>*49.05 Communication loss action* | Control panel or PC tool selected as active control location for drive has ceased communicating. | Check PC tool or control panel connection.<br>Check control panel connector.<br>Check mounting platform if being used.<br>Disconnect and reconnect the control panel. |
| A88F | Cooling fan | Maintenance timer limit exceeded. | Consider changing the cooling fan. Parameter *05.04 Fan on-time counter* shows the running time of the cooling fan. |
| A8A0 | AI supervision<br>Programmable warning:<br>*12.03 AI supervision function* | 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 input.<br>Check the minimum and maximum limits of the input in parameter group *12 Standard AI*. |
| A8A1 | RO life warning | The relay has changed states more than the recommended number of times. | Change the control board or stop using the relay output. |
| | 0001 | Relay output 1 | Change the control board or stop using relay output 1. |
| | 0002 | Relay output 2 | Change the control board or stop using relay output 2. |
| | 0003 | Relay output 3 | Change the control board or stop using relay output 3. |
| A8A2 | RO toggle warning | The relay output is changing states faster than recommended, for example, if a fast changing frequency signal is connected to it. The relay lifetime will be exceeded shortly. | Replace the signal connected to the relay output source with a less frequently changing signal. |
| | 0001 | Relay output 1 | Select a different signal with parameter *10.24 RO1 source*. |
| | 0002 | Relay output 2 | Select a different signal with parameter *10.27 RO2 source*. |
| | 0003 | Relay output 3 | Select a different signal with parameter *10.30 RO3 source*. |
| A8B0 | ABB Signal supervision 1<br>(Editable message text)<br>Programmable warning:<br>*32.06 Supervision 1 action* | Warning generated by the signal supervision function 1. | Check the source of the warning (parameter *32.07 Supervision 1 signal*). |
| A8B1 | ABB Signal supervision 2<br>(Editable message text)<br>Programmable warning:<br>*32.16 Supervision 2 action* | Warning generated by the signal supervision function 2. | Check the source of the warning (parameter *32.17 Supervision 2 signal*). |
| A8B2 | ABB Signal supervision 3<br>(Editable message text)<br>Programmable warning:<br>*32.26 Supervision 3 action* | Warning generated by the signal supervision function 3. | Check the source of the warning (parameter *32.27 Supervision 3 signal*). |

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| Code (hex) | Warning / Aux. code | Cause | What to do |
|---|---|---|---|
| A8B3 | ABB Signal supervision 4 (Editable message text) Programmable warning: *32.36 Supervision 4 action* | Warning generated by the signal supervision function 4. | Check the source of the warning (parameter *32.37 Supervision 4 signal*). |
| A8B4 | ABB Signal supervision 5 (Editable message text) Programmable warning: *32.46 Supervision 5 action* | Warning generated by the signal supervision function 5. | Check the source of the warning (parameter *32.47 Supervision 5 signal*). |
| A8B5 | ABB Signal supervision 6 (Editable message text) Programmable warning: *32.56 Supervision 6 action* | Warning generated by the signal supervision function 6. | Check the source of the warning (parameter *32.57 Supervision 6 signal*). |
| A8BE | ULC overload warning Programmable fault: *37.03 ULC overload actions* | Selected signal has exceeded the user overload curve. | Check for any operating conditions increasing the monitored signal (for example, the loading of the motor if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*). |
| A8BF | ULC underload warning Programmable fault: *37.04 ULC underload actions* | Selected signal has fallen below the user underload curve. | Check for any operating conditions decreasing the monitored signal (for example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*). |
| A981 | External warning 1 (Editable message text) Programmable warning: *31.01 External event 1 source* *31.02 External event 1 type* | Fault in external device 1. | Check the external device. Check setting of parameter *31.01 External event 1 source*. |
| A982 | External warning 2 (Editable message text) Programmable warning: *31.03 External event 2 source* *31.04 External event 2 type* | Fault in external device 2. | Check the external device. Check setting of parameter *31.03 External event 2 source*. |
| A983 | External warning 3 (Editable message text) Programmable warning: *31.05 External event 3 source* *31.06 External event 3 type* | Fault in external device 3. | Check the external device. Check setting of parameter *31.05 External event 3 source*. |
| A984 | External warning 4 (Editable message text) Programmable warning: *31.07 External event 4 source* *31.08 External event 4 type* | Fault in external device 4. | Check the external device. Check setting of parameter *31.07 External event 4 source*. |

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| Code (hex) | Warning / Aux. code | Cause | What to do |
|---|---|---|---|
| A985 | External warning 5 (Editable message text) Programmable warning: *31.09 External event 5 source* *31.10 External event 5 type* | Fault in external device 5. | Check the external device. Check setting of parameter *31.09 External event 5 source*. |
| AF88 | Season configuration warning | You have configured a season which starts before the previous season. | Configure the seasons with increasing start dates, see parameters *34.60 Season 1 start date*…*34.63 Season 4 start date*. |
| AF8C | Process PID sleep mode | The drive is entering sleep mode. | Informative warning. See section *Sleep and boost functions for process PID control* (page *142*), and parameters *40.43*…*40.48*. |
| AFAA | Autoreset | A fault is about to be autoreset. | Informative warning. See the settings in parameter group *31 Fault functions*. |
| AFE1 | Emergency stop (off2) | Drive has received an emergency stop (mode selection off2) command. | Check that it is safe to continue operation. Then return emergency stop push button to normal position. Restart drive. If the emergency stop was unintentional, check the source selected by parameter *21.05 Emergency stop source*. |
| AFE2 | Emergency stop (off1 or off3) | Drive has received an emergency stop (mode selection off1 or off3) command. | |
| AFE9 | Start delay | The start delay is active and the drive will start the motor after a predefined delay. | Informative warning. See parameter *21.22 Start delay*. |
| AFED | Run permissive | Run permissive is keeping the drive from running the motor. | Check the setting of (and source selected by) parameter *20.40 Run permissive*. |
| AFEE | Start interlock 1 | Start interlock 1 is keeping the drive from starting. | Check the signal source selected for parameter *20.41 Start interlock 1*. |
| AFEF | Start interlock 2 | Start interlock 2 is keeping the drive from starting. | Check the signal source selected for parameter *20.42 Start interlock 2*. |
| AFF0 | Start interlock 3 | Start interlock 3 is keeping the drive from starting. | Check the signal source selected for parameter *20.43 Start interlock 3*. |
| AFF1 | Start interlock 4 | Start interlock 4 is keeping the drive from starting. | Check the signal source selected for parameter *20.44 Start interlock 4*. |
| 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. |
| AFF8 | Motor heating active | Pre-heating is being performed | Informative warning. Motor pre-heating is active. Current specified by parameter *21.16 Pre-heating current* is being passed through the motor. |
| AFFE | Override active | Drive is in override mode. | Informative warning. |

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| Code (hex) | Warning / Aux. code | Cause | What to do |
|---|---|---|---|
| B5A0 | STO event<br>Programmable event:<br>*31.22 STO indication run/stop* | Safe torque off function is active, ie, safety circuit signal(s) connected to connector STO is lost. | Informative warning.<br>Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the *Hardware manual* of the drive and description of parameter *31.22 STO indication run/stop* (page *427*). |
| B686 | Checksum mismatch<br>Programmable event:<br>*96.54 Checksum action* | The calculated parameter checksum does not match any enabled reference checksum. | See *A686 Checksum mismatch* (page *191*). |
| D501 | No more available PFC motors | No more PFC motors can be started because they can be interlocked or in the Hand mode. | Check that there are no interlocked PFC motors, see parameters: *76.81…76.84*.<br>If all motors are in use, the PFC system is not adequately dimensioned to handle the demand. |
| D502 | All motors interlocked | All the motors in the PFC system are interlocked. | Check that there are no interlocked PFC motors, see parameters *76.81…76.84*. |
| D503 | VSD controlled PFC motor interlocked | The motor connected to the drive is interlocked (unavailable). | Motor connected to the drive is interlocked and thus cannot be started. Remove the corresponding interlock to start the drive controlled PFC motor. See parameters *76.81…76.84*. |

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# Fault messages

| Code (hex) | Fault / Aux. code | Cause | What to do |
|---|---|---|---|
| 1080 | Backup/Restore timeout | Panel or PC tool has failed to communicate with the drive when backup was being made or restored. | Request backup or restore again. |
| 1081 | Rating ID fault | Drive software has not been able to read the rating ID of the drive. | Reset the fault to make the drive try to reread the rating ID.<br>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. |
| 2310 | Overcurrent | Output current has exceeded internal fault limit.<br>In addition to an actual overcurrent situation, this fault may also be caused by an earth fault or supply phase loss. | Check motor load.<br>Check acceleration times in parameter group *23 Speed reference ramp* (speed control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*.<br>Check motor and motor cable (including phasing and delta/star connection).<br>Check there are no contactors opening and closing in motor cable.<br>Check that the start-up data in parameter group 99 corresponds to the motor rating plate.<br>Check that there are no power factor correction capacitors or surge absorbers in motor cable.<br>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<br>Programmable fault: *31.20 Earth fault* | Drive has detected load unbalance typically due to earth fault in motor or motor cable. | Check there are no power factor correction capacitors or surge absorbers in motor cable.<br>Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable.<br>Try running the motor in scalar control mode if allowed. (See parameter *99.04 Motor control mode*.)<br>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.<br>Check there are no power factor correction capacitors or surge absorbers in motor cable.<br>Cycle the power to the drive. |

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| Code (hex) | Fault / Aux. code | Cause | What to do |
|---|---|---|---|
| 2381 | IGBT overload | Excessive IGBT junction to case temperature. This fault protects the IGBT(s) and can be activated by a short circuit in the motor cable. | Check motor cable.<br>Check ambient conditions.<br>Check air flow and fan operation.<br>Check heatsink fins for dust pick-up.<br>Check motor power against drive power. |
| 3130 | Input phase loss<br>Programmable fault: *31.21 Supply phase loss* | Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse. | Check input power line fuses.<br>Check for loose power cable connections.<br>Check for input power supply imbalance. |
| 3181 | Wiring or earth fault<br>Programmable fault: *31.23 Wiring or earth fault* | Incorrect input power and motor cable connection (ie. input power cable is connected to drive motor connection). | Check input power connections. |
| 3210 | DC link overvoltage | Excessive intermediate circuit DC voltage. | Check that overvoltage control is on (parameter *30.30 Overvoltage control*).<br>Check that the supply voltage matches the nominal input voltage of the drive.<br>Check the supply line for static or transient overvoltage.<br>Check brake chopper and resistor (if present).<br>Check deceleration time.<br>Use coast-to-stop function (if applicable).<br>Retrofit drive with brake chopper and brake resistor.<br>Check that the brake resistor is dimensioned properly and the resistance is between acceptable range for the drive. |
| 3220 | DC link undervoltage | Intermediate circuit DC voltage is not sufficient because of a missing supply phase, blown fuse or fault in the rectifier bridge. | Check supply cabling, fuses and switchgear. |
| 3381 | Output phase loss<br>Programmable fault: *31.19 Motor phase loss* | Motor circuit fault due to missing motor connection (all three phases are not connected). | Connect motor cable. |
| 4110 | Control board temperature | Control board temperature is too high. | Check proper cooling of the drive.<br>Check the auxiliary cooling fan. |
| 4210 | IGBT overtemperature | Estimated drive IGBT temperature is excessive. | Check ambient conditions.<br>Check air flow and fan operation.<br>Check heatsink fins for dust pick-up.<br>Check motor power against drive power. |

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| Code (hex) | Fault / Aux. code | Cause | What to do |
|---|---|---|---|
| 4290 | Cooling | Drive module temperature is excessive. | Check ambient temperature. If it exceeds 50 °C /122 °F, ensure that load current does not exceed derated load capacity of drive. See chapter *Technical data*, section *Derating* in the *Hardware manual* of the drive.<br>Check drive module cooling air flow and fan operation.<br>Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary. |
| 42F1 | IGBT temperature | Drive IGBT temperature is excessive. | Check ambient conditions.<br>Check air flow and fan operation.<br>Check heatsink fins for dust pick-up.<br>Check motor power against drive power. |
| 4310 | Excess temperature | Power unit module temperature is excessive. | Check ambient conditions.<br>Check air flow and fan operation.<br>Check heatsink fins for dust pick-up.<br>Check motor power against drive power. |
| 4380 | Excess temperature difference | High temperature difference between the IGBTs of different phases. | Check the motor cabling.<br>Check cooling of drive module(s). |
| 4981 | External temperature 1 (Editable message text) | Measured temperature 1 has exceeded fault limit. | Check the value of parameter *35.02 Measured temperature 1*.<br>Check the cooling of the motor (or other equipment whose temperature is being measured). |
| 4982 | External temperature 2 (Editable message text) | Measured temperature 2 has exceeded fault limit. | Check the value of parameter *35.03 Measured temperature 2*.<br>Check the cooling of the motor (or other equipment whose temperature is being measured). |
| 5080 | Fan | Cooling fan feedback missing. | See *A581 Fan* (page *190*). |
| 5090 | STO hardware failure | STO hardware diagnostics has detected hardware failure. | Contact your local ABB representative for hardware replacement. |
| 5091 | Safe torque off Programmable fault: *31.22 STO indication run/stop* | Safe torque off function is active, ie, safety circuit signal(s) connected to connector STO is broken during start or run. | Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the *Hardware manual* of the drive and description of parameter *31.22 STO indication run/stop* (page *427*).<br>Check the value of parameter *95.04 Control board supply*. |
| 5092 | PU logic error | Power unit memory has cleared. | Contact your local ABB representative. |
| 5093 | Rating ID mismatch | The hardware of the drive does not match the information stored in the memory. This may occur, for example, after a firmware update. | Cycle the power to the drive. You may have to be repeat this. |
| 5094 | Measurement circuit temperature | Problem with internal temperature measurement of the drive. | Contact your local ABB representative. |

| Code (hex) | Fault / Aux. code | Cause | What to do |
|---|---|---|---|
| 5098 | I/O communication loss | Internal standard I/O communication failure. | Try resetting the fault or reboot the drive. |
| 50A0 | Fan | Cooling fan stuck or disconnected. | Check fan operation and connection. Replace fan if faulty. |
| 5681 | PU communication | Communication errors detected between the drive control unit and the power unit. | Check the connection between the drive control unit and the power unit. Check the value of parameter *95.04 Control board supply*. |
| 5682 | Power unit lost | Connection between the drive control unit and the power unit is lost. | Check the connection between the control unit and the power unit. |
| 5691 | Measurement circuit ADC | Measurement circuit fault. | Contact your local ABB representative. |
| 5692 | PU board powerfail | Power unit power supply failure. | Contact your local ABB representative. |
| 5693 | Measurement circuit DFF | Measurement circuit fault. | Contact your local ABB representative. |
| 5696 | PU state feedback | Short-circuit in motor cable(s) or motor. (State feedback from output phases does not match control signals.) For frames R6 and R7. | 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. Cycle the power to the drive. |
| 5697 | Charging feedback | Charging feedback signal missing. | Check the feedback signal coming from the charging system |
| 5698 | Unknown PU fault | The power unit logic has generated a fault which is not known by the software. | Check the logic and software compatibility. |
| 6181 | FPGA version incompatible | Firmware and FPGA versions are incompatible. | Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative |
| 6200 | Checksum mismatch Programmable fault: *96.54 Checksum action* | The calculated parameter checksum does not match any enabled reference checksum. | See *A686 Checksum mismatch* (page *191*). |
| 6306 | FBA A mapping file | Fieldbus adapter A mapping file read error. | Contact your local ABB representative. |
| 6481 | Task overload | Internal fault. | Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative |

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| Code (hex) | Fault / Aux. code | Cause | What to do |
|---|---|---|---|
| 6487 | Stack overflow | Internal fault. | Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative |
| 64A1 | Internal file load | File read error. | Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative |
| 64A4 | Rating ID fault | Rating ID load error. | Contact your local ABB representative. |
| 64A6 | Adaptive program | Error running the adaptive program. | Check the auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the state (00=base program) and "YY" specifies the number of the function block (0000=generic error). "ZZZZ" indicates the problem. |
| | 000A | Program corrupted or block non-existent | Restore the template program or download the program to the drive. |
| | 000C | Required block input missing | Check the inputs of the block. |
| | 000E | Program corrupted or block non-existent | Restore the template program or download the program to the drive. |
| | 0011 | Program too large. | Remove blocks until the error stops. |
| | 0012 | Program is empty. | Correct the program and download it to the drive. |
| | 001C | A non-existing parameter or block is used in the program. | Edit the program to correct the parameter reference, or to use an existing block. |
| | 001D | Parameter type invalid for selected pin. | Edit the program to correct the parameter reference. |
| | 001E | Output to parameter failed because the parameter was write-protected. | Check the parameter reference in the program. Check for other sources affecting the target parameter. |
| | 0023 | Program file incompatible with current firmware version. | Adapt the program to current block library and firmware version. |
| | 0024 | | |
| | Other | – | Contact your local ABB representative, quoting the auxiliary code. |
| 64B1 | Internal SSW fault | Internal fault. | Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative. |
| 64B2 | User set fault | Loading of user parameter set failed because<br>• requested set does not exist<br>• set is not compatible with control program<br>• drive was switched off during loading. | Ensure that a valid user parameter set exists. Reload if uncertain. |
| 64E1 | Kernel overload | Operating system error. | Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative. |

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| Code (hex) | Fault / Aux. code | Cause | What to do |
|---|---|---|---|
| 64B1 | Fault reset | A fault has been reset. The cause of the fault no longer exists and the fault reset has been requested and completed. | Informative fault. |
| 6581 | Parameter system | Parameter load or save failed. | Try forcing a save using parameter *96.07 Parameter save manually*. Retry. |
| 6591 | Backup/Restore timeout | During backup creating or restoring operation a panel or PC-tool has failed to communicate with the drive as part this operation. | Check panel or PC-tool communication and if it is still in backup or restore state. |
| 65A1 | FBA A parameter conflict | The drive does not have a functionality requested by PLC, or requested functionality has not been activated. | Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *51 FBA A settings*. |
| 6681 | EFB comm loss  Programmable fault: *58.14 Communication loss action* | Communication break in embedded fieldbus (EFB) communication. | Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the EIA-485/X5 terminals on the control unit. |
| 6682 | EFB config file | Embedded fieldbus (EFB) configuration file could not be read. | Contact your local ABB representative. |
| 6683 | EFB invalid parameterization | Embedded fieldbus (EFB) parameter settings inconsistent or not compatible with selected protocol. | Check the settings in parameter group *58 Embedded fieldbus*. |
| 6684 | EFB load fault | Embedded fieldbus (EFB) protocol firmware could not be loaded. | Contact your local ABB representative. |
| | | Version mismatch between EFB protocol firmware and drive firmware. | |
| 6685 | EFB fault 2 | Fault reserved for the EFB protocol application. | Check the documentation of the protocol. |
| 6686 | EFB fault 3 | Fault reserved for the EFB protocol application. | Check the documentation of the protocol. |
| 6882 | Text 32-bit table overflow | Internal fault. | Reset the fault. Contact your local ABB representative if the fault persists. |
| 6885 | Text file overflow | Internal fault. | Reset the fault. Contact your local ABB representative if the fault persists. |
| 7081 | Control panel loss  Programmable fault: *49.05 Communication loss action* | Control panel or PC tool selected as active control location for drive has ceased communicating. | Check PC tool or control panel connection. Check control panel connector. Disconnect and reconnect the control panel. |
| 7085 | Incompatible option module | Fieldbus option module not supported. | Replace the module with a supported type. |
| 7100 | Excitation current | Excitation current feedback low or missing | |

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| Code (hex) | Fault / Aux. code | Cause | What to do |
|---|---|---|---|
| 7121 | Motor stall<br>Programmable fault: *31.24 Stall function* | Motor is operating in stall region because of, for example, excessive load or insufficient motor power. | Check motor load and drive ratings.<br>Check fault function parameters. |
| 7122 | Motor overload | Motor current is too high. | Check for overloaded motor.<br>Adjust the parameters used for the motor overload function (*35.51*…*35.53*) and *35.55*…*35.56*. |
| 7181 | Brake resistor | Brake resistor broken or not connected. | Check that a brake resistor has been connected.<br>Check the condition of the brake resistor.<br>Check the dimensioning of the brake resistor. |
| 7183 | BR excess temperature | Brake resistor temperature has exceeded fault limit defined by parameter *43.11 Brake resistor fault limit*. | Stop drive. Let resistor cool down.<br>Check resistor overload protection function settings (parameter group *43 Brake chopper*).<br>Check fault limit setting, parameter *43.11 Brake resistor fault limit*.<br>Check that braking cycle meets allowed limits. |
| 7184 | Brake resistor wiring | Brake resistor short circuit or brake chopper control fault. | Check brake chopper and brake resistor connection.<br>Ensure brake resistor is not damaged. |
| 7191 | BC short circuit | Short circuit in brake chopper IGBT. | Ensure brake resistor is connected and not damaged.<br>Check the electrical specifications of the brake resistor against chapter *Resistor braking* in the *Hardware manual* of the drive.<br>Replace brake chopper (if replaceable). |
| 7192 | BC IGBT excess temperature | Brake chopper IGBT temperature has exceeded internal fault limit. | Let chopper cool down.<br>Check for excessive ambient temperature.<br>Check for cooling fan failure.<br>Check for obstructions in the air flow.<br>Check resistor overload protection function settings (parameter group *43 Brake chopper*).<br>Check that braking cycle meets allowed limits.<br>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*.<br>Check adequacy of motor braking torque.<br>Check applicability of torque control.<br>Check need for brake chopper and resistor(s). |

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| Code (hex) | Fault / Aux. code | Cause | What to do |
|---|---|---|---|
| 80B2 | Signal supervision 3 (Editable message text) Programmable fault: *32.26 Supervision 3 action* | Fault generated by the signal supervision function 3. | Check the source of the fault (parameter *32.27 Supervision 3 signal*). |
| 80B3 | Signal supervision 4 (Editable message text) Programmable fault: *32.36 Supervision 4 action* | Fault generated by the signal supervision function 4. | Check the source of the fault (parameter *32.37 Supervision 4 signal*). |
| 80B4 | Signal supervision 5 (Editable message text) Programmable fault: *32.46 Supervision 5 action* | Fault generated by the signal supervision function 5. | Check the source of the fault (parameter *32.47 Supervision 5 signal*). |
| 80B5 | Signal supervision 6 (Editable message text) Programmable fault:, *32.56 Supervision 6 action* | Fault generated by the signal supervision function 6. | Check the source of the fault (parameter *32.57 Supervision 6 signal*). |
| 9081 | External fault 1 (Editable message text) Programmable fault: *31.01 External event 1 source*, *31.02 External event 1 type* | Fault in external device 1. | Check the external device. Check setting of parameter *31.01 External event 1 source*. |
| 9082 | External fault 2 (Editable message text) Programmable fault: *31.03 External event 2 source*, *31.04 External event 2 type* | Fault in external device 2. | Check the external device. Check setting of parameter *31.03 External event 2 source*. |
| 9083 | External fault 3 (Editable message text) Programmable fault: *31.05 External event 3 source*, *31.06 External event 3 type* | Fault in external device 3. | Check the external device. Check setting of parameter *31.05 External event 3 source*. |
| 9084 | External fault 4 (Editable message text) Programmable fault: *31.07 External event 4 source*, *31.08 External event 4 type* | Fault in external device 4. | Check the external device. Check setting of parameter *31.07 External event 4 source*. |
| 9085 | External fault 5 (Editable message text) Programmable fault: *31.09 External event 5 source*, *31.10 External event 5 type* | Fault in external device 5. | Check the external device. Check setting of parameter *31.09 External event 5 source*. |
| FA81 | Safe torque off 1 | Safe torque off function is active, ie, STO circuit 1 is broken. | Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the *Hardware manual* of the drive and description of parameter *31.22 STO indication run/stop* (page *427*). Check the value of parameter *95.04 Control board supply*. |
| FA82 | Safe torque off 2 | Safe torque off function is active, ie, STO circuit 2 is broken. | |

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| Code (hex) | Fault / Aux. code | Cause | What to do |
|---|---|---|---|
| FF61 | ID run | Motor ID run was not completed successfully. | Check the nominal motor values in parameter group *99 Motor data*. Check that no external control system is connected to the drive. Cycle the power to the drive (and its control unit, if powered separately). Check that no operation limits prevent the completion of the ID run. Restore parameters to default settings and try again. Check that the motor shaft is not locked. Check the auxiliary code. The second number of the code indicates the problem (see actions for each code below). |
| | 0001 | Maximum current limit too low. | Check settings of parameters *99.06 Motor nominal current* and *30.17 Maximum current*. Make sure that *30.17* > *99.06*. Check that the drive is dimensioned correctly according to the motor. |
| | 0002 | Maximum speed limit or calculated field weakening point too low. | Check settings of parameters<br>• *30.11 Minimum speed*<br>• *30.12 Maximum speed*<br>• *99.07 Motor nominal voltage*<br>• *99.08 Motor nominal frequency*<br>• *99.09 Motor nominal speed*.<br>Make sure that<br>• *30.12* > (0.55 × *99.09*) > (0.50 × synchronous speed)<br>• *30.11* $\leq$ 0, and<br>• supply voltage $\geq$ (0.66 × *99.07*. |
| | 0003 | Maximum torque limit too low. | Check settings of parameter *99.12 Motor nominal torque*, and the torque limits in group *30 Limits*. Make sure that the maximum torque limit in force is greater than 100%. |
| | 0004 | Current measurement calibration did not finish within reasonable time | Contact your local ABB representative. |
| | 0005…0008 | Internal error. | Contact your local ABB representative. |
| | 0009 | (Asynchronous motors only) Acceleration did not finish within reasonable time. | Contact your local ABB representative. |
| | 000A | (Asynchronous motors only) Deceleration did not finish within reasonable time. | Contact your local ABB representative. |
| | 000B | (Asynchronous motors only) Speed dropped to zero during ID run. | Contact your local ABB representative. |
| | 000C | (Permanent magnet motors only) First acceleration did not finish within reasonable time. | Contact your local ABB representative. |

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| Code (hex) | Fault / Aux. code | Cause | What to do |
|---|---|---|---|
| | 000D | (Permanent magnet motors only) Second acceleration did not finish within reasonable time. | Contact your local ABB representative. |
| | 000E…0010 | Internal error. | Contact your local ABB representative. |
| | 0011 | (Synchronous reluctance motors only) Pulse test error. | Contact your local ABB representative. |
| | 0012 | Motor too large for advanced standstill ID run. | Check that the motor and drive sizes are compatible. Contact your local ABB representative. |
| | 0013 | (Asynchronous motors only) Motor data error. | Check that the motor nominal value settings in the drive are the same as in the motor nameplate. Contact your local ABB representative. |
| FF63 | STO diagnostics failure. | SW internal malfunction. | Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. |
| FF81 | FB A force trip | A fault trip command has been received through fieldbus adapter A. | Check the fault information provided by the PLC. |
| FF8E | EFB force trip | A fault trip command has been received through the embedded fieldbus interface. | Check the fault information provided by the PLC. |

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# 8

# Modbus RTU control through the embedded fieldbus interface (EFB)

## What this chapter contains

The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

## System overview

The drive can be connected to an external control system through a communication link using either a fieldbus adapter or the embedded fieldbus interface.

The embedded fieldbus interface supports the Modbus RTU protocol. The drive control program can handle 10 Modbus registers in a 10-millisecond time level. For example, if the drive receives a request to read 20 registers, it will start its response within 22 ms of receiving the request – 20 ms for processing the request and 2 ms overhead for handling the bus. The actual response time depends on other factors as well, such as the baud rate (a parameter setting in the drive).

The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the embedded fieldbus interface and other available sources, for example, digital and analog inputs.

**Data flow**

Control Word (CW)
References
}
Process I/O (cyclic)

Status Word (SW)
Actual values

Parameter R/W
requests/responses
} Service messages (acyclic)

Fieldbus controller

Termination ON[1]

Fieldbus

Termination OFF

Drive

Termination OFF

Drive

Termination ON [1]

Drive

[1] The device at both ends on the fieldbus must have termination on.
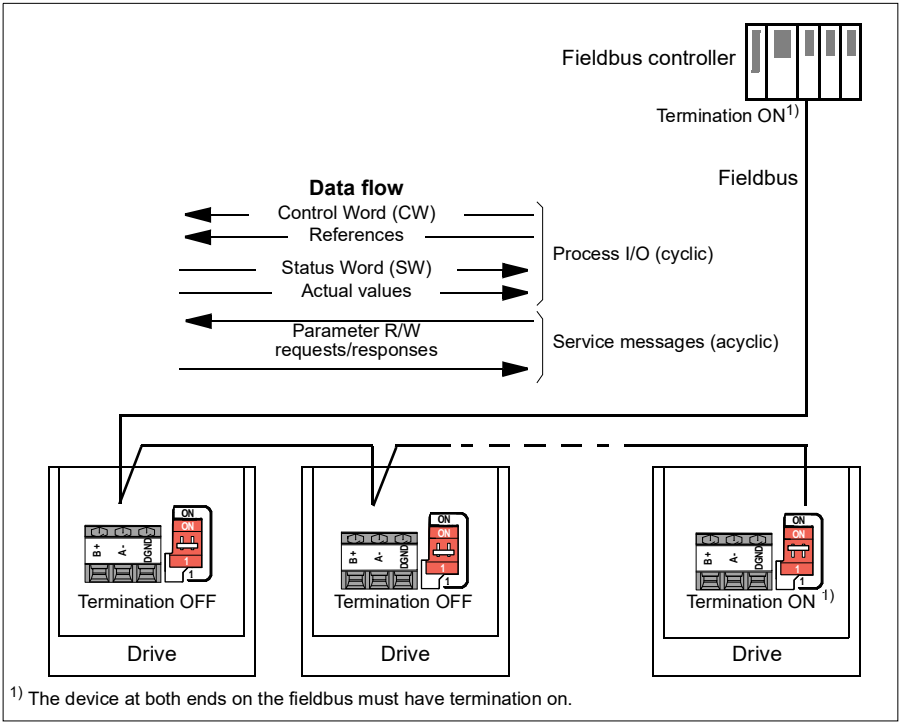
## Connecting the drive to the fieldbus

Connect the fieldbus to the EIA-485 Modbus RTU terminal on the RIIO-01 module which is attached on the control unit of the drive. The connection diagram is shown below.

See also chapter *BACnet MS/TP control through the embedded fieldbus interface (EFB)*, section *Hardware installation* (page *240*).

Use preferably three conductors and a shield for the connection.



1) If the device is at the end of the fieldbus, set switch termination to ON.
2) Tie shield conductors together at the drive – Do NOT terminate at SCR.
3) Terminate shield ONLY at the "Ground" terminal in the automation controller.
4) Terminate DGND conductor at the "Signal ground reference" terminal in the automation controller.

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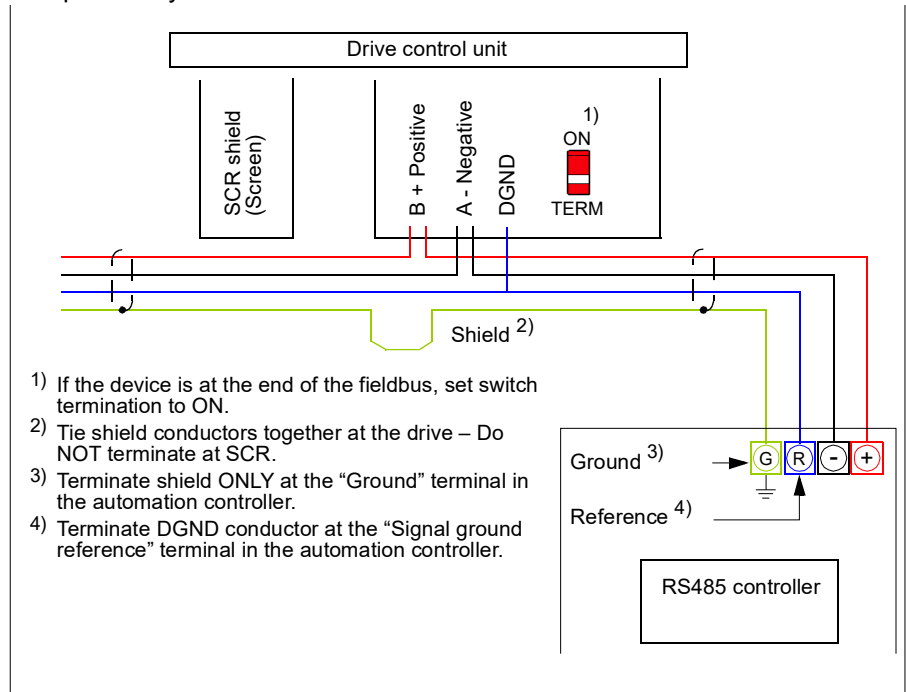
## Setting up the embedded fieldbus interface

Set the drive up for the embedded fieldbus communication with the parameters shown in the table below. The **Setting for fieldbus control** column gives either the value to use or the default value. The **Function/Information column** gives a description of the parameter.

| Parameter | Setting for fieldbus control | Function/Information |
|---|---|---|
| COMMUNICATION INITIALIZATION | | |
| *58.01 Protocol enable* | *Modbus RTU* | Initializes embedded fieldbus communication. |
| EMBEDDED MODBUS CONFIGURATION | | |
| *58.03 Node address* | 1 (default) | Node address. There must be no two nodes with the same node address online. |
| *58.04 Baud rate* | *19.2 kbps* (default) | Defines the communication speed of the link. Use the same setting as in the master station. |
| *58.05 Parity* | *8 EVEN 1* (default) | Selects the parity and stop bit setting. Use the same setting as in the master station. |
| *58.14 Communication loss action* | *No action* (default) | Defines the action taken when a communication loss is detected. |
| *58.15 Communication loss mode* | *Cw / Ref1 / Ref2* (default) | Enables/disables communication loss monitoring and defines the means for resetting the counter of the communication loss delay. |
| *58.16 Communication loss time* | 30.0 s (default) | Defines the timeout limit for the communication monitoring. |
| *58.17 Transmit delay* | 0 ms (default) | Defines a response delay for the drive. |
| *58.25 Control profile* | *ABB Drives* (default) | Selects the control profile used by the drive. See section *Basics of the embedded fieldbus interface* (page *215*). |
| *58.26 EFB ref1 type* *58.27 EFB ref2 type* | *Speed or frequency* (default for *58.26*), *Transparent*, *General*, *Speed*, *Frequency* | Defines the types of fieldbus references 1 and 2. The scaling for each reference type is defined by parameters *46.01*…*46.03*. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode. |
| *58.28 EFB act1 type* *58.29 EFB act2 type* | *Speed or frequency* (default for *58.28*), *Transparent* (default for *58.29*), *General*, *Speed*, *Frequency* | Defines the types of actual values 1 and 2. The scaling for each actual value type is defined by parameters *46.01*…*46.03*. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode. |

| Parameter | | Setting for fieldbus control | Function/Information |
|---|---|---|---|
| *58.31*<br>*58.32* | *EFB act1 transparent source*<br><br>*EFB act2 transparent source* | *Not selected* | Defines the source of actual values 1 and 2 when the *58.26 EFB ref1 type* (*58.27 EFB ref2 type*) is set to *Transparent*. |
| *58.33* | *Addressing mode* | *Mode 0* (default) | Defines the mapping between parameters and holding registers in the 400001…465536 (100…65535) Modbus register range. |
| *58.34* | *Word order* | *LO-HI* (default) | Defines the order of the data words in the Modbus message frame. |
| *58.101*<br>…<br>*58.114* | *Data I/O 1*<br>…<br>*Data I/O 14* | For example, the default settings (I/Os 1…6 contain the control word, the status word, two references and two actual values)<br><br>*RO/DIO control word*, *AO1 data storage*, *AO2 data storage*, *Feedback data storage*, *Setpoint data storage* | Defines the address of the drive parameter which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus In/Out parameters. Select the parameters that you want to read or write through the Modbus I/O words.<br><br>These settings write the incoming data into storage parameters *10.99 RO/DIO control word*, *13.91 AO1 data storage*, *13.92 AO2 data storage*, *40.91 Feedback data storage* or *40.92 Setpoint data storage*. |
| *58.06* | *Communication control* | *Refresh settings* | Validates the settings of the configuration parameters. |

The new settings will take effect when the drive is powered up the next time, or when they are validated by parameter *58.06 Communication control* (*Refresh settings*).

## Setting the drive control parameters

After the embedded fieldbus interface has been set up, check and adjust the drive control parameters listed in the table below. The **Setting for fieldbus control** column gives the value or values to use when the embedded fieldbus signal is the desired source or destination for that particular drive control signal. The **Function/Information** column gives a description of the parameter.

| Parameter | Setting for fieldbus control | Function/Information |
|---|---|---|
| CONTROL COMMAND SOURCE SELECTION | | |
| *20.01 Ext1 commands* | *Embedded fieldbus* | Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location. |

| Parameter | Setting for fieldbus control | Function/Information |
|---|---|---|
| *20.06 Ext2 commands* | *Embedded fieldbus* | Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location. |

| SPEED REFERENCE SELECTION | | |
|---|---|---|
| *22.11 Ext1 speed ref1* | *EFB ref1* | Selects a reference received through the embedded fieldbus interface as speed reference 1. |
| *22.18 Ext2 speed ref1* | *EFB ref1* | Selects a reference received through the embedded fieldbus interface as speed reference 2. |

| FREQUENCY REFERENCE SELECTION | | |
|---|---|---|
| *28.11 Ext1 frequency ref1* | *EFB ref1* | Selects a reference received through the embedded fieldbus interface as frequency reference 1. |
| *28.15 Ext2 frequency ref1* | *EFB ref1* | Selects a reference received through the embedded fieldbus interface as frequency reference 2. |

| OTHER SELECTIONS |
|---|
| EFB references can be selected as the source at virtually any signal selector parameter by selecting *Other*, then either *03.09 EFB reference 1* or *03.10 EFB reference 2*. |

| SYSTEM CONTROL INPUTS | | |
|---|---|---|
| *96.07 Parameter save manually* | *Save* (reverts to *Done*) | Saves parameter value changes (including those made through fieldbus control) to permanent memory. |

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# Basics of the embedded fieldbus interface

The cyclic communication between a fieldbus system and the drive consists of 16-bit data words or 32-bit data words (with a transparent control profile).

The diagram below illustrates the operation of the embedded fieldbus interface. The signals transferred in the cyclic communication are explained further below the diagram.
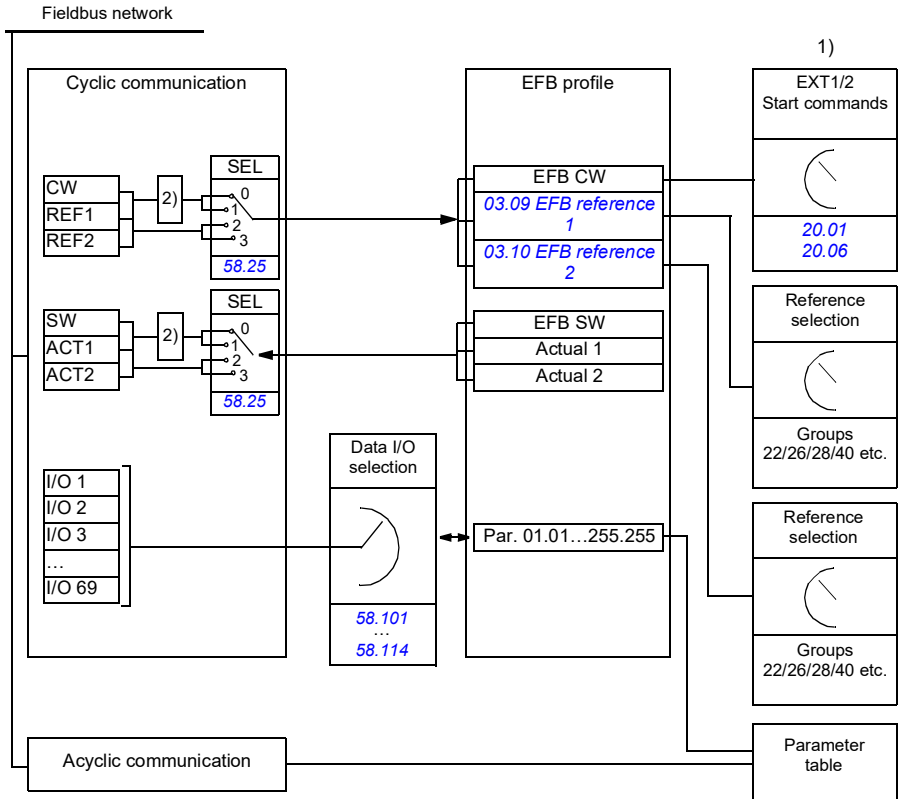


1. See also other parameters which can be controlled through fieldbus.
2. Data conversion if parameter *58.25 Control profile* is set to *ABB Drives*. See section *About the control profiles* (page *218*).

### ■ Control word and Status word

The Control Word (CW) is a 16-bit or 32-bit packed boolean word. It is the principal means of controlling the drive from a fieldbus system. The CW is sent by the fieldbus controller to the drive. With drive parameters, the user selects the EFB CW as the source of drive control commands (such as start/stop, emergency stop, selection between external control locations 1/2, or fault reset). The drive switches between its states according to the bit-coded instructions of the CW.

The fieldbus CW is either written to the drive as it is or the data is converted. See section *About the control profiles* (page *218*).

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 *218*).

### ■ 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 *218*).

### ■ 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 *218*).

### ■ Data input/outputs

Data input/outputs are 16-bit or 32-bit words containing selected drive parameter values. Parameters *58.101 Data I/O 1* … *58.114 Data I/O 14* define the addresses from which the master either reads data (input) or to which it writes data (output).

### ■ Register addressing

The address field of Modbus requests for accessing holding registers is 16 bits. This allows the Modbus protocol to support addressing of 65536 holding registers.

Historically, Modbus master devices used 5-digit decimal addresses from 40001 to 49999 to represent holding register addresses. The 5-digit decimal addressing limited to 9999 the number of holding registers that could be addressed.

Modern Modbus master devices typically provide a means to access the full range of 65536 Modbus holding registers. One of these methods is to use 6-digit decimal addresses from 400001 to 465536. This manual uses 6-digit decimal addressing to represent Modbus holding register addresses.

Modbus master devices that are limited to the 5-digit decimal addressing may still access registers 400001 to 409999 by using 5-digit decimal addresses 40001 to 49999. Registers 410000-465536 are inaccessible to these masters.

See parameter *58.33 Addressing mode*.

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

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# About the control profiles

A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- if packed boolean words are converted and how
- if signal values are scaled and how
- how drive register addresses are mapped for the fieldbus master.

You can configure the drive to receive and send messages according to one of the two profiles:

- *ABB Drives*
- *DCU Profile*.

For the ABB Drives profile, the embedded fieldbus interface of the drive converts the fieldbus data to and from the native data used in the drive. The DCU Profile involves no data conversion or scaling. The figure below illustrates the effect of the profile selection.
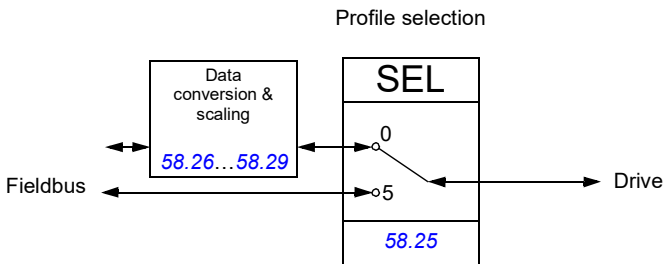


Control profile selection with parameter *58.25 Control profile* is:
- (0) *ABB Drives*
- (5) *DCU Profile*.

# Control Word

## ■ Control Word for the ABB Drives profile

The table below shows the contents of the fieldbus Control Word for the ABB Drives control profile. The embedded fieldbus interface converts this word to the form in which it is used in the drive. The upper case boldface text refers to the states shown in *State transition diagram for the ABB Drives profile* on page *226*.

| Bit | Name | Value | STATE/Description |
|-----|------|-------|-------------------|
| 0 | OFF1_ CONTROL | 1 | Proceed to READY TO OPERATE. |
| | | 0 | Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active. |
| 1 | OFF2_ CONTROL | 1 | Continue operation (OFF2 inactive). |
| | | 0 | Emergency OFF, coast to stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**. |
| 2 | OFF3_ CONTROL | 1 | Continue operation (OFF3 inactive). |
| | | 0 | Emergency stop, stop within time defined by drive parameter. Proceed to **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. **Warning:** Ensure that the motor and driven machine can be stopped using this stop mode. |
| 3 | INHIBIT_ OPERATION | 1 | Proceed to **OPERATION ENABLED**. **Note:** Run permissive signal must be active; see the drive documentation. If the drive is set to receive the Run permissive signal from the fieldbus, this bit activates the signal. |
| | | 0 | Inhibit operation. Proceed to **OPERATION INHIBITED**. |
| 4 | RAMP_OUT_ ZERO | 1 | Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**. |
| | | 0 | Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force). |
| 5 | RAMP_HOLD | 1 | ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**. |
| | | 0 | Halt ramping (Ramp Function Generator output held). |
| 6 | RAMP_IN_ ZERO | 1 | Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters. |
| | | 0 | Force Ramp Function Generator input to zero. |
| 7 | RESET | 0=>1 | Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters. |
| | | 0 | Continue normal operation. |

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| Bit | Name | Value | STATE/Description |
|-----|------|-------|-------------------|
| 8 | Reserved | | |
| 9 | Reserved | | |
| 10 | REMOTE_CMD | 1 | Fieldbus control d. |
| | | 0 | Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. |
| | | | Control Word = 0 and Reference = 0: Fieldbus control d. Reference and deceleration/acceleration ramp are locked. |
| 11 | EXT_CTRL_LOC | 1 | Select External Control Location EXT2. Effective if the control location is parameterized to be selected from the fieldbus. |
| | | 0 | Select External Control Location EXT1. Effective if the control location is parameterized to be selected from the fieldbus. |
| 12 | USER_0 | | Writable control bits that can be combined with drive logic for application-specific functionality. |
| 13 | USER_1 | | |
| 14 | USER_2 | | |
| 15 | USER_3 | | |

■ **Control Word for the DCU Profile**

The embedded fieldbus interface writes the fieldbus Control Word as is to the drive Control Word bits 0 to 15. Bits 16 to 32 of the drive Control Word are not in use.

| Bit | Name | Value | State/Description |
|-----|------|-------|-------------------|
| 0 | STOP | 1 | Stop according to the Stop Mode parameter or the stop mode request bits (bits 7…9). |
| | | 0 | (no op) |
| 1 | START | 1 | Start the drive. |
| | | 0 | (no op) |
| 2 | REVERSE | 1 | Reverse direction of motor rotation. |
| | | 0 | Direction of motor rotation depends on the sign of reference: |
| | | | Positive reference: Forward |
| | | | Negative reference: Reverse. |
| 3 | Reserved | | |
| 4 | RESET | 0=>1 | Fault reset if an active fault exists. |
| | | 0 | (no op) |
| 5 | EXT2 | 1 | Select External control location EXT2. Effective if the control location is parameterized to be selected from the fieldbus. |
| | | 0 | Select External control location EXT1. Effective if the control location is parameterized to be selected from the fieldbus. |

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| Bit | Name | Value | State/Description |
|-----|------|-------|-------------------|
| 6 | RUN_DISABLE | 1 | Run disable. If the drive is set to receive the run enable signal from the fieldbus, this bit deactivates the signal. |
| | | 0 | Run enable. If the drive is set to receive the run enable signal from the fieldbus, this bit activates the signal. |
| 7 | STOPMODE_RAMP | 1 | Normal ramp stop mode |
| | | 0 | (no op) Default to parameter stop mode if bits 7…9 are all 0. |
| 8 | STOPMODE_EMERGENCY_RAMP | 1 | Emergency ramp stop mode. |
| | | 0 | (no op) Default to parameter stop mode if bits 7…9 are all 0. |
| 9 | STOPMODE_COAST | 1 | Coast stop mode. |
| | | 0 | (no op) Default to parameter stop mode if bits 7…9 are all 0. |
| 10 | RAMP_PAIR _2 | 1 | Select ramp set 2 (Acceleration time 2 / Deceleration time 2) when parameter *23.11 Ramp set selection* is set to *EFB DCU CW bit 10* |
| | | 0 | Select ramp set 1 (Acceleration time 1 / Deceleration time 1) when parameter *23.11 Ramp set selection* is set to *EFB DCU CW bit 10*. |
| 11 | RAMP_OUT_ZERO | 1 | Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force). |
| | | 0 | Normal operation. |
| 12 | RAMP_HOLD | 1 | Halt ramping (Ramp Function Generator output held). |
| | | 0 | Normal operation. |
| 13 | RAMP_IN_ZERO | 1 | Force Ramp Function Generator input to zero. |
| | | 0 | Normal operation. |
| 14 | REQ_LOCAL_LOCK | 1 | Drive does not switch to local control mode (see parameter *19.18 HAND/OFF disable source*. |
| | | 0 | Drive can switch between local and external control modes. |
| 15 | TORQ_LIM_PAIR _2 | 1 | Select torque limit set 2 (Minimum torque 2 / Maximum torque 2) when parameter *30.18 Torq lim sel* is set to *EFB*. |
| | | 0 | Select torque limit set 1 (Minimum torque 1 / Maximum torque 1) when parameter *30.18 Torq lim sel* is set to *EFB*. |
| 16 | FB_LOCAL_CTL | 1 | Local mode for control from the fieldbus is requested. Steal control from the active source. |
| | | 0 | (no op) |
| 17 | FB_LOCAL_REF | 1 | Local mode for reference from the fieldbus is requested. Steal reference from the active source. |
| | | 0 | (no op) |
| 18 | Reserved for RUN_DISABLE_1 | | Not yet implemented. |

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| Bit | Name | Value | State/Description |
|---|---|---|---|
| 19 | Reserved | | |
| 20 | Reserved | | |
| 21 | Reserved | | |
| 22 | USER_0 | | Writable control bits that can be combined with drive logic for application-specific functionality. |
| 23 | USER_1 | | |
| 24 | USER_2 | | |
| 25 | USER_3 | | |
| 26…31 | Reserved | | |

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# Status Word

## ◼ Status Word for the ABB Drives profile

The table below shows the fieldbus Status Word for the ABB Drives control profile. The embedded fieldbus interface converts the drive Status Word into this form for the fieldbus. The upper case boldface text refers to the states shown in *State transition diagram for the ABB Drives profile* on page *226*.

| Bit | Name | Value | STATE/Description |
|-----|------|-------|-------------------|
| 0 | RDY_ON | 1 | **READY TO SWITCH ON**. |
| | | 0 | **NOT READY TO SWITCH ON**. |
| 1 | RDY_RUN | 1 | **READY TO OPERATE**. |
| | | 0 | **OFF1 ACTIVE**. |
| 2 | RDY_REF | 1 | **OPERATION ENABLED**. |
| | | 0 | **OPERATION INHIBITED**. |
| 3 | TRIPPED | 1 | **FAULT**. |
| | | 0 | No fault. |
| 4 | OFF_2_STATUS | 1 | OFF2 inactive. |
| | | 0 | **OFF2 ACTIVE**. |
| 5 | OFF_3_STATUS | 1 | OFF3 inactive. |
| | | 0 | **OFF3 ACTIVE**. |
| 6 | SWC_ON_ INHIB | 1 | **SWITCH-ON INHIBITED**. |
| | | 0 | – |
| 7 | ALARM | 1 | Warning/Alarm. |
| | | 0 | No warning/alarm. |
| 8 | AT_ SETPOINT | 1 | **OPERATING**. Actual value equals Reference (is within tolerance limits, for example, in speed control, speed error is 10% max. of nominal motor speed). |
| | | 0 | Actual value differs from Reference (is outside tolerance limits). |
| 9 | REMOTE | 1 | Drive control location: REMOTE (EXT1 or EXT2). |
| | | 0 | Drive control location: LOCAL. |
| 10 | ABOVE_ LIMIT | 1 | Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation. Set by drive parameters: *46.31 Above speed limit* and *46.32 Above frequency limit*. These parameters are indicated by bit 10 of *06.11 Main status word*. |
| | | 0 | Actual frequency or speed within supervision limit. |

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| Bit | Name | Value | STATE/Description |
|---|---|---|---|
| 11 | USER_0 | | Status bits that can be combined with drive logic for application-specific functionality. |
| 12 | USER_1 | | |
| 13 | USER_2 | | |
| 14 | USER_3 | | |
| 15 | Reserved | | |

## ■ Status Word for the DCU Profile

The embedded fieldbus interface writes the drive Status Word bits 0 to 15 to the fieldbus Status Word as is. 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 | Run permissive and all start interlocks are active. |
| | | 0 | Run permissive and all start interlocks are not active. |
| 2 | STARTED | 1 | Drive has received start command. |
| | | 0 | Drive has not received start command. |
| 3 | RUNNING | 1 | Drive is modulating. |
| | | 0 | Drive is not modulating. |
| 4 | ZERO_SPEED | 1 | Drive is at zero speed. |
| | | 0 | Drive is not at zero speed. |
| 5 | ACCELERATING | 1 | Drive speed is increasing. |
| | | 0 | Drive speed is not increasing. |
| 6 | DECELERATING | 1 | Drive speed is decreasing. |
| | | 0 | Drive speed is not decreasing. |
| 7 | AT_SETPOINT | 1 | Drive is at setpoint. |
| | | 0 | Drive is not at setpoint. |
| 8 | LIMIT | 1 | Drive operation is limited. |
| | | 0 | Drive operation is not limited. |
| 9 | SUPERVISION | 1 | Actual value (speed, frequency or torque) is above a limit. Limit is set with parameters 46.31…46. |
| | | 0 | Actual value (speed, frequency or torque) is within limits. |
| 10 | REVERSE_REF | 1 | Drive reference is in the reverse direction. |
| | | 0 | Drive reference is in the forward direction |
| 11 | REVERSE_ACT | 1 | Drive is running in the reverse direction |
| | | 0 | Drive is running in the forward direction |
| 12 | PANEL_LOCAL | 1 | Panel/keypad (or PC tool) is in local control mode. |
| | | 0 | Panel/keypad (or PC tool) is not in local control mode. |

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| Bit | Name | Value | State/Description |
|-----|------|-------|-------------------|
| 13 | FIELDBUS_LOCAL | 1 | Fieldbus is in local control mode. |
| | | 0 | Fieldbus is not in local control mode. |
| 14 | EXT2_ACT | 1 | External control location EXT2 is active. |
| | | 0 | External control location EXT1 is active. |
| 15 | FAULT | 1 | Drive is faulted. |
| | | 0 | Drive is not faulted. |
| 16 | ALARM | 1 | Warning/Alarm is active. |
| | | 0 | No warning/alarm. |
| 17 | Reserved | | |
| 18 | DIRLOCK | 1 | Direction lock is ON. (Direction change is locked out.) |
| | | 0 | Direction lock is OFF. |
| 19 | LOCALLOCK | 1 | Local mode lock is ON. (Local mode is locked out.) |
| | | 0 | Local mode lock is OFF. |
| 20 | Reserved | | |
| 21 | Reserved | | |
| 22 | USER_0 | | Status bits that can be combined with drive logic for application-specific functionality. |
| 23 | USER_1 | | |
| 24 | USER_2 | | |
| 25 | USER_3 | | |
| 26 | REQ_CTL | 1 | Control has been granted to this channel. |
| | | 0 | Control has not been granted to this channel. |
| 27 | REQ_REF1 | 1 | Reference 1 has been requested in this channel. |
| | | 0 | Reference 1 has not been requested in this channel. |
| 28 | REQ_REF2 | 1 | Reference 2 has been requested in this channel. |
| | | 0 | Reference 2 has not been requested in this channel. |
| 29…31 | Reserved | | |

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# State transition diagrams

■ **State transition diagram for the ABB Drives profile**

The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile and the drive is configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections *Control Word for the ABB Drives profile* on page *219* and *Status Word for the ABB Drives profile* on page *223*.

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MAINS OFF

SWITCH-ON INHIBITED — (SW Bit6=1)

**ABB Drives profile**

Power ON

(CW Bit0=0)

NOT READY TO SWITCH ON — (SW Bit0=0)

A B C D

CW = Control Word
SW = Status Word
n = Speed
I = Input Current
RFG = Ramp Function Generator
f = Frequency

(CW Bit3=0)

(CW=xxxx x1xx xxxx x**110**)

OPERATION INHIBITED — (SW Bit2=0)

READY TO SWITCH ON — (SW Bit0=1)

operation inhibited

(CW=xxxx x1xx xxxx x**111**)

from any state

Fault

from any state

READY TO OPERATE — (SW Bit1=1)

FAULT — (SW Bit3=1)

**OFF1** (CW Bit0=0)

(CW Bit7=1)

OFF1 ACTIVE — (SW Bit1=0)

(CW=xxxx x1xx xxxx **1111** and SW Bit12=1)

n(f)=0 / I=0

from any state

from any state

(CW Bit3=1 and SW Bit12=1)

Emergency Stop **OFF3** (CW Bit2=0)

Emergency OFF **OFF2** (CW Bit1=0)

B C D

OFF3 ACTIVE — (SW Bit5=0)

OFF2 ACTIVE — (SW Bit4=0)

(CW Bit4=0)

n(f)=0 / I=0

**8**

OPERATION ENABLED — (SW Bit2=1)

C D

A

(CW Bit5=0)

(CW=xxxx x1xx xxx1 **1111**)

RFG: OUTPUT ENABLED

D

B

(CW Bit6=0)

(CW=xxxx x1xx xx11 **1111**)

RFG: ACCELERATOR ENABLED

STATE

C

condition

(CW=xxxx x1xx x111 **1111**)

rising edge of the bit

OPERATION — (SW Bit8=1)

D

The start and stop sequences are given below.

Control word:

Start:

- 1150 (476h) –> NOT READY TO SWITCH ON
- If MSW bit 0 = 1 then
    - 1150 (47Eh) –> READY TO SWITCH ON (Stopped)
    - 1151 (47Fh) –> OPERATION (Running)

Stop:

- 1150 (47Eh) = OFF1 ramp stop (Note: uninterruptable ramp stop)
- 1149 (47Dh) = coast to stop
- 1147 (47Bh) = emergency stop

Fault reset:

- Rising edge of MCW bit 7

Start after STO:

- If *31.22 STO indication run/stop* is not Fault/ Fault, check that *06.18 Start inhibit status word*, bit 7 STO = 0 before giving a start command.

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# References

■ **References for the ABB Drives profile and DCU Profile**

The ABB Drives profile supports the use of two references, EFB reference 1 and EFB reference 2. The references are 16-bit words each containing a sign bit and a 15-bit integer. A negative reference is formed by calculating the two's complement from the corresponding positive reference.

The references are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type*.

```
Fieldbus ─────────────────▶ Drive

                            46.01 (with speed reference)
              20000 ──┬──   46.02 (with frequency reference)

                      │     46.03 (with torque reference)
              10000 ──┼──   46.04 (with power reference)

                  0 ──┼──   0

                      │     (46.03) (with torque reference)
             -10000 ──┼──   -(46.04) (with power reference)

                      │     -(46.01) (with speed reference)
             -20000 ──┴──   -(46.02) (with frequency reference)
```
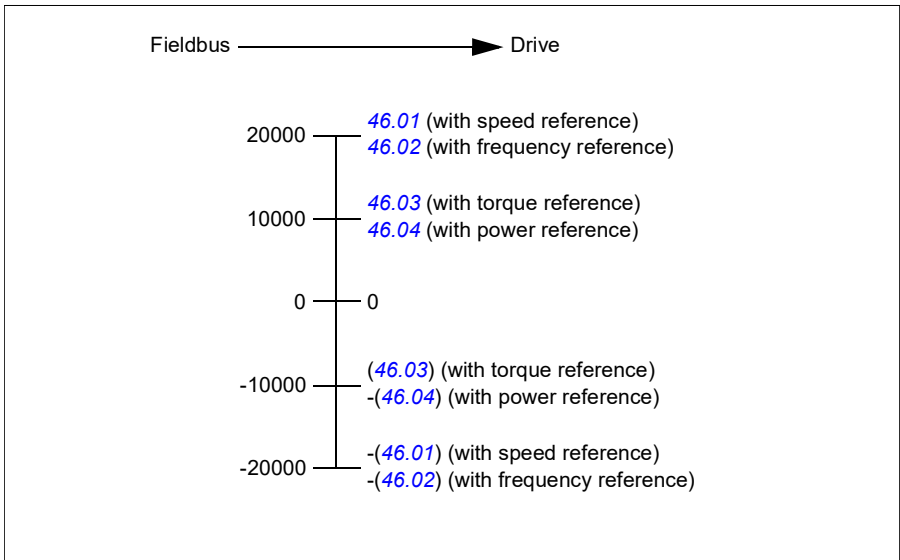
The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

# Actual values

■ **Actual values for the ABB Drives profile and DCU Profile**

The ABB Drives profile supports the use of two fieldbus actual values, ACT1 and ACT2. The actual values are 16-bit words each containing a sign bit and a 15-bit integer. A negative value is formed by calculating the two's complement from the corresponding positive value.

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *58.28 EFB act1 type* and *58.29 EFB act2 type*.
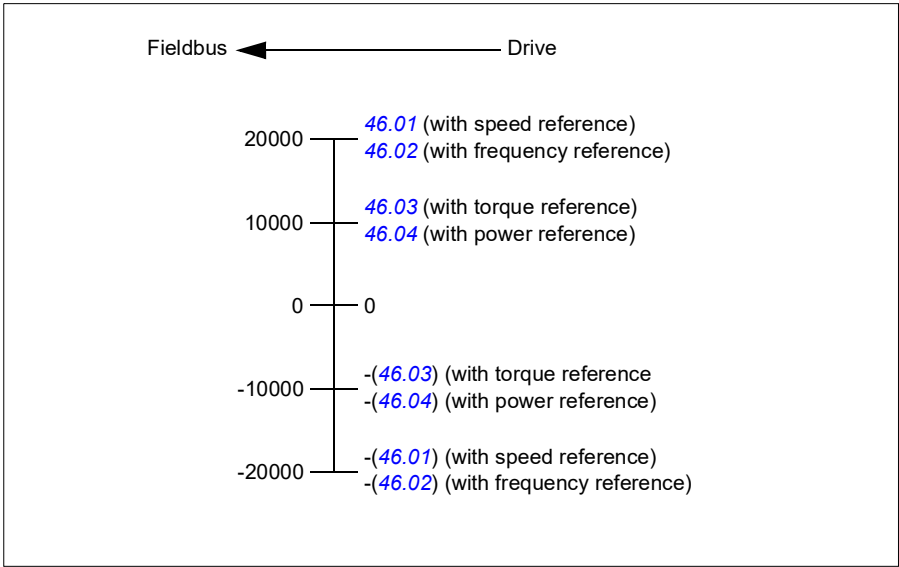
# Modbus holding register addresses

## ■ Modbus holding register addresses for the ABB Drives profile and DCU Profile

The table below shows the default Modbus holding register addresses for the drive data with the ABB Drives profile. This profile provides a converted 16-bit access to the drive data.

**Note:** Only the 16 least significant bits of the drive's 32-bit Control and Status Words can be accessed.

**Note:** Bits 16 through 32 of the DCU Control/Status word are not in use if 16-bit control/status word is used with the DCU Profile.

| Register address | Register data (16-bit words) |
|---|---|
| 400001 | Default: Control word (*CW 16bit*). See sections *Control Word for the ABB Drives profile* (page *219*) and *Control Word for the DCU Profile* (page *220*). <br> The selection can be changed using parameter *58.101 Data I/O 1*. |
| 400002 | Default: Reference 1 (*Ref1 16bit*). <br> The selection can be changed using parameter *58.102 Data I/O 2*. |
| 400003 | Default: Reference 2 (*Ref2 16bit*). <br> The selection can be changed using parameter *58.103 Data I/O 3*. |
| 400004 | Default: Status Word (*SW 16bit*). See sections *Status Word for the ABB Drives profile* (page *223*) and *Status Word for the DCU Profile* (page *224*). <br> The selection can be changed using parameter *58.104 Data I/O 4*. |
| 400005 | Default: Actual value 1 (*Act1 16bit*). <br> The selection can be changed using parameter *58.105 Data I/O 5*. |
| 400006 | Actual value 2 (*Act2 16bit*). <br> The selection can be changed using parameter *58.106 Data I/O 6*. |
| 400007…400014 | Data in/out 7…14. <br> Selected by parameters *58.107 Data I/O 7*…*58.114 Data I/O 14*. |
| 400015…400089 | Unused |
| 400090…400100 | Error code access. See section *Error code registers (holding registers 400090…400100)* (page *238*). |
| 400101…465536 | Parameter read/write. <br> Parameters are mapped to register addresses according to parameter *58.33 Addressing mode*. |

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## Modbus function codes

The table below shows the Modbus function codes supported by the embedded fieldbus interface.

| Code | Function name | Description |
|------|---------------|-------------|
| 01h | Read Coils | Reads the 0/1 status of coils (0X references). |
| 02h | Read Discrete Inputs | Reads the 0/1 status of discrete inputs (1X references). |
| 03h | Read Holding Registers | Reads the binary contents of holding registers (4X references). |
| 05h | Write Single Coil | Forces a single coil (0X reference) to 0 or 1. |
| 06h | Write Single Register | Writes a single holding register (4X reference). |
| 08h | Diagnostics | Provides a series of tests for checking the communication, or for checking various internal error conditions.<br>Supported subcodes:<br>• 00h Return Query Data: Echo/loopback test.<br>• 01h Restart Comm Option: Restarts and initializes the EFB, clears communications event counters.<br>• 04h Force Listen Only Mode<br>• 0Ah Clear Counters and Diagnostic Register<br>• 0Bh Return Bus Message Count<br>• 0Ch Return Bus Comm. Error Count<br>• 0Dh Return Bus Exception Error Count<br>• 0Eh Return Slave Message Count<br>• 0Fh Return Slave No Response Count<br>• 10h Return Slave NAK (negative acknowledge) Count<br>• 11h Return Slave Busy Count<br>• 12h Return Bus Character Overrun Count<br>• 14h Clear Overrun Counter and Flag |
| 0Bh | Get Comm Event Counter | Returns a status word and an event count. |
| 0Fh | Write Multiple Coils | Forces a sequence of coils (0X references) to 0 or 1. |
| 10h | Write Multiple Registers | Writes the contents of a contiguous block of holding registers (4X references). |
| 16h | Mask Write Register | Modifies the contents of a 4X register using a combination of an AND mask, an OR mask, and the register's current contents. |
| 17h | Read/Write Multiple Registers | Writes the contents of a contiguous block of 4X registers, then reads the contents of another group of registers (the same or different than those written) in a server device. |

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| Code | Function name | Description |
|------|---------------|-------------|
| 2Bh / 0Eh | Encapsulated Interface Transport | Supported subcodes: <br> • 0Eh Read Device Identification: Allows reading the identification and other information. <br> Supported ID codes (access type): <br> • 00h: Request to get the basic device identification (stream access) <br> • 04h: Request to get one specific identification object (individual access) <br> Supported Object IDs: <br> • 00h: Vendor Name ("ABB") <br> • 01h: Product Code (for example, "AHVKA") <br> • 02h: Major Minor Revision (combination of contents of parameters *07.05 Firmware version* and *58.02 Protocol ID*). <br> • 03h: Vendor URL ("www.abb.com") <br> • 04h: Product name: ("ACH480"). |

## Exception codes

The table below shows the Modbus exception codes supported by the embedded fieldbus interface.

| Code | Name | Description |
|------|------|-------------|
| 01h | ILLEGAL FUNCTION | The function code received in the query is not an allowable action for the server. |
| 02h | ILLEGAL ADDRESS | The data address received in the query is not an allowable address for the server. |
| 03h | ILLEGAL VALUE | The requested quantity of registers is larger than the device can handle. This error does not mean that a value written to the device is outside of the valid range. |
| 04h | DEVICE FAILURE | An unrecoverable error occurred while the server was attempting to perform the requested action. See section *Error code registers (holding registers 400090…400100)* on page *238*. |

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# Coils (0xxxx reference set)

Coils are 1-bit read/write values. Control Word bits are exposed with this data type. The table below summarizes the Modbus coils (0xxxx reference set). Note that the references are 1-based index which match the address transmitted on the wire.

| Reference | ABB Drives profile | DCU Profile |
|---|---|---|
| 000001 | OFF1_CONTROL | STOP |
| 000002 | OFF2_CONTROL | START |
| 000003 | OFF3_CONTROL | Reserved |
| 000004 | INHIBIT_OPERATION | Reserved |
| 000005 | RAMP_OUT_ZERO | RESET |
| 000006 | RAMP_HOLD | EXT2 |
| 000007 | RAMP_IN_ZERO | RUN_DISABLE |
| 000008 | RESET | STOPMODE_RAMP |
| 000009 | Not for ACH480 | STOPMODE_EMERGENCY_RAMP |
| 000010 | Not for ACH480 | STOPMODE_COAST |
| 000011 | REMOTE_CMD | Reserved |
| 000012 | EXT_CTRL_LOC | RAMP_OUT_ZERO |
| 000013 | USER_0 | RAMP_HOLD |
| 000014 | USER_1 | RAMP_IN_ZERO |
| 000015 | USER_2 | Reserved |
| 000016 | USER_3 | Reserved |
| 000017 | Reserved | FB_LOCAL_CTL |
| 000018 | Reserved | FB_LOCAL_REF |
| 000019 | Reserved | Reserved |
| 000020 | Reserved | Reserved |
| 000021 | Reserved | Reserved |
| 000022 | Reserved | Reserved |
| 000023 | Reserved | USER_0 |
| 000024 | Reserved | USER_1 |
| 000025 | Reserved | USER_2 |
| 000026 | Reserved | USER_3 |
| 000027 | Reserved | Reserved |
| 000028 | Reserved | Reserved |
| 000029 | Reserved | Reserved |
| 000030 | Reserved | Reserved |
| 000031 | Reserved | Reserved |
| 000032 | Reserved | Reserved |

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| Reference | ABB Drives profile | DCU Profile |
|-----------|--------------------|-------------|
| 000033 | Control for relay output RO1 (parameter *10.99 RO/DIO control word*, bit 0) | Control for relay output RO1 (parameter *10.99 RO/DIO control word*, bit 0) |
| 000034 | Control for relay output RO2 (parameter *10.99 RO/DIO control word*, bit 1) | Control for relay output RO2 (parameter *10.99 RO/DIO control word*, bit 1) |
| 000035 | Control for relay output RO3 (parameter *10.99 RO/DIO control word*, bit 2) | Control for relay output RO3 (parameter *10.99 RO/DIO control word*, bit 2) |
| 000036 | Control for relay output RO4 (parameter *10.99 RO/DIO control word*, bit 3) | Control for relay output RO4 (parameter *10.99 RO/DIO control word*, bit 3) |
| 000037 | Control for relay output RO5 (parameter *10.99 RO/DIO control word*, bit 4) | Control for relay output RO5 (parameter *10.99 RO/DIO control word*, bit 4) |

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## Discrete inputs (1xxxx reference set)

Discrete inputs are 1-bit read-only values. Status Word bits are exposed with this data type. The table below summarizes the Modbus discrete inputs (1xxxx reference set). Note that the references are 1-based index which match the address transmitted on the wire.

| Reference | ABB Drives profile | DCU Profile |
|-----------|--------------------|-------------|
| 100001 | RDY_ON | READY |
| 100002 | RDY_RUN | D |
| 100003 | RDY_REF | Reserved |
| 100004 | TRIPPED | RUNNING |
| 100005 | OFF_2_STATUS | ZERO_SPEED |
| 100006 | OFF_3_STATUS | Reserved |
| 100007 | SWC_ON_INHIB | Reserved |
| 100008 | ALARM | AT_SETPOINT |
| 100009 | AT_SETPOINT | LIMIT |
| 100010 | REMOTE | SUPERVISION |
| 100011 | ABOVE_LIMIT | Reserved |
| 100012 | USER_0 | Reserved |
| 100013 | USER_1 | PANEL_LOCAL |
| 100014 | USER_2 | FIELDBUS_LOCAL |
| 100015 | USER_3 | EXT2_ACT |
| 100016 | Reserved | FAULT |
| 100017 | Reserved | ALARM |
| 100018 | Reserved | Reserved |
| 100019 | Reserved | Reserved |
| 100020 | Reserved | Reserved |
| 100021 | Reserved | Reserved |
| 100022 | Reserved | Reserved |
| 100023 | Reserved | USER_0 |
| 100024 | Reserved | USER_1 |
| 100025 | Reserved | USER_2 |
| 100026 | Reserved | USER_3 |
| 100027 | Reserved | REQ_CTL |
| 100028 | Reserved | Reserved |
| 100029 | Reserved | Reserved |
| 100030 | Reserved | Reserved |
| 100031 | Reserved | Reserved |
| 100032 | Reserved | Reserved |

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| Reference | ABB Drives profile | DCU Profile |
|---|---|---|
| 100033 | Delayed status of digital input DI1 (parameter *10.02 DI delayed status*, bit 0) | Delayed status of digital input DI1 (parameter *10.02 DI delayed status*, bit 0) |
| 100034 | Delayed status of digital input DI2 (parameter *10.02 DI delayed status*, bit 1) | Delayed status of digital input DI2 (parameter *10.02 DI delayed status*, bit 1) |
| 100035 | Delayed status of digital input DI3 (parameter *10.02 DI delayed status*, bit 2) | Delayed status of digital input DI3 (parameter *10.02 DI delayed status*, bit 2) |
| 100036 | Delayed status of digital input DI4 (parameter *10.02 DI delayed status*, bit 3) | Delayed status of digital input DI4 (parameter *10.02 DI delayed status*, bit 3) |
| 100037 | Delayed status of digital input DI5 (parameter *10.02 DI delayed status*, bit 4) | Delayed status of digital input DI5 (parameter *10.02 DI delayed status*, bit 4) |
| 100038 | Delayed status of digital input DI6 (parameter *10.02 DI delayed status*, bit 5) | Delayed status of digital input DI6 (parameter *10.02 DI delayed status*, bit 5) |

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## Error code registers (holding registers 400090…400100)

These registers contain information about the last query. The error register is cleared when a query has finished successfully.

| Reference | Name | Description |
|---|---|---|
| 400090 | Reset Error Registers | 1 = Reset internal error registers (91…95). 0 = Do nothing. |
| 400091 | Error Function Code | Function code of the failed query. |
| 400092 | Error Code | Set when exception code 04h is generated (see table above).<br>• 00h No error<br>• 02h Low/High limit exceeded<br>• 03h Faulty Index: Unavailable index of an array parameter<br>• 05h Incorrect Data Type: Value does not match the data type of the parameter<br>• 65h General Error: Undefined error when handling query |
| 400093 | Failed Register | The last register (discrete input, coil, input register or holding register) that failed to be read or written. |
| 400094 | Last Register Written Successfully | The last register (discrete input, coil, input register or holding register) that was written successfully. |
| 400095 | Last Register Read Successfully | The last register (discrete input, coil, input register or holding register) that was read successfully. |

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# BACnet MS/TP control through the embedded fieldbus interface (EFB)

## Contents of this chapter

The chapter describes BACnet MS/TP control through the embedded fieldbus interface (EFB): supported functionality, services and objects as well as how to configure the BACnet through the **Primary settings** menu and with parameters.

## BACnet overview

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

You will find BACnet Protocol Implementation Conformance Statement (PICS) (3AXD10000786871 [English]) for the ACH480 in the ABB Document library on the Internet.

# 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.
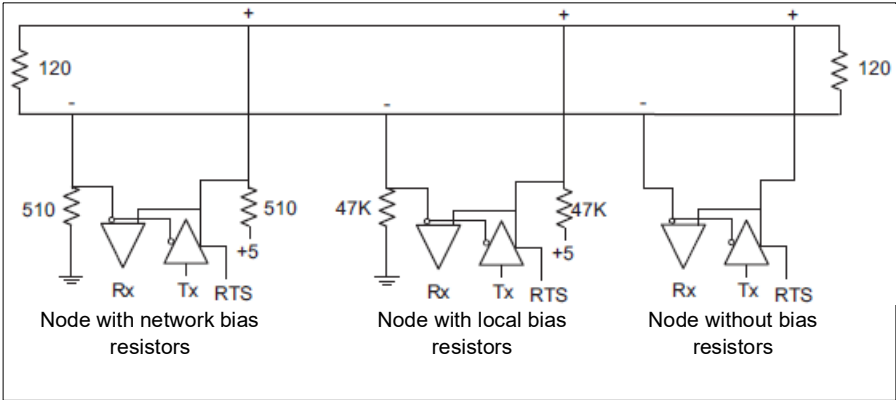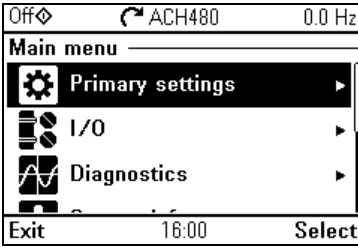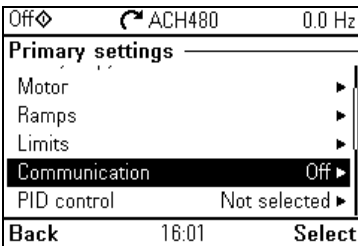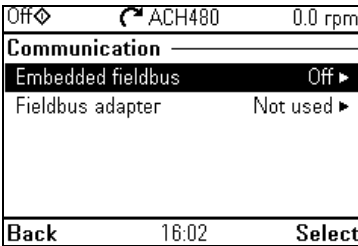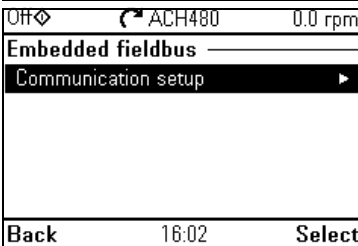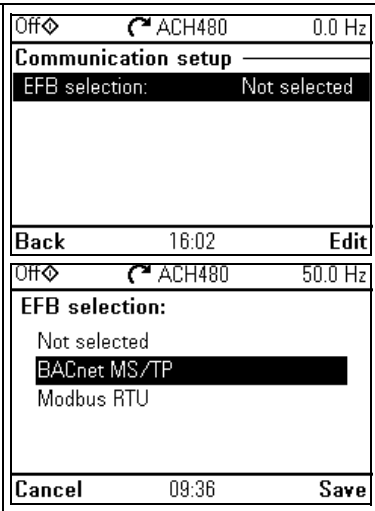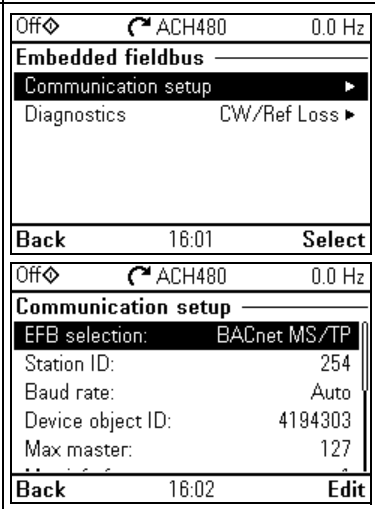


Node with network bias resistors        Node with local bias resistors        Node without bias resistors

## ◼ Connecting the drive to the building automation controller

For connecting the EFB terminal block X5 of the drive to the building automation controller via the EIA-485 network, see section *Connecting the drive to the fieldbus* on page *210*.

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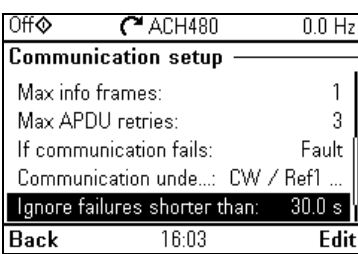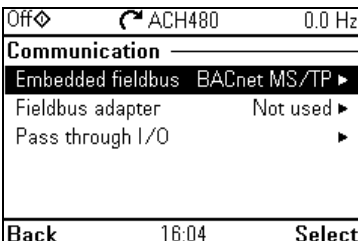
# Starting up BACnet communication through the Primary settings menu

The **Primary settings** menu enables easy programming of the most common settings for the drive including BACnet communication settings.

| Commissioning |
|---|
| ☐ To start up fieldbus communication select **Menu > Primary settings > Communication**. <br><br> Off◇  ↻ ACH480  0.0 Hz <br> **Main menu** <br> ⚙ **Primary settings** ▶ <br> 📇 I/O ▶ <br> 🖪 Diagnostics ▶ <br> Exit  16:00  Select <br><br> Off◇  ↻ ACH480  0.0 Hz <br> **Primary settings** <br> Motor ▶ <br> Ramps ▶ <br> Limits ▶ <br> Communication  Off ▶ <br> PID control  Not selected ▶ <br> Back  16:01  Select |
| ☐ Select **Embedded fieldbus > Communication setup**. <br><br> Off◇  ↻ ACH480  0.0 rpm <br> **Communication** <br> Embedded fieldbus  Off ▶ <br> Fieldbus adapter  Not used ▶ <br><br> Back  16:02  Select <br><br> Off◇  ↻ ACH480  0.0 rpm <br> **Embedded fieldbus** <br> Communication setup  ▶ <br><br> Back  16:02  Select |

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| | | |
|---|---|---|
| ☐ | Select **EFB selection** and then **select BACnet MS/TP** and press **Save**. | Off◇     ⵌ ACH480    0.0 Hz <br> **Communication setup** ———— <br> EFB selection:     Not selected <br><br><br><br> **Back**    16:02    **Edit** <br> Off◇    ⵌ ACH480    50.0 Hz <br> **EFB selection:** <br> Not selected <br> **BACnet MS/TP** <br> Modbus RTU <br><br> **Cancel**    09:36    **Save** |
| ☐ | To set up BACnet MS/TP parameters select **Embedded fieldbus > Communication setup >** Roll the screen down to see all rows. | Off◇    ⵌ ACH480    0.0 Hz <br> **Embedded fieldbus** ———— <br> Communication setup    ▶ <br> Diagnostics    CW/Ref Loss ▶ <br><br><br> **Back**    16:01    **Select** <br> Off◇    ⵌ ACH480    0.0 Hz <br> **Communication setup** ———— <br> EFB selection:    BACnet MS/TP <br> Station ID:    254 <br> Baud rate:    Auto <br> Device object ID:    4194303 <br> Max master:    127 <br> **Back**    16:02    **Edit** |

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| | | |
|---|---|---|
| ☐ | After setting all necessary parameters, select **Apply settings to embedded fieldbus** to validate your settings. | Off◇　　　C ACH480　　0.0 Hz<br>**Communication setup**<br>Max info frames:　　　　　　1<br>Max APDU retries:　　　　　3<br>If communication fails:　　Fault<br>Communication unde...:  CW / Ref1 ...<br>Ignore failures shorter than:　30.0 s<br>**Back**　　　16:03　　**Edit**<br><br>Off◇　　　C ACH480　　0.0 Hz<br>**Communication setup**<br>Max APDU retries:　　　　　3<br>If communication fails:　　Fault<br>Communication unde...:  CW / Ref1 ...<br>Ignore failures shorter than:　30.0 s<br>↰Apply settings to embedded fieldb...<br>**Back**　　　16:04　　**Select** |
| ☐ | After validating the settings, press **Back** twice until you see **Pass through I/O** on the **Communication** menu.<br>Select **Pass through I/O** and then **Drive control setup**. | Off◇　　　C ACH480　　0.0 Hz<br>**Communication**<br>Embedded fieldbus　BACnet MS/TP ▶<br>Fieldbus adapter　　Not used ▶<br>Pass through I/O　　　　　▶<br><br><br>**Back**　　　16:04　　**Select** |

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| | |
|---|---|
| For relay output control through BACnet MS/TP, select **Relay outputs** and set the source of appropriate relays to EFB. | Off◇　　　　⟳ ACH480　　　0.0 Hz<br>**Drive control setup** ─────<br>Relay outputs　　　　　　▶<br>Analog outputs　　　　　▶<br><br><br>**Back**　　　16:04　　**Select**<br><br>Off◇　　　　⟳ ACH480　　　0.0 Hz<br>**Relay outputs** ─────<br>RO1　　　　　Not energized ▶<br>RO2　　　　　　　Custom ▶<br>RO3　　　　　　　Custom ▶<br><br><br>**Back**　　　16:04　　**Select**<br><br>Off◇　　　　⟳ ACH480　　　0.0 Hz<br>**RO1** ─────<br>Actual command:　　　　　0<br>Source:　　　　　　EFB/FBA<br>Off delay:　　　　　0.0 s<br>On delay:　　　　　0.0 s<br><br>**Back**　　　16:04　　**Edit** |

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| | |
|---|---|
| ☐ For analog output control through BACnet MS/TP, select **Analog outputs** and configure the appropriate analog outputs. | Off◇    ⌒ ACH480    0.0 Hz<br>**Drive control setup** ───<br>Relay outputs             ▶<br>Analog outputs          ▶<br><br><br>**Back**      16:04      **Select**<br><br>Off◇    ⌒ ACH480    0.0 Hz<br>**Analog outputs** ───<br>AO1: 0.000 V      Custom ▶<br>AO2: 0.000 mA     Custom ▶<br><br><br>**Back**      16:05      **Select**<br><br>Off◇    ⌒ ACH480    0.0 Hz<br>**AO1:** ───<br>Output value:         0.000 V<br>EFB/FBA Source value:   0.00 %<br>Source:              Custom<br>Source min:           0.0 %<br>Source max:         50.0 %<br>**Back**      16:05      **View** |

# Starting up fieldbus communication with parameters

Follow these steps to setup fieldbus communication with parameters in the **Parameters** menu. For example of appropriate values, see section *Activating drive control functions* on page *246*.

1. Power up the drive.

2. Enable BACnet communication by setting parameter *58.01 Protocol enable* to *BACnet MSTP*.

3. Configure network settings with parameters *58.03 Node address* and *58.04 Baud rate*.

4. Define the device object instance value with parameter *58.40 Device object ID*.

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**Note:** The object instance value should be unique and in the range 1…4194303.

5. Define communication loss function to detect communication loss between EFB and the drive:

   • Set the communication loss mode and communication loss time with parameters *58.15 Communication loss mode* and *58.16 Communication loss time*.

   • Select how the drive reacts to an EFB communication break with parameter *58.14 Communication loss action*.

6. Save the valid parameter values to permanent memory by setting parameter *96.07 Parameter save manually* to *Save*.

7. Validate the settings made in parameter group *58 Embedded fieldbus* by setting parameter *58.06 Communication control* to *Refresh settings*.

8. You can use parameters *58.07*…*58.13* for diagnostics. You can reset counters *58.08*…*58.12* by setting the parameter value to 0.

9. Set the relevant drive control parameters to control the drive according to the application.

**Note:** You find all embedded fieldbus parameters in group *58 Embedded fieldbus* on page *500*.

## Activating drive control functions

### ◼ Drive control

To enable fieldbus control of various drive functions through BACnet MS/TP, do the following:

• Configure the drive to accept embedded fieldbus communication by enabling BACnet communication and defining the node address and device id for the drive.

• Select the individual control functions to use the embedded fieldbus as a source. This makes the input source come from the corresponding BACnet object.

**Note:** Change those parameter of the functions that you want to control through BACnet MS/TP. All other parameters can remain as factory default values.

**Start/stop direction control**

For Start/stop direction control through fieldbus, configure the following drive parameters and set the fieldbus controller supplied command(s) in the appropriate location:

| Drive parameter | Value | Description | BACnet object |
|---|---|---|---|
| *20.01 Ext1 commands* | Embedded fieldbus | Start/stop by fieldbus with Ext1 selected | BV10 |
| *20.07 Ext2 commands* | Embedded fieldbus | Start/stop by fieldbus with Ext2 selected | BV10 |

| Drive parameter | Value | Description | BACnet object |
|---|---|---|---|
| *20.21 Direction* | Request | Direction by fieldbus, if required | BV11 |

**Input reference select**

The tables below show how to use the BACnet embedded fieldbus to select the drive input references for frequency and speed control modes

- For frequency control, set parameter *99.04 Motor control mode* = *Scalar* (default value for ACH480). See section *Frequency reference* on page *247* and parameter group *28 Frequency reference chain* on page *405*.

- For speed control, set parameter *99.04 Motor control mode* = *Vector*. See section *Speed reference* on page *247* and parameter group *22 Speed reference selection* on page *388*.

Vector control has better accuracy than scalar control, but vector control cannot be used in all situations. See parameter *99.04 Motor control mode*.

Frequency reference

For using the BACnet embedded fieldbus to provide input frequency references to the drive, configure the following drive parameters and set the fieldbus controller supplied reference word(s) in the appropriate location:

| Drive parameter | Value | Description | BACnet object |
|---|---|---|---|
| *19.11 Ext1/Ext2 selection* | 32 = *EFB MCW bit 11* | Reference set selection by fieldbus | BV13 |
| *28.11 Ext1 frequency ref1* | 8 = *EFB ref1* [1] | Frequency reference source 1 | AV16 Input Reference1 |
| *28.15 Ext2 frequency ref1* | 9 = *EFB ref2* [1] | Frequency reference source 2 | AV17 Input Reference 2 |
| *46.02 Frequency scaling* | 50.00 Hz [1] | 16-bit scaling of frequency-related parameters | No direct BACnet object |

[1] As an example

Speed reference

For using the BACnet embedded fieldbus to provide input speed references to the drive, configure the following drive parameters and set the fieldbus controller supplied reference word(s) in the appropriate location:

| Drive parameter | Value | Description | BACnet object |
|---|---|---|---|
| *19.11 Ext1/Ext2 selection* | 32 =*EFB MCW bit 11* | Reference set selection by fieldbus | BV13 |
| *22.11 Ext1 speed ref1* | 8 = *EFB ref1* [1] | Speed reference source 1 | AV16 Input Reference1 |
| *22.18 Ext2 speed ref1* | 9 = *EFB ref2* [1] | Speed reference source 2 | AV17 Input Reference 2 |
| *46.01 Speed scaling* | 1500 rpm [1] | 16-bit scaling of speed-related parameters | No direct BACnet object |

[1] As an example

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## ■ Miscellaneous drive control

To use the BACnet embedded fieldbus for different drive control functions, configure the following drive parameters and set the fieldbus controller supplied command(s) in the appropriate location:

| Drive parameter | Value | Description | BACnet object |
|---|---|---|---|
| *20.40 Run permissive* | 15 = *Embedded fieldbus* | Run permission by fieldbus | BV12 |
| No direct drive parameter. Via BACnet object the fault reset always goes through. | - | Fault reset via fieldbus | BV14 |
| *20.41 Start interlock 1* | 15 = *Embedded fieldbus* | Source for start interlock 1 is fieldbus | BV20 |
| *20.42 Start interlock 2* | 15 = *Embedded fieldbus* | Source for start interlock 2 is fieldbus | BV21 |

### Relay output control

For relay output control through BACnet embedded fieldbus,

- set the following drive parameters to select the source for the ROs
- program the drive for control through BACnet.

| Drive parameter | Value | Description | BACnet object |
|---|---|---|---|
| *10.24 RO1 source* | 40 = *RO/DIO control word bit0* | Relay output 1 controlled by fieldbus | BO0 |
| *10.27 RO2 source* | 41 = *RO/DIO control word bit1* | Relay output 2 controlled by fieldbus | BO1 |
| *10.30 RO3 source* | 42 = *RO/DIO control word bit2* | Relay output 3 controlled by fieldbus | BO2 |
|  | Other (*10.99 RO/DIO control word*, bit 8) | Digital output 1 controlled by fieldbus<br>Note: You can use BO5 in ACH480 if DIO1 output source is set to 10.99 bit 8. | BO5 |

### Data point connections

The BACnet objects control parameter *10.99 RO/DIO control word* bit values. These bits need to be connected to the corresponding RO and DO sources as above.

| BACnet object | Drive parameter | Description |
|---|---|---|
| BO0…BO2 | *10.99 RO/DIO control word* | Storage parameter for relay outputs and digital output |

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## Analog output control

For analog output control through BACnet embedded fieldbus, configure the following drive parameters and set the fieldbus controller supplied analog value(s) in the appropriate location:

| Drive parameter | Value | Description | BACnet object |
|---|---|---|---|
| *13.12 AO1 source* | 37 = *AO1 data storage* | Analog output 1 controlled by fieldbus | AO0 |
| *13.22 AO2 source* | 38 = *AO2 data storage* | Analog output 2 controlled by fieldbus | AO1 |
| *13.17 AO1 source min* | 0.0 [1] | Minimum value of signal selected by parameter *13.12 AO1 source* | No direct BACnet object |
| *13.18 AO1 source max* | 100.0 [1] | Maximum value of signal selected by parameter *13.12 AO1 source* | No direct BACnet object |
| *13.27 AO2 source min* | 0.0 [1] | Minimum value of signal selected by parameter *13.22 AO2 source* | No direct BACnet object |
| *13.28 AO2 source max* | 100.0 [1] | Maximum value of signal selected by parameter *13.22 AO2 source* | No direct BACnet object |

[1] As an example

### Data point connections

The BACnet objects control parameters *13.91 AO1 data storage* and *13.92 AO2 data storage* values. These values need to be connected to the corresponding AO sources as above.

| BACnet object | Drive parameter | Description |
|---|---|---|
| AO0 | *13.91 AO1 data storage* | Storage parameter for AO1 |
| AO1 | *13.92 AO2 data storage* | Storage parameter for AO2 |

## PID control

For PID control through BACnet embedded fieldbus, configure the following drive parameters and set the fieldbus controller supplied PID value(s) in the appropriate location:

| Drive parameter | Value | Description | BACnet object |
|---|---|---|---|
| *40.08 Set 1 feedback 1 source* | 10 = *Feedback data storage* | Feedback 1 source data storage | AV43 |
| *40.09 Set 1 feedback 2 source* | 10 = *Feedback data storage* | Feedback 2 source data storage | AV43 |
| *40.16 Set 1 setpoint 1 source* | 24 = *Setpoint data storage* | Setpoint 1 source data storage | AV42 |
| *40.17 Set 1 setpoint 2 source* | 24 = *Setpoint data storage* | Setpoint 2 source data storage | AV42 |

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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.

| BACnet object | Drive parameter | Description |
|---|---|---|
| AV43 | *40.91 Feedback data storage* | Storage parameter for process feedback value |
| AV42 | *40.92 Setpoint data storage* | Storage parameter for process setpoint value |

## ■ Communication fault

BACnet has no built-in feature to detect communication timeout, because it is not a synchronous protocol. If communication timeouts are needed, you can use the following parameters to detect timeouts based on different packets and specifying the drive action.

| Drive parameter | Value | Description |
|---|---|---|
| *58.15 Communication loss mode* | 1 = *Any message*<br>2 = *Cw / Ref1 / Ref2* | Defines which message types reset the timeout counter for detecting an EFB communication loss. |
| *58.14 Communication loss action* | 0 = *No action*<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.<br>Changes to this parameter take effect after the control unit is rebooted or the new settings are validated by parameter *58.06 Communication control* (1 = *Refresh settings*). |
| *58.16 Communication loss time* | 0.0…6000.0 s | Sets a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified by parameter *58.16 Communication loss time* is taken. |

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## ■ Drive feedback

The inputs to the BMS controller (drive output signals) have pre-defined content. These drive feedback signals do not require any additional drive configuration. The following table lists a subset of the supported feedback data. For a complete listing, see the Protocol Implementation Conformance Statement (PICS) (3AXD10000387059 [English]), which you can find in the ABB Document library on the Internet.

| Drive parameter | Description | BACnet object |
|---|---|---|
| *01.01 Motor speed used* | Estimated motor speed (rpm) | AV0 |
| *01.06 Output frequency* | Estimated drive output frequency (Hz) | AV1 |
| *01.11 DC voltage* | DC link voltage (V) | AV2 |
| *01.13 Output voltage* | Calculated motor voltage (V AC) | AV3 |
| *01.07 Motor current* | Measured (absolute) motor current (A) | AV4 |
| *01.10 Motor torque* | Motor torque in percent of the nominal motor torque (%) | AV5 |

| Drive parameter | Description | BACnet object |
|---|---|---|
| *01.14 Output power* | Drive output power (kW) | AV6 |
| *05.11 Inverter temperature* | Estimated drive temperature in percent of fault limit (%) | AV7 |
| *01.20 Inverter kWh counter* | Amount of energy that has passed through the drive (in either direction) in full kilowatthours. Whenever the counter rolls over, *01.19 Inverter MWh counter* is incremented. The minimum value is zero. | AV9 |
| *35.01 Motor estimated temperature* | Displays the motor temperature (°C or °F) as estimated by the internal motor thermal protection model. The unit is selected by parameter *96.16 Unit selection*. | AV15 |
| *01.03 Motor speed %* | Motor speed in percent of the synchronous motor speed. | AV31 |
| *40.01 Process PID output actual* | PID controller output | AV44 |
| *40.04 Process PID deviation actual* | PID deviation | AV49 |
| *01.50 Current hour kWh* | Current day energy consumption. This is the energy of the last 24 hours (not necessarily continuous) the drive has been running, not the energy of a calendar day. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle. | AV130 |
| *01.51 Previous hour kWh* | Previous hour energy consumption. The value *01.50 Current hour kWh* is stored here when its values has been cumulated for 60 minutes. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle. | AV131 |
| *01.52 Current day kWh* | Current day energy consumption. This is the energy of the last 24 hours (not necessarily continuous) the drive has been running, not the energy of a calendar day. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle. | AV132 |
| *01.53 Previous day kWh* | Previous day energy consumption. The value *01.52 Current day kWh* is stored here when its value has been cumulated for 24 hours. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle. | AV133 |
| *04.01 Tripping fault* | Fault that caused the current trip (active fault) | AV18 |
| *04.11 Latest fault* | Previous fault (non-active) | AV19 |
| *04.12 2nd latest fault* | Fault before the previous fault (non-active) | AV20 |

The actual output values of the drive can be read from AV0…AV6, AV31 and AV32:

| Object ID | Default object name | Description | Min/max present value | Unit | Present value access type |
|---|---|---|---|---|---|
| AV0 | Output-RPM | Motor speed | 0, nominal speed | rpm | R |
| AV1 | Output-Freq | Output frequency | -500, 500 | Hz | R |

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| Object ID | Default object name | Description | Min/max present value | Unit | Present value access type |
|-----------|--------------------|-------------|----------------------|------|--------------------------|
| AV2 | DC-Voltage | DC link voltage | 0, 2000 | V | R |
| AV3 | Output-Voltage | AC output voltage | 0, 2000 | V | R |
| AV4 | Output-Current | Output current of drive | 0, nominal current | A | R |
| AV5 | Output-Torque | Output torque of motor as a percentage of nominal torque | -1600, 1600 | % | R |
| AV6 | Output-Power | Output power in kW | nominal power (+/-) | kW | R |
| AV31 | Output-Speed | Actual motor speed | -200, 200 | % | R |
| AV32 | Output-Current-Range | Actual motor current | 0, 200 | % | R |

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# Parameter setting example

## ■ Frequency control

The table below shows an example of how to configure a basic frequency control application. The rest of parameters can be left as default values.

| Drive parameter | Settings | Description |
|---|---|---|
| *58.06 Communication control* | 0 = *Enabled* | Normal operation |
| *58.03 Node address* | 181 [1] | Defines the node address of the drive on the fieldbus link. |
| *58.40 Device object ID* | 51 [1] | Configures device object ID. |
| *58.16 Communication loss time* | 30 [1] | Sets the communication timeout as 30 seconds. |
| *58.15 Communication loss mode* | 1 = *Any message* [1] | The timeout feature monitors any directed message received from the drive. |
| *58.06 Communication control* | 0 = *Refresh settings* | Refreshes settings and takes changed EFB configuration settings in use. |
| *20.01 Ext1 commands* | | Selects the embedded fieldbus interface as the source of start and stop commands for external control location 1. |
| *28.11 Ext1 frequency ref1* | | Selects embedded fieldbus reference 1 as the source for frequency reference 1. |

[1] Example

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# BACnet protocol implementation conformance statement

Document: 3AXD10000786871, Rev 1

Date: Sept 12, 2018
Vendor name: ABB, Vendor ID 127
Product name: HVAC Drive
Product model number: ACH480
Applications software version: Drive FW: 2.x.x.x BACnet Appl: 2025
Firmware revision: 14.01
BACnet protocol revision: 14

■ **Product description:**

The ACH480 is a high-performance variable speed drive (VSD) designed for HVAC and refrigeration applications. Product supports native BACnet, connecting directly to the MS/TP LAN. MS/TP baud rates are supported up to 115.2 kbps, as well as master and slave mode functionalities. Over BACnet, the drive can be fully controlled and monitored as a standard variable speed drive. In addition, the drive's standard I/O is available over BACnet to the user application.

■ **BACnet standardized device profile (Annex L):**

☐ BACnet Operator Workstation (B-OWS)
☐ BACnet Advanced Operator Workstation (B-AWS)
☐ BACnet Operator Display (B-OD)
☐ BACnet Building Controller (B-BC)
☐ BACnet Advanced Application Controller (B-AAC)
☑ BACnet Application specific Controller (B-ASC)
☐ BACnet Smart Sensor (B-SS)
☐ BACnet Smart Actuator (B-SA)

■ **List all BACnet interoperability building blocks supported (Annex K):**

| | |
|---|---|
| DS-RP-B | Data Sharing-ReadProperty |
| DS-RPM-B | Data Sharing-ReadProperty Multiple |
| DS-WP-B | Data Sharing-WriteProperty |
| DS-WPM-B | Data Sharing-WriteProperty Multiple |
| DS-COV-B | Data Sharing-Change of Value |
| DM-DDB-B | Device Management-DynamicDeviceBinding |
| DM-DOB-B | Device Management-DynamicObjectBinding |
| DM-DCC-B | Device Management-DeviceCommunicationControl |
| DM-RD-B | Device Management-ReinitializeDevice |
| DM-TS-B | Device Management-Time Synchronization |

### ■ Segmentation capability:

☐ Able to transmit segmented messages    Window size: -
☐ Able to receive segmented messages    Window size: -

### ■ Standard object types supported:

Object instantiation is static, i.e. objects cannot be created or deleted. Refer to tables at end of this document for object details.

### ■ Data link layer options:

☐ BACnet IP, (Annex J)
☐ BACnet IP, (Annex J), foreign device
☐ ISO 8802-3, Ethernet (Clause 7)
☐ ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
☐ ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s) _____
☑ MS/TP master (Clause 9), baud rate(s): 9.6k, 19.2k, 38.4k, 76.8k, 115.2k
☑ MS/TP slave (Clause 9), baud rate(s): 9.6k, 19.2k, 38.4k, 76.8k, 115.2k
☐ Point-to-point, EIA 232 (Clause 10), baud rate(s):_____
☐ Point-to-point, modem, (Clause 10), baud rate(s):_____
☐ LonTalk, (Clause 11), medium: _____
☐ BACnet/ZigBee (ANNEX O)
☐ Other: _____

### ■ Device address binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐ Yes  ☑ No

### ■ Networking options:

☐ Router, Clause 6
      BACnet/IP to MS/TP
      BACnet/ ISO 8802-3, Ethernet to MS/TP
      BACnet/IP to BACnet/ ISO 8802-3, Ethernet
      BACnet/IP to BACnet/ ISO 8802-3, Ethernet to MS/TP
☐ Annex H, BACnet tunneling router over IP
☐ BACnet/IP broadcast management device (BBMD)
      Does the BBMD support registrations by foreign devices? ☐ Yes  ☐ No
          Max BDT (Broadcast distribution table)-entries:
      Does the BBMD support network address translation? ☐ Yes  ☐ No

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■ **Network security options:**

☑ Non-secure device - is capable of operating without BACnet network security
☐ Secure device - is capable of using BACnet network security (NS-SD BIBB)
    ☐ Multiple application-specific keys:
    ☐ Supports encryption (NS-ED BIBB)
    ☐ Key server (NS-KS BIBB)

■ **Character sets supported:**

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

| | | |
|---|---|---|
| ☑ ISO 10646 (UTF-8) | ☐ IBM /Microsoft DBCS | ☐ ISO 8859-1 |
| ☐ ISO 10646 (UCS-2) | ☐ ISO 10646 (UCS-4) | ☐ JIS X 0208 |

If this product is a communication gateway, describe the types of non-BACnet equipment/network(s) that the gateway supports:

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## Object/Property support matrix

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

| Property | Object type | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| | Binary input | Binary output | Binary value | Analog input | Analog output | Analog value | Multistate value | Loop |
| Object identifier | R | R | R | R | R | R | R | R |
| Object name | W, P | W, P | R | W, P | W, P | R[1] | R | W,P |
| Object type | R | R | R | R | R | R | R | R |
| Present value | R | C | C | R | C | C | R | R |
| Status flags | R | R | R | R | R | R | R | R |
| Event state | R | R | R | R | R | R | R | R |
| Out-of-service | W | W | W | W | W | W | W | W |
| Polarity | W, P | W, P | | | | | | |
| Active text | R | R | R | | | | | |
| Inactive text | R | R | R | | | | | |
| Units | | | | R | R | R | | |
| Min present value | | | | R | R | R | | |
| Max present value | | | | R | R | R | | |
| Priority array | | R | R | | R | R | | |
| Relinquish default | | W, P | W,P | | W, P | W, P | | |
| COV increment | | | | W,P | W,P | W,P | | |
| Number of states | | | | | | | R | |
| State text | | | | | | | R | |
| Property list | R | R | R | R | R | R | R | R |
| | • R = Read only, W = Writable, C = Commandable, P = Persist<br>• AV16, AV17, AV21, AV22, AV40- AV44, AV55, AV56, AV59, AV120-129 have W, P<br>• Max length of writable object names is 25 characters | | | | | | | |

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## Device object instance summary

The following table summarizes the device object supported:

| Device object | | | |
| --- | --- | --- | --- |
| Property | Flag | Type | Default value |
| Object identifier | W, P | OID | 4194303 |
| Object name | W, P | CharString, max length 25 | AC Drive 4194303 |
| Object type | R | Enum | DEV (8) |
| System status | R | Enum | |
| Vendor name | R | CharString | ABB |
| Vendor identifier | R | Unsigned | 127 |
| Model name | R | CharString | ACH480 |

| Firmware revision | R | CharString | 14.01 |
|---|---|---|---|
| Application software revision | R | CharString | |
| Description | W, P | CharString, max length 100 | "ACH480 is a high-performance variable speed drive designed for HVAC and refrigeration applications." |
| Location | W, P | CharString, max length 50 | "(not set)" |
| Protocol version | R | Unsigned | 1 |
| Protocol revision | R | Unsigned | 14 |
| Protocol services supported | R | BitString | |
| Protocol object types supported | R | BitString | |
| Object list | R | Array of OID | |
| Max APDU length accepted | R | Unsigned | 480 |
| Segmentation supported | R | Enum | No segmentation (3) |
| Local time | R | BACnetTime | |
| Local date | R | BACnetDate | |
| APDU timeout | W, P | Unsigned | 10000 ms |
| Number of APDU retries | W, P | Unsigned | 3 |
| Max master | W, P | Unsigned | 127 |
| Max info frames | W, P | Unsigned | 1 |
| Device address binding | R | List of Struct | |
| Database revision | R, P | Unsigned | |
| Active COV subscriptions | R | Array of BACnetCOVSubscription | |
| Serial number | R | CharString | |
| Property list | R | Array of Unsigned | |
| | | **Flags:** R = Read only, W = Writable, C = Commandable, P = Persist | |

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# Binary input object instance summary

The following table summarizes the binary input objects supported:

| Object ID | Object name | Description | Active/Inactive text | Present value access type |
|---|---|---|---|---|
| BI0 | RO1-Monitor | Status of relay output 1 | On / Off | R |
| BI1 | RO2-Monitor | Status of relay output 2 | On / Off | R |
| BI2 | RO3-Monitor | Status of relay output 3 | On / Off | R |
| BI6 | DI1-Monitor | Status of digital input 1 | On / Off | R |
| BI7 | DI2-Monitor | Status of digital input 2 | On / Off | R |
| BI8 | DI3-Monitor | Status of digital input 3 | On / Off | R |
| BI9 | DI4-Monitor | Status of digital input 4 | On / Off | R |
| BI10 | DI5-Monitor | Status of digital input 5 | On / Off | R |
| BI11 | DI6-Monitor | Status of digital input 6 | On / Off | R |

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

## Binary output object instance summary

The following table summarizes the binary output objects supported:

| Object ID | Object name | Description | Active/Inactive text | Present value access type |
|-----------|-------------|-------------|----------------------|---------------------------|
| BO0 | RO1-Command | Output state of relay 1 | On / Off | C |
| BO1 | RO2-Command | Output state of relay 2 | On / Off | C |
| BO2 | RO3-Command | Output state of relay 3 | On / Off | C |
| BO5 | DO1-Command | Output state of digital output 1 | On / Off | C |

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

## Binary value object instance summary

The following table summarizes the binary value objects supported:

| Object ID | Object name | Description | Active/Inactive text | Present value access type |
|-----------|-------------|-------------|----------------------|---------------------------|
| BV0 | RUN-STOP-Monitor | Drive's run status | Run / Stop | R |
| BV1 | Direction-Monitor | Rotational direction of the motor | Reverse / Forward | R |
| BV2 | OK-FAULT-Monitor | Actual fault status of drive | Fault / OK | R |
| BV3 | EXT1-EXT2-Monitor | Actual control source | Ext2 / Ext1 | R |
| BV4 | HAND-AUTO-Monitor | Actual operating mode. | Hand / Auto | R |
| BV5 | Warning-Monitor | Actual warning status | Warning / OK | R |
| BV7 | Ready-Monitor | Actual ready status | Ready / Not-Ready | R |
| BV8 | At-Setpoint-Monitor | Actual at setpoint status | Yes / No | R |
| BV9 | Enabled-Monitor | Actual run enabled status | Enable / Disable | R |
| BV10 | RUN-STOP-Command | Command to start drive | Run / Stop | C |
| BV11 | Direction-Command | Command to rotational direction | Reverse / Forward | C |
| BV12 | Run-Permissive-Command | Command to run permissive command | Enable / Disable | C |
| BV13 | EXT1-EXT2-Command | Commanded to external 1 or external 2 selection | Ext2 / Ext1 | C |

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| Object ID | Object name | Description | Active/Inactive text | Present value access type |
|---|---|---|---|---|
| BV14 | Fault-Reset-Command | Commanded to fault reset | Reset / No | W |
| BV15-BV16 | \<Reserved\> | | | |
| BV17 | Lock-Parameters | Actual status of parameter lock. | Lock / Unlock | R |
| BV18 | Control-Override-Command | Command the drive into BACnet control override. In this mode, BACnet acquires drive control from its normal source. Note that HAND mode of the panel has priority over BACnet Control Override. | On / Off | C |
| BV19 | Control-Override-Monitor | Indicates if drive has been placed in BACnet control override by commanding BV18. In this mode, BACnet acquires drive control from its normal source. Note that HAND mode of the panel has priority over BACnet control override. | On / Off | R |
| BV20 | Start-Interlock-1-Command | Command to start enable 1 | Enable / Disable | C |
| BV21 | Start-Interlock-2-Command | Command to start enable 2 | Enable / Disable | C |
| BV24 | Started-Monitor | Actual start status | Started / Not-Started | R |
| BV25 | Safe-Torque-Off-Monitor | Actual status of Safe Torque Off | Active / OK | R |
| BV26 | Underload-Monitor | Indicates if ULC signal is lower than the Underload curve | Underload / OK | R |
| BV27 | Overload-Monitor | Indicates if ULC signal is higher than the overload curve | Overload / OK | R |
| BV28 | Motor-Heating-Command | Command to motor heating mode | On / Off | W |
| BV29 | Motor-Heating-Monitor | Actual status of motor heating mode | On / Off | R |
| BV30 | User0-Monitor | Actual status of "User bit0" in drive status word | On / Off | R |
| BV31 | User1-Monitor | Actual status of "User bit1" in drive status word | On / Off | R |
| BV32 | User2-Monitor | Actual status of "User bit2" in drive status word | On / Off | R |
| BV33 | User3-Monitor | Actual status of "User bit3" in drive status word | On / Off | R |
| BV34 | User0-Command | Commands "User bit0" in drive status word | On / Off | C |
| BV35 | User1-Command | Commands "User bit1" in drive status word | On / Off | C |
| BV36 | User2-Command | Commands "User bit2" in drive status word | On / Off | C |

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| Object ID | Object name | Description | Active/Inactive text | Present value access type |
|-----------|-------------|-------------|----------------------|---------------------------|
| BV37 | User3-Command | Commands "User bit3" in drive status word | On / Off | C |
| BV38 | <Reserved> | | | |
| BV39 | Parameter-Save-Command | Command to save drive parameters and BACnet property data (properties marked as 'P=Persist') | Save / No | W |
| BV40 | PID-Set-Select | Command to Process PID set1 or Process PID set2 selection | Set1 / Set2 | W |

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

## Analog input object instance summary

The following table summarizes the analog input objects supported:

| Object ID | Default object name | Description | Min / Max present value | Units | Present value access type |
|-----------|---------------------|-------------|-------------------------|-------|---------------------------|
| AI0 | AI1-Monitor | Indicates the input level of analog input 1. | 0…100 | Percent (%) | R |
| AI1 | AI2-Monitor | Indicates the input level of analog input 2. | 0…100 | Percent (%) | R |

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

## Analog output object instance summary

The following table summarizes the analog output objects supported:

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| Object ID | Default object name | Description | Min / Max present value | Units | Present value access type |
|-----------|---------------------|-------------|-------------------------|-------|---------------------------|
| AO0 | AO1-Command | Controls analog output 1 (drive must be configured for BACnet control). | 0…100 | Percent | C |
| AO1 | AO2-Command | Controls analog output 2 (drive must be configured for BACnet control). | 0…100 | Percent | C |

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

## Analog value object instance summary

The following table summarizes the analog value objects supported:

| Object ID | Default object name | Description | Min / Max present value | Units | Present value access type |
|---|---|---|---|---|---|
| AV0 | Output-RPM | Motor speed | 0, nominal speed | rpm | R |
| AV1 | Output-Freq | Output frequency | -500, 500 | Hz | R |
| AV2 | DC-Voltage | DC bus voltage | 0, 2000 | V | R |
| AV3 | Output-Voltage | AC output voltage | 0, 2000 | V | R |
| AV4 | Output-Current | Output current of drive | 0, nominal current | A | R |
| AV5 | Output-Torque | Output torque of motor as a percentage of nominal torque | -1600, 1600 | % | R |
| AV6 | Output-Power | Output power in kW | nominal power (+/-) | kW | R |
| AV7 | Operating-Temp-Range | Heatsink temperature | -40, 160 | % | R |
| AV8 | Kilowatt-Hour-Meter-R | Drive's cumulative energy usage. This value is resettable. | 0,65535 | kWh | W |
| AV9 | Kilowatt-Hour-Meter-NR | Drive's cumulative energy usage. This value is not resettable. | 0, 65535999999 | kWh | R |
| AV10 | Process-PID-Feedback | This object is the process PID feedback signal. | 0, 100 | % | R |
| AV11 | Process-PID-Deviation | This object is the process PID output signal's deviation from its setpoint. | 0, 100 | % | R |
| AV12 | External-PID-Feedback | This object is the external PID feedback signal. | 0, 100 | % | R |
| AV13 | External-PID-Deviation | This object is the external PID output signal's deviation from its setpoint. | 0, 100 | % | R |
| AV14 | Running-Hours | Drive's resettable run time (reset by writing 0). | 0, 3.40282347e38 | hours | R |
| AV15 | Motor-Temp-Degrees-C | Motor temperature | -10, 200 | °C | R |
| AV16 | Input-Reference-1 | Speed setpoint 1 | -150, 150 | % | C |
| AV17 | Input-Reference-2 | Speed setpoint 2. | -150, 150 | % | C |

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| Object ID | Default object name | Description | Min / Max present value | Units | Present value access type |
|---|---|---|---|---|---|
| AV18 | Active-Fault | Displays most recent fault currently active. | | | R |
| AV19 | Previous-Fault-1 | Displays most recent stored (non-active) fault | | | R |
| AV20 | Previous-Fault-2 | Displays the second most recent stored (non-active) fault | | | R |
| AV21 | AO1-Monitor | Output level of analog output 1 | 0, 100 | % | R |
| AV22 | AO2-Monitor | Output level of analog output 2 | 0, 100 | % | R |
| AV23 | Accel-1-Seconds | Ramp1 acceleration time | 0, 1800 | s | W |
| AV24 | Decel-1-Seconds | Ramp 1 deceleration time | 0, 1800 | s | W |
| AV25 | Mbox-Param | Parameter number to be used by mailbox function. | | No Units | W |
| AV26 | Mbox-Data | Set (W) or indicate (R) of the data value of mailbox function | | No Units | W |
| AV27 | External-PID-Setpoint | This object sets the external PID controller setpoint | 0,100 | % | C |
| AV27-AV28 | <Reserved> | | | | |
| AV29 | Min-Speed | Defines the allowed minimum output frequency | -500, 500 | Hz | W |
| AV30 | Max-Speed | Defines the allowed maximum output frequency | -500, 500 | Hz | W |
| AV31 | Output-Speed | Actual motor speed | -200, 200 | % | R |
| AV32 | Output-Current-Range | Actual motor current | 0, 200 | % | R |
| AV33 | Max-Current | Max motor current | 0, nominal current | A | W |
| AV34-AV39 | <Reserved> | | | | |
| AV40 | LOOP-Feedback-Monitor | Loop controller feedback value after source selection, mathematical function and filtering (read-only) | 0, 100 | % | R |
| AV41 | LOOP-Setpoint-Monitor | Loop controller setpoint value after source selection, mathematical function limitation and ramping (read-only) | 0,100 | % | R |

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| Object ID | Default object name | Description | Min / Max present value | Units | Present value access type |
|---|---|---|---|---|---|
| AV42 | LOOP-Setpoint | Command to store loop controller setpoint value used as input for the process | 0,100 | % | C |
| AV43 | LOOP-Feedback | Stores the feedback value for loop controller | 0, 100 | % | W |
| AV44 | LOOP-Output | Loop controller output | 0, 100 | % | R |
| AV45 | LOOP- Gain | Loop controller gain | 0.1, 100 | No Units | W |
| AV46 | LOOP-Integration-Time | Loop controller integration time | 0, 3600 | s | W |
| AV47-AV48 | <Reserved> | | | | |
| AV49 | LOOP-Deviation-Monitor | Loop controller deviation | 0, 100 | % | R |
| AV50-AV52 | <Reserved> | | | | |
| AV53 | LOOP-1-Gain | Loop controller gain (set 2) | 0.1, 100 | No Units | W |
| AV54 | LOOP-1-Integration-Time | Loop controller integration time (set 2) | 0, 3600 | s | W |
| AV55 | LOOP-2-Feedback-Monitor | External loop controller feedback value after source selection, mathematical function and filtering (read-only) | 0, 100 | % | R |
| AV56 | LOOP-2-Setpoint-Monitor | External loop controller setpoint value after source selection, mathematical function limitation and ramping (read-only) | 0,100 | % | R |
| AV57-AV58 | <Reserved> | | | | |
| AV59 | LOOP-2-Output | External loop controller output | 0, 100 | % | R |
| AV60 | LOOP-2-Gain | External loop controller gain | 0.1, 100 | No Units | W |
| AV61 | LOOP-2-Integration-Time | External loop controller integration time | 0, 3600 | s | W |
| AV62-AV63 | <Reserved> | | | | |
| AV64 | LOOP-2-Deviation-Monitor | External loop controller deviation | 0, 100 | % | R |
| AV65-119 | <Reserved> | | | No Units | W |

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| Object ID | Default object name | Description | Min / Max present value | Units | Present value access type |
|---|---|---|---|---|---|
| AV120 | Data-IO-1 | Holds the value of drive parameter, which is mapped using Data I/O parameter 58.101 | | No Units | W |
| AV121 | Data-IO-2 | Holds the value of drive parameter, which is mapped using Data I/O parameter 58.102 | | No Units | W |
| AV122 | Data-IO-3 | Holds the value of drive parameter, which is mapped using Data I/O parameter 58.103 | | No Units | W |
| AV123 | Data-IO-4 | Holds the value of drive parameter, which is mapped using Data I/O parameter 58.104 | | No Units | W |
| AV124 | Data-IO-5 | Holds the value of drive parameter, which is mapped using Data I/O parameter 58.105 (Read-only) | | No Units | R |
| AV125 | Data-IO-6 | Holds the value of drive parameter, which is mapped using Data I/O parameter 58.106 (Read-only) | | No Units | R |
| AV126 | Data-IO-7 | Holds the value of drive parameter, which is mapped using Data I/O parameter 58.107 (Read-only) | | No Units | R |
| AV127 | Data-IO-8 | Holds the value of drive parameter, which is mapped using Data I/O parameter 58.108 (Read-only) | | No Units | R |
| AV128 | Data-IO-9 | Holds the value of drive parameter, which is mapped using Data I/O parameter 58.109 (Read-only) | | No Units | R |
| AV129 | Data-IO-10 | Holds the value of drive parameter, which is mapped using Data I/O parameter 58.110 (Read-only) | | No Units | R |
| AV130 | Kilowatt-Hour-This-Hour | Current hour energy consumption | 0, 3.40282347e38 | kWh | R |
| AV131 | Kilowatt-Hour-Last-Hour | Last hour energy consumption | 0, 3.40282347e38 | kWh | R |
| AV132 | Kilowatt-Hour-This-Day | Current day energy consumption | 0, 3.40282347e38 | kWh | R |

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| Object ID | Default object name | Description | Min / Max present value | Units | Present value access type |
|---|---|---|---|---|---|
| AV133 | Kilowatt-Hour-Last-Day | Last day energy consumption | 0, 3.40282347e38 | kWh | R |

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

## Multistate value object instance summary

The following table summarizes the multistate value objects supported:

| Object ID | Object name | Description | State text | Present value access type |
|---|---|---|---|---|
| MSV0 | HAND-AUTO-Reference | Indicates whether the drive is under Hand or Auto control, or if override mode is active. | Off, Hand, Auto, Override | R |
| MSV1 | Active-Fault-1 | Enumerated type of the most recent fault currently active | None, Comm-Error, Overcurrent, Overtemperature, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Overload, Motor-Underload, External-Fault, Operator-Interface-Error, Config-Error, Feedback-Failure, Output-Phase-Loss Motor-Stall, Power-Unit-Error, Input-Phase-Fault, Internal-Failure, STO-Active, Other | R |

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| Object ID | Object name | Description | State text | Present value access type |
|-----------|-------------|-------------|------------|---------------------------|
| MSV2 | Active-Fault-2 | Enumerated type of the 2nd most recent fault currently active | None, Comm-Error, Overcurrent, Overtemperature, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Overload, Motor-Underload, External-Fault, Operator-Interface-Error, Config-Error, Feedback-Failure, Output-Phase-Loss Motor-Stall, Power-Unit-Error, Input-Phase-Fault, Internal-Failure, STO-Active, Other | R |
| MSV3 | Active-Fault-3 | Enumerated type of the 3rd most recent fault currently active | None, Comm-Error, Overcurrent, Overtemperature, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Overload, Motor-Underload, External-Fault, Operator-Interface-Error, Config-Error, Feedback-Failure, Output-Phase-Loss Motor-Stall, Power-Unit-Error, Input-Phase-Fault, Internal-Failure, STO-Active, Other | R |

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| Object ID | Object name | Description | State text | Present value access type |
|-----------|-------------|-------------|------------|---------------------------|
| MSV4 | Active-Warning-1 | Enumerated type of the most recent warning currently active | None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other | R |
| MSV5 | Active-Warning-2 | Enumerated type of the 2nd most recent warning currently active | None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other | R |
| MSV6 | Active-Warning-3 | Enumerated type of the 3rd most recent warning currently active | None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other | R |

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

## Loop object instance summary

The following table summarizes the loop objects supported:

| Object ID | Object name | Description | Manipulated variable reference | Controlled variable reference | Setpoint reference | Present value access type |
|-----------|-------------|-------------|--------------------------------|-------------------------------|--------------------|---------------------------|
| LOOP0 | LOOP-Set1 | Loop object for process PID set 1 | AV44 Present Value | AV43 Present Value | AV42 Present Value | R |

| Object ID | Object name | Description | Manipulated variable reference | Controlled variable reference | Setpoint reference | Present value access type |
|---|---|---|---|---|---|---|
| LOOP1 | LOOP-Set2 | Loop object for process PID set 2 | AV44 Present Value | AV43 Present Value | AV42 Present Value | R |

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

## Mailbox function

The drive provides a Mailbox function to access parameters that have not been pre-defined by the protocol. Using mailbox, any drive parameter can be identified and read. Mailbox can also be used to adjust parameter settings by writing a value to any parameter identified. The following table shows the mailbox objects.

| Object ID | Default object name | Description | Min/max present value | Unit | Present value access type |
|---|---|---|---|---|---|
| AV25 | Mbox-Param | Parameter number to be used by mailbox function. | | No units | W |
| AV26 | Mbox-Data | Set (W) or indicate (R) of the data value of mailbox function | | | W |

To use the Mailbox function, write the parameter address to the Mbox-Param object as a floating point value. The three lowest digits in the integer part are used for the parameter index within the parameter group.

**Example:** For parameter 47.01, write the address as 47001.00 to the Mbox-Param object. For parameter 47.999, write the address as 47999.00 to the Mbox-Param object.

Read or write the value to the Mbox-Data object as a floating point value. If the parameter is a decimal type parameter it's value is shown as a decimal number. The value of an integer type parameter is shown as an integer number.

**Example:** If parameter 47.01 has value 12.554 it is shown just as it is. If parameter 47.21 has value 125, it is shown just like that, without a decimal part.

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# 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.

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■ **Supported features**

In the N2 fieldbus protocol the drive appears as a "virtual object".
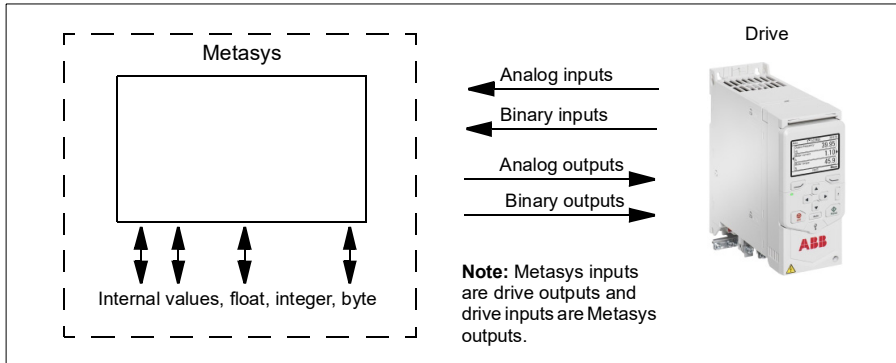


A virtual object is made up of:
- analog inputs
- binary inputs
- analog outputs
- binary outputs
- internal values for floating point, integer, and byte values.

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.

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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.
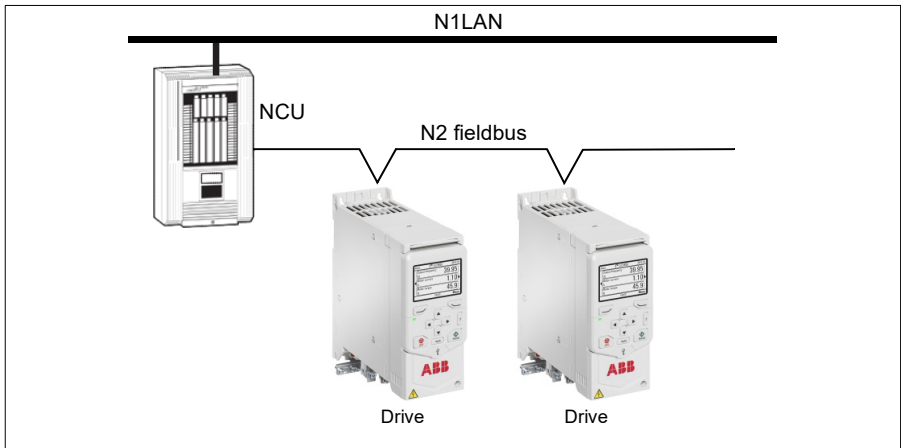
The following diagram shows the drive's integration to the Johnson Controls Metasys Companion system.
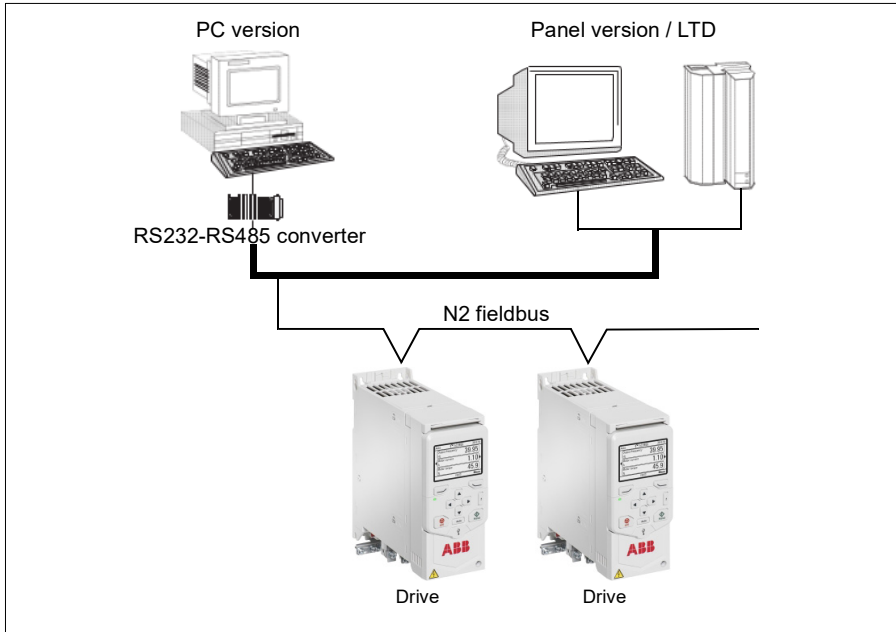


On the N2 fieldbus each drive can be accessed by the full complement of Metasys FMS features, including change-of-state (COS) monitoring, alarm notification, scheduling, trend, and totalization.

On one N2 fieldbus segment there can be up to 32 nodes while integrating drives with Johnson Controls Metasys.
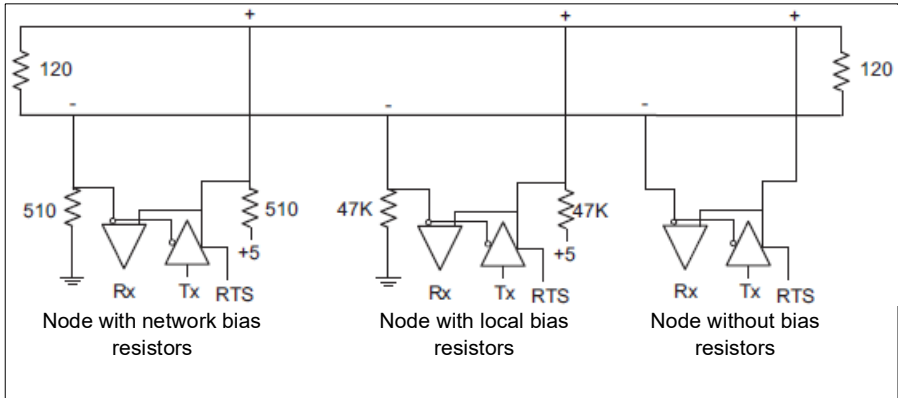
### ■ Drive device type

For the Metasys and Metasys Companion products, the device type for the drive is VND.

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# Hardware installation

## ◼ Connecting devices to a N2 EIA-485 network

The figure shows three types of nodes connected on the EIA-485 network.



| Node with network bias resistors | Node with local bias resistors | Node without bias resistors |

## ◼ Connecting the drive to the building automation controller

For connecting the EFB terminal block X5 of the drive to the building automation controller via the EIA-485 network, see section *Connecting the drive to the fieldbus* on page *210*.

# N2 analog input objects

The following table lists the N2 analog input objects defined for the drive.

| No | Object | Drive parameter | Scale factor | Units | Range | Notes |
|---|---|---|---|---|---|---|
| AI1 | OUTPUT FREQUENCY | *01.06 Output frequency* | 100 | Hz | 0…250 | |
| AI2 | RATED SPEED | *01.62 Abs motor speed %* | 100 | % | 0…100 | |
| AI3 | SPEED | *01.01 Motor speed used* | 100 | rpm | 0…9999 | |
| AI4 | CURRENT | *01.07 Motor current* | 100 | A | 0…9999 | |
| AI5 | TORQUE | *01.10 Motor torque* | 100 | % | -200…200 | |
| AI6 | POWER | *01.17 Motor shaft power* | 10 | kW | 0…9999 | |
| AI7 | DRIVE TEMPERATURE | *05.11 Inverter temperature* | 10 | % | -40…160 | |

(N2 analog inputs)

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| N2 analog inputs | | | | | | |
|---|---|---|---|---|---|---|
| No | Object | Drive parameter | Scale factor | Units | Range | Notes |
| AI8 | KILOWATT HOURS | *01.58 Cumulative inverter energy (resettable)* | 10 | kW | 0…65535 | |
| AI9 | MEGAWATT HOURS | Derived value | 10000 | MWh | 0…65535 | Parameter *01.54 Cumulative inverter energy* / 1000 |
| AI10 | RUN TIME | *05.03 Hours run* | 10 | h | 0…65535 | |
| A11 | DC BUS VOLTAGE | *01.11 DC voltage* | 100 | V | 0…999 | |
| AI12 | OUTPUT VOLTAGE | *01.13 Output voltage* | 1 | V | 0…999 | |
| AI13 | PRC PID FEEDBACK | *40.97 Process PID feedback %* | 100 | % | 0…100 | |
| AI14 | PRC PID DEVIATION | *40.99 Process PID deviation %* | 100 | % | 0…100 | |
| AI15 | EXT PID FEEDBACK | Derived value | 10 | % | 0…100 | = *71.02 Feedback act value* * 1000 / *71.14 Setpoint scaling* |
| AI16 | EXT PID DEVIATION | Derived value | 10 | % | 0…100 | = *71.04 Deviation act value* * 1000 / *71.14 Setpoint scaling* |
| AI17 | LAST FAULT | Derived value | 1 | | fault code | Most recent fault |
| AI18 | PREV FAULT | Derived value | 1 | | fault code | Second most recent fault |
| AI19 | OLDEST FAULT | Derived value | 1 | | fault code | Third most recent fault |
| AI20 | AI 1 ACTUAL | *12.101 AI1 percent value* | 100 | % | 0…100 | |
| AI21 | AI 2 ACTUAL | *12.102 AI2 percent value* | 100 | % | 0…100 | |
| AI22 | AO 1 ACTUAL | *13.11 AO1 actual value* | 1000 | mA | 0…20 | |
| AI23 | AO 2 ACTUAL | *13.21 AO2 actual value* | 1000 | mA | 0…20 | |
| AI24 | MOTOR TEMP | Derived value | 1 | °C | 0…200 | Value is derived from *35.01*, *35.02* and *35.03*:<br>• If *35.11* and *35.21* are both non-zero, the temperature is the maximum value of *35.02* and *35.03*.<br>• If only *35.11* is non-zero, the temperature is value of *35.02*.<br>• If only *35.21* is non-zero, the temperature is value of *35.03*.<br>• If both *35.11* and *35.21* are zero, the value is as *35.01*. |

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# N2 binary input objects

The following table lists the N2 binary input objects defined for the drive.

| No | Object | Drive parameter | Range |
|---|---|---|---|
| **N2 binary inputs** | | | |
| BI1 | STOP/RUN | Status Word, bit 2 | 0 = Drive received start command<br>1 = Drive has not received start command |
| BI2 | FORWARD/REVERSE | Status Word, bit 11 | 0 = Forward, 1 = Reverse |
| BI3 | FAULT STATUS | Status Word, bit 15 | 0 = OK, 1 = Drive fault |
| BI4 | RELAY 1 STATUS | *10.21 RO status*, bit 0 | 0 = Off, 1 = On |
| BI5 | RELAY 2 STATUS | *10.21 RO status*, bit 1 | 0 = Off, 1 = On |
| BI6 | RELAY 3 STATUS | *10.21 RO status*, bit 2 | 0 = Off, 1 = On |
| BI7…BI9 | NA | | |
| BI10 | INPUT 1 STATUS | *10.02 DI delayed status*, bit 0 | 0 = Off, 1 = On |
| BI11 | INPUT 2 STATUS | *10.02 DI delayed status*, bit 1 | 0 = Off, 1 = On |
| BI12 | INPUT 3 STATUS | *10.02 DI delayed status*, bit 2 | 0 = Off, 1 = On |
| BI13 | INPUT 4 STATUS | *10.02 DI delayed status*, bit 3 | 0 = Off, 1 = On |
| BI14 | INPUT 5 STATUS | *10.02 DI delayed status*, bit 4 | 0 = Off, 1 = On |
| BI15 | INPUT 6 STATUS | *10.02 DI delayed status*, bit 5 | 0 = Off, 1 = On |
| BI16 | EXTERNAL 2 SELECT | DCU Status Word, bit 14 | 0 = EXT1 active, 1 = EXT2 active |
| BI17 | HAND/AUTO | DCU Status Word, bit 12 | 0 = AUTO, 1 = HAND |
| BI18 | ALARM | DCU Status Word, bit 16 | 0 = OK, 1 = Warning/alarm |
| BI20 | DRIVE READY | DCU Status Word, bit 0 | 0 = Not ready, 1 = Ready |
| BI21 | AT SETPOINT | DCU Status Word, bit 7 | 0 = No, 1 = At setpoint |
| BI22 | RUN ENABLED | DCU Status Word, bit 1 | 0 = Not enabled, 1 = Enabled |
| BI23 | N2 LOCAL MODE | DCU Status Word, bit 13 | 0 = Auto, 1 = N2 local |
| BI24 | N2 CONTROL SRC | DCU Status Word, bit 26 | 0 = No, 1 = Yes |
| BI25 | N2 REF1 SRC | DCU Status Word, bit 27 | 0 = No, 1 = Yes |
| BI26 | N2 REF2 SRC | DCU Status Word, bit 28 | 0 = No, 1 = Yes |

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# N2 analog output objects

The following table lists the N2 analog output objects defined for the drive.

| No | Object | Drive parameter | Scale factor | Units | Range | Notes |
|----|--------|-----------------|--------------|-------|-------|-------|
| | | | | | **N2 analog outputs** | |
| AO1 | REFERENCE 1 | Reference 1 | 10 | % | 0…100 | |
| AO2 | REFERENCE 2 | Reference 2 | 10 | % | 0…100 | |
| AO3 | ACCEL TIME 1 | No direct mapping | 1000 | s | 0.1…1800 | If parameter *99.04 Motor control mode* is set<br>• to vector mode (*99.04* = 0), map to *23.12 Acceleration time 1*.<br>• to scalar mode (*99.04* = 1), map to *28.72 Freq acceleration time 1*. |
| AO4 | DECEL TIME 1 | No direct mapping | 1000 | s | 0.1…1800 | If parameter *99.04 Motor control mode* is set<br>• to vector mode (*99.04* = 0), map to *23.13 Deceleration time 1*<br>• to scalar mode (*99.04* = 1), map to *28.73 Freq deceleration time 1*. |
| AO5 | CURRENT LIMIT | *30.17 Maximum current* | 100 | A | $0…1.3*I_{2N}$ | |
| AO6 | PID1-CONT GAIN | *40.32 Set 1 gain* | 100 | % | 0.1…100 | |
| AO7 | PID1-CONT I-TIME | *40.33 Set 1 integration time* | 10 | s | 0.1…600 | |
| AO8 | PID1-CONT D-TIME | *40.34 Set 1 derivation time* | 10 | s | 0…10 | |
| AO9 | PID1-CONT D FILTER | *40.35 Set 1 derivation filter time* | 10 | s | 0…10 | |
| AO10 | PID2-CONT GAIN | *41.32 Set 2 gain* | 100 | % | 0.1…100 | |
| AO11 | PID2-CONT I-TIME | *41.33 Set 2 integration time* | 10 | s | 0.1…600 | |
| AO12 | PID2-CONT D-TIME | *41.34 Set 2 derivation time* | 1000 | s | 0…10 | |
| AO13 | PID2-CONT D FILTER | *41.35 Set 2 derivation filter time* | 10 | s | 0…10 | |
| AO14 | COMMAND AO 1 | *13.91 AO1 data storage* | 10 | % | 0…100 | |
| AO15 | COMMAND AO 2 | *13.92 AO2 data storage* | 10 | % | 0…100 | |
| AO16 | EXT PID SETPOINT | *71.21 Internal setpoint 1* | 100 | % | 0…100 | |

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| N2 analog outputs | | | | | | |
|---|---|---|---|---|---|---|
| No | Object | Drive parameter | Scale factor | Units | Range | Notes |
| AO17 | SPD OUT MIN | Derived value | 10 | % | 0…200 | Writing:<br>• <u>scalar mode</u>: *30.13 Minimum frequency* = AO17 * *99.08 Motor nominal frequency*<br>• <u>vector mode</u>: *30.11 Minimum speed* = AO17 * *99.09 Motor nominal speed*.<br>Reading:<br>• <u>scalar mode</u>: *99.08 Motor nominal frequency* / *30.13 Minimum frequency*<br>• <u>vector mode</u>: *99.09 Motor nominal speed* / *30.11 Minimum speed*. |
| AO18 | SPD OUT MAX | Derived value | 10 | % | 0…200 | Writing:<br>• <u>scalar mode</u>: *30.14 Maximum frequency* =AO17 * *99.08 Motor nominal frequency*<br>• <u>vector mode</u>: *30.12 Maximum speed* = AO17 * *99.09 Motor nominal speed*.<br>Reading:<br>• <u>scalar mode</u>: *99.08 Motor nominal frequency* / *30.13 Minimum frequency*<br>• <u>vector mode</u>: *99.09 Motor nominal speed*/*30.11 Minimum speed*. |
| AO19 | MAILBOX PARAMETER | | 1 | | 0…65535 | Mailbox feature is not supported |
| AO20 | MAILBOX DATA | | 1 | | 0…65535 | Mailbox feature is not supported |

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# N2 binary output objects

The following table lists the N2 binary output objects defined for the drive.

| N2 binary outputs | | | | |
|---|---|---|---|---|
| No | Object | Drive parameter | Range | Notes |
| BO1 | STOP/START | DCU Control Word, bit 0 and bit 1 | 0 = Stop,<br>1 = Start to Speed | Stop: set bit 0, clear bit 1<br>Start: set bit 1, clear bit 0 |
| BO2 | FORWARD/REVERSE | DCU Control Word, bit 12 | 0 = Forward,<br>1 = Reverse | |

| N2 binary outputs | | | | |
|-----|--------|----------------|-------|-------|
| No | Object | Drive parameter | Range | Notes |
| BO3 | PANEL LOCK | Derived | 0 = Open, 1 = Locked | Derived from 96.03 Access level status, bit 14 parameter lock |
| BO4 | RUN ENABLE | Derived value | 0 = Enable, 1 = Disable | Invert DCU control word bit 6, RUN_DISABLE |
| BO5 | REF1/REF2 SELECT | DCU Control Word, bit 5, EXT | 0 = Ref1, 1 = Ref2 | |
| BO6 | FAULT RESET | DCU Control Word, bit 4, RESET | Change 0 -> 1 Resets | |
| BO7 | COMMAND RO 1 | *10.99 RO/DIO control word*, bit 0 | 0 = Off, 1 = On | |
| BO8 | COMMAND RO 2 | *10.99 RO/DIO control word*, bit 1 | 0 = Off, 1 = On | |
| BO9 … BO12 | NA | | | |
| BO13 | RESET RUN TIME | Indirectly mapping | 0 = N/A, 1 = On (Reset run rime, *05.03 Hours run*) | |
| BO14 | RESET KWH COUNT | Indirectly mapping | 0 = N/A, 1 = On (Reset kWh count *01.58 Cumulative inverter energy (resettable)*) | |
| BO15 | PRC PID SELECT | *40.57 PID set1/set2 selection* (indirectly) | 0 = SET1, 1 = SET2 | If BO15 = 0, *40.57 PID set1/set2 selection* is set to PID Set1 (1). If BO15 = 1, *40.57 PID set1/set2 selection* is set to PID Set2 (2). |
| BO16 | N2 LOCAL CTL [1] | DCU Control Word, bit 16 | 0 = Auto, 1 = N2 | |
| BO17 | N2 LOCAL REF [1] | DCU Control Word, bit 17 | 0 = Auto, 1 = N2 | |
| BO18 | SAVE PARAMETERS | *96.07 Parameter save manually* (indirectly) | 0 = N/A, 1 = On (Save Parameters) | |
| BO19 | READ MAILBOX | | 0 = No, 1 = Yes | Mailbox feature is not supported |
| BO20 | WRITE MAILBOX | | 0 = No, 1 = Yes | Mailbox feature is not supported |

[1] N2 LOCAL CTL and N2 LOCAL REF have priority over drive input terminals. Use these binary outputs for temporary N2 control of the drive when COMM is not the selected control source Need to be verified.

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## DDL file for NCU

The listing below is the data definition language (DDL) file for ACH480 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 ACH480.DDL file listing.

```
*********************************************************************************************

*                    ABB Drives,  ACH 480 Variable Frequency Drive

*********************************************************************************************

CSMODEL "ACH_480 ","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","%"
```

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```
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 "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"
```

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```
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 "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"
```

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# 11

# Fieldbus control through a fieldbus adapter

## What this chapter contains

This chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) through an optional fieldbus adapter module.

The fieldbus control interface of the drive is described first, followed by a configuration example.

## System overview

The drive can be connected to an external control system through an optional fieldbus adapter ("fieldbus adapter A" = FBA A) mounted onto the control unit of the drive. The drive can be configured to receive all of its control information through the fieldbus interface, or the control can be distributed between the fieldbus interface and other available sources such as digital and analog inputs, depending on how control locations EXT1 and EXT2 are configured.

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Fieldbus adapters are available for various communication systems and protocols, for example

- BACnet/IP (FBIP-21 adapter)
- CANopen (FCAN-01 adapter)
- ControlNet (FCNA-01 adapter)
- DeviceNet$^{TM}$ (FDNA-01 adapter)
- Ethernet POWERLINK (FEPL-02 adapter)
- EtherCAT (FECA-01 adapter)
- EtherNet/IP$^{TM}$ (FENA-21 adapter)
- Modbus/RTU (FSCA-01 adapter)
- ModbusTCP (FBMT-21 adapter, FENA-21 adapter)
- PROFINET IO (FENA-21 adapter)
- PROFIBUS DP (FPBA-01 adapter)

**Note:** The text and examples in this chapter describe the configuration of one fieldbus adapter (FBA A) by parameters *50.01* …*50.18* and parameter groups *51 FBA A settings*…*53 FBA A data out*.
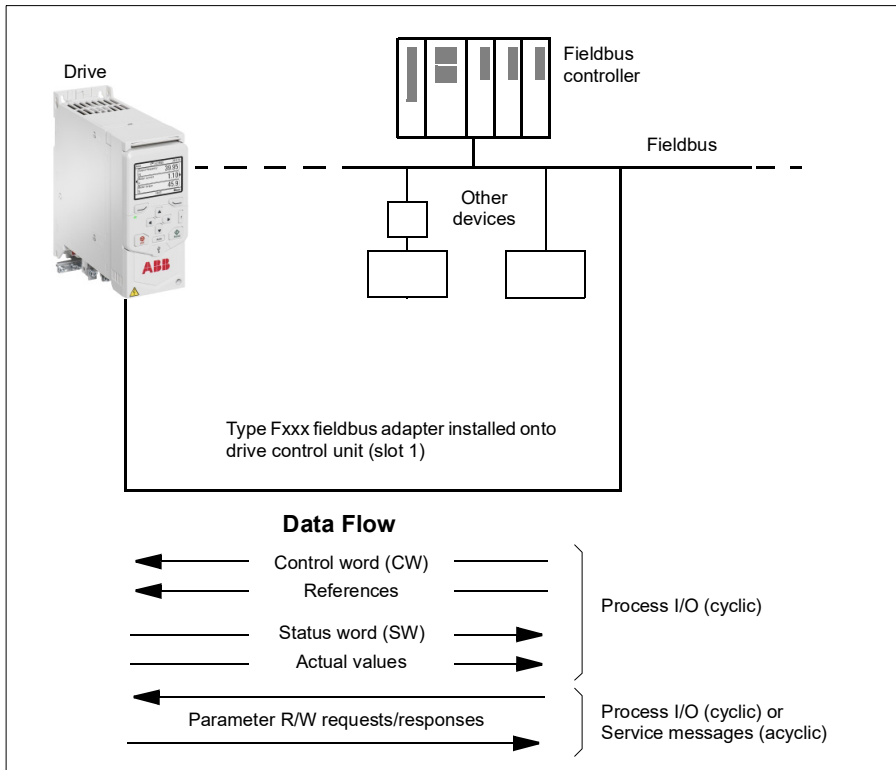
# Basics of the fieldbus control interface

The cyclic communication between a fieldbus system and the drive consists of 16- or 32-bit input and output data words. The drive is able to support a maximum of 12 data words (16 bits) in each direction.

Data transmitted from the drive to the fieldbus controller is defined by parameters *52.01 FBA A data in1* … *52.12 FBA A data in12*. The data transmitted from the fieldbus controller to the drive is defined by parameters *53.01 FBA A data out1* … *53.12 FBA A data out12*.
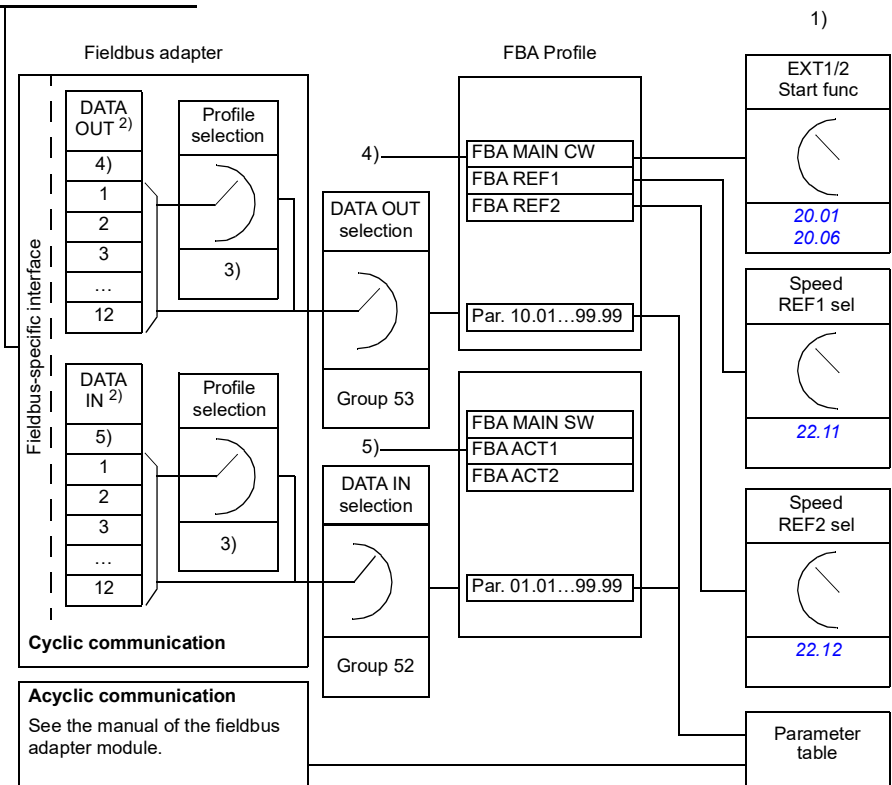


1) See also other parameters which can be controlled from fieldbus.
2) The maximum number of data words used is protocol-dependent.
3) Profile/instance selection parameters. Fieldbus module specific parameters. For more information, see the *User's manual* of the appropriate fieldbus adapter module.
4) With DeviceNet, the control part is transmitted directly.
5) With DeviceNet, the actual value part is transmitted directly.

■ **Control word and Status word**

The Control word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive through the adapter module. The drive switches between its states according to the bit-coded instructions in the Control word, and returns status information to the master in the Status word.

For the ABB Drives communication profile, the contents of the Control word and the Status word are detailed on pages *291* and *292*, respectively. The drive states are presented in the state diagram (page *293*). For other fieldbus-specific communication profiles, see the *User's manual* of the fieldbus adapter.

**Debugging the network words**

If parameter *50.12 FBA A debug mode* is set to *Fast*, the Control word received from the fieldbus is shown by parameter *50.13 FBA A control word*, and the Status word transmitted to the fieldbus network by *50.16 FBA A status word*. This "raw" data is very useful to determine if the fieldbus master is transmitting the correct data before handing control to the fieldbus network.

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■ **References**

References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

ABB drives can receive control information from multiple sources including analog and digital inputs, the drive control panel and a fieldbus adapter module. In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information such as reference. This is done using the source selection parameters in groups *22 Speed reference selection* and *28 Frequency reference chain*.

**Debugging the network words**

If parameter *50.12 FBA A debug mode* is set to *Fast*, the references received from the fieldbus are displayed by *50.14 FBA A reference 1* and *50.15 FBA A reference 2*.

**Scaling of references**

**Note:** The scalings described below are for the ABB Drives communication profile. Fieldbus-specific communication profiles may use different scalings. For more information, see the *User's manual* of the fieldbus adapter.

The references are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of *50.04 FBA A ref1 type* and *50.05 FBA A ref2 type*.
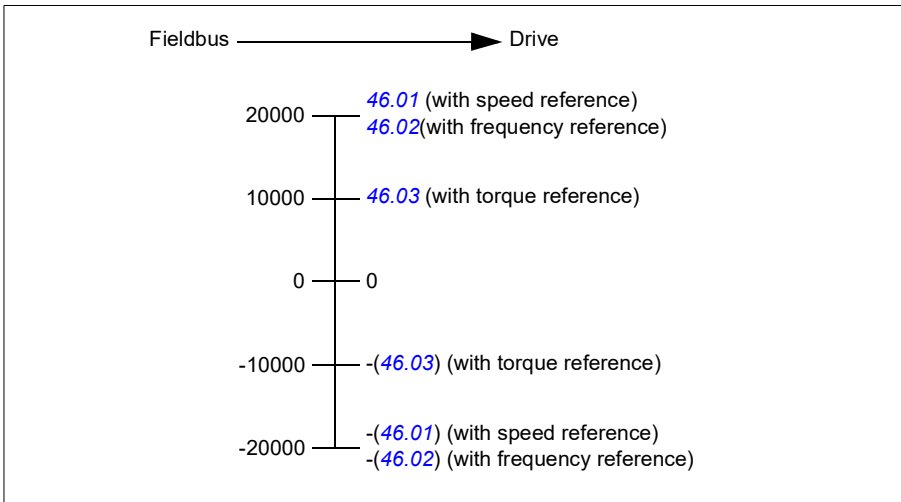


The scaled references are shown by parameters *03.05 FB A reference 1* and *03.06 FB A reference 2*.

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■ **Actual values**

**Note:** The scalings described below are for the ABB Drives communication profile. Fieldbus-specific communication profiles may use different scalings. For more information, see the *User's manual* of the fieldbus adapter.

Actual values are 16-bit words containing information on the operation of the drive. The types of the monitored signals are selected by parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.

**Debugging the network words**

If parameter *50.12 FBA A debug mode* is set to *Fast*, the actual values sent to the fieldbus are displayed by *50.17 FBA A actual value 1* and *50.18 FBA A actual value 2*.

**Scaling of actual values**

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.



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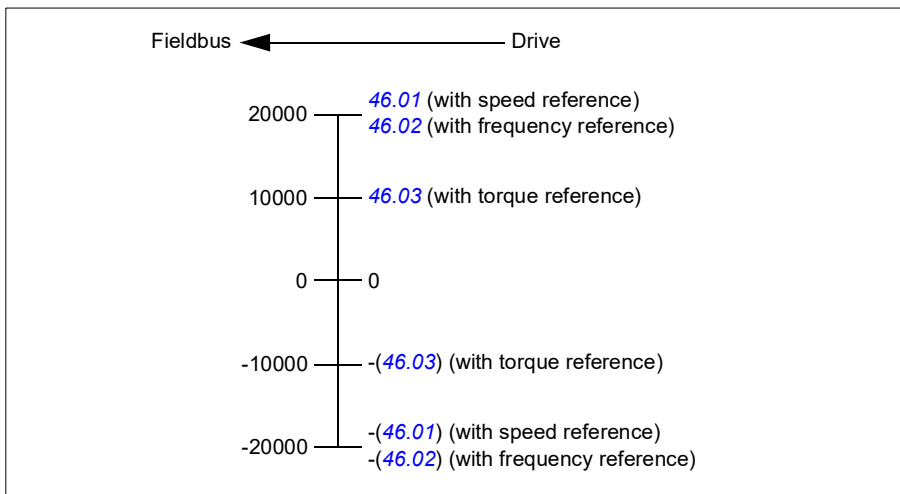
◼ **Contents of the fieldbus Control word (ABB Drives profile)**

The upper case boldface text refers to the states shown in the state diagram (page *293*).

| Bit | Name | Value | STATE/Description |
|-----|------|-------|-------------------|
| 0 | Off1 control | 1 | Proceed to **READY TO OPERATE**. |
| | | 0 | Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active. |
| 1 | Off2 control | 1 | Continue operation (OFF2 inactive). |
| | | 0 | Emergency OFF, coast to a stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**. |
| 2 | Off3 control | 1 | Continue operation (OFF3 inactive). |
| | | 0 | Emergency stop, stop within time defined by drive parameter. Proceed to **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. ⚠ **WARNING:** Ensure motor and driven machine can be stopped using this stop mode. |
| 3 | Run | 1 | Proceed to **OPERATION ENABLED**. **Note:** Run permissive signal must be active; see the drive documentation. If the drive is set to receive the Run permissive signal from the fieldbus, this bit activates the signal.See also parameter *06.18 Start inhibit status word*. |
| | | 0 | Inhibit operation. Proceed to **OPERATION INHIBITED**. |
| 4 | Ramp out zero | 1 | Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**. |
| | | 0 | Force Ramp function generator output to zero. The drive will immediately decelerate to zero speed (observing the torque limits). |
| 5 | Ramp hold | 1 | ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**. |
| | | 0 | Halt ramping (Ramp Function Generator output held). |
| 6 | Ramp in zero | 1 | Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters. |
| | | 0 | Force Ramp function generator input to zero. |
| 7 | Reset | 0=>1 | Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source of the reset signal by drive parameters. |
| | | 0 | Continue normal operation. |
| 8…9 | Reserved | | |
| 10 | Remote cmd | 1 | Fieldbus control enabled. |
| | | 0 | Control word and reference not getting through to the drive, except for bits 0…2. |
| 11 | Ext ctrl loc | 1 | Select External Control Location EXT2. Effective if control location is parameterized to be selected from fieldbus. |
| | | 0 | Select External Control Location EXT1. Effective if control location is parameterized to be selected from fieldbus. |
| 12 | User bit 0 | 1 | User configurable |
| | | 0 | |
| 13 | User bit 1 | 1 | |
| | | 0 | |
| 14 | User bit 2 | 1 | |
| | | 0 | |
| 15 | User bit 3 | 1 | |
| | | 0 | |

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■ **Contents of the fieldbus Status word (ABB Drives profile)**

The upper case boldface text refers to the states shown in the state diagram (page *293*).

| Bit | Name | Value | STATE/Description |
|---|---|---|---|
| 0 | Ready to switch ON | 1 | **READY TO SWITCH ON**. |
|   |   | 0 | **NOT READY TO SWITCH ON**. |
| 1 | Ready run | 1 | **READY TO OPERATE**. |
|   |   | 0 | **OFF1 ACTIVE**. |
| 2 | Ready ref | 1 | **OPERATION ENABLED**. |
|   |   | 0 | **OPERATION INHIBITED**. See also parameter *06.18 Start inhibit status word*. |
| 3 | Tripped | 1 | **FAULT**. |
|   |   | 0 | No fault. |
| 4 | Off 2 inactive | 1 | OFF2 inactive. |
|   |   | 0 | **OFF2 ACTIVE**. |
| 5 | Off 3 inactive | 1 | OFF3 inactive. |
|   |   | 0 | **OFF3 ACTIVE**. |
| 6 | Switch-on inhibited | 1 | **SWITCH-ON INHIBITED**. |
|   |   | 0 | – |
| 7 | Warning | 1 | Warning active. |
|   |   | 0 | No warning active. |
| 8 | At setpoint | 1 | **OPERATING**. Actual value equals reference = is within tolerance limits (see parameters *46.21…46.22*). |
|   |   | 0 | Actual value differs from reference = is outside tolerance limits. |
| 9 | Remote | 1 | Drive control location: REMOTE (EXT1 or EXT2). |
|   |   | 0 | Drive control location: LOCAL. |
| 10 | Above limit | - | See bit 10 of *06.17 Drive status word 2*. |
| 11 | User bit 0 | - | See parameter *06.30 MSW bit 11 selection*. |
| 12 | User bit 1 | - | See parameter *06.31 MSW bit 12 selection*. |
| 13 | User bit 2 | - | See parameter *06.32 MSW bit 13 selection*. |
| 14 | User bit 3 | - | See parameter *06.33 MSW bit 14 selection*. |
| 15 | Reserved | | |

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■ **The state diagram**



CW   = Control word
SW   = Status word
bx   = bit x
n    = Speed
I    = Input Current
RFG  = Ramp Function
       Generator
f    = Frequency
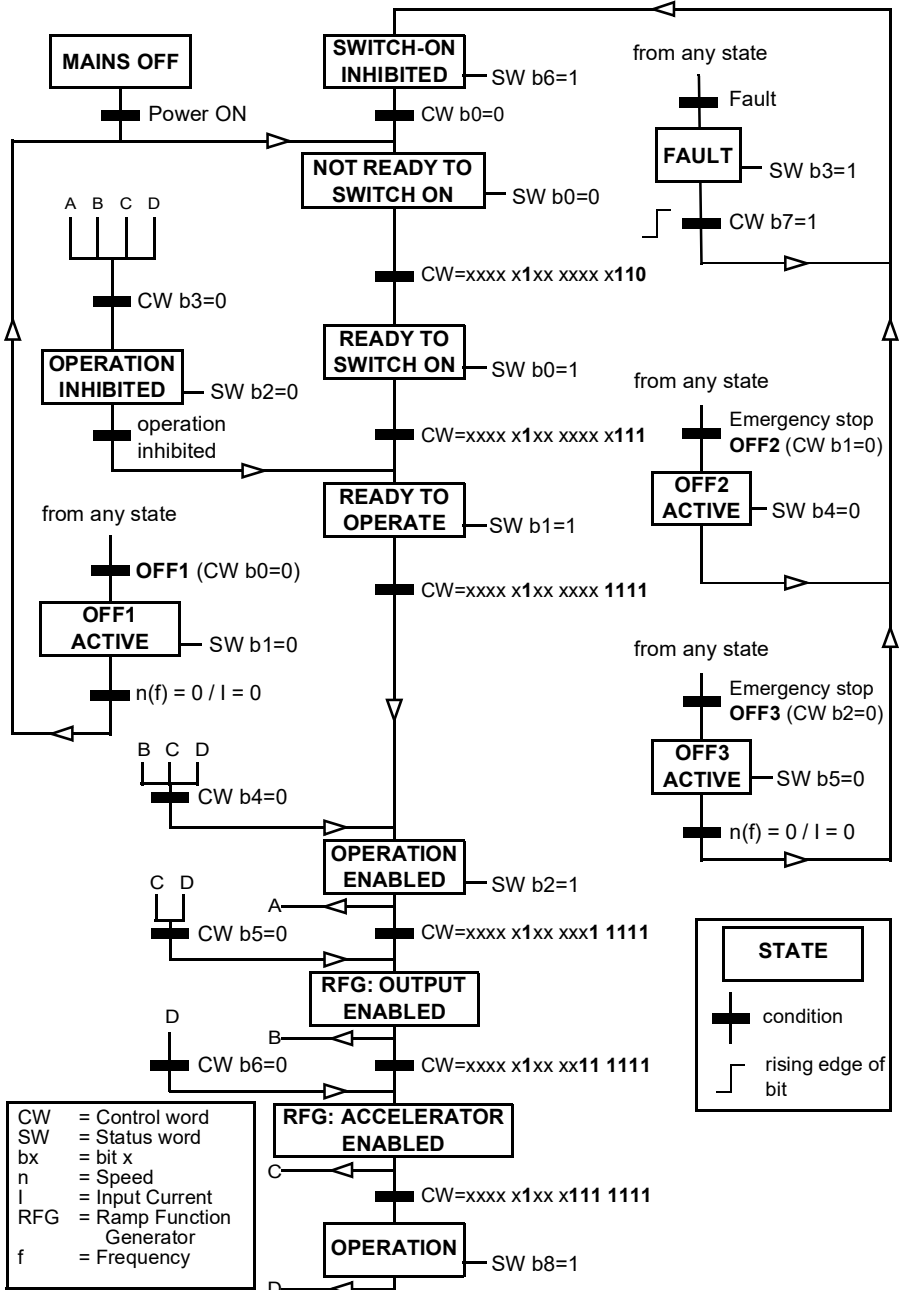
## Setting up the drive for fieldbus control

1. Install the fieldbus adapter module mechanically and electrically according to the instructions given in the *User's manual* of the module.

2. Power up the drive.

3. Enable the communication between the drive and the fieldbus adapter module with parameter *50.01 FBA A enable*.

4. With *50.02 FBA A comm loss func*, select how the drive should react to a fieldbus communication break.
   **Note:** This function monitors both the communication between the fieldbus master and the adapter module and the communication between the adapter module and the drive.

5. With *50.03 FBA A comm loss t out*, define the time between communication break detection and the selected action.

6. Select application-specific values for the rest of the parameters in group *50 Fieldbus adapter (FBA)*, starting from *50.04*. Examples of appropriate values are shown in the tables below.

7. Set the fieldbus adapter module configuration parameters in group *51 FBA A settings*. As a minimum, set the required node address and the communication profile.

8. Define the process data transferred to and from the drive in parameter groups *52 FBA A data in* and *53 FBA A data out*.
   **Note:** Depending on the communication protocol and profile being used, the Control word and Status word may already be configured to be sent/received by the communication system.

9. Save the valid parameter values to permanent memory by setting parameter *96.07 Parameter save manually* to *Save*.

10. Validate the settings made in parameter groups 51, 52 and 53 by setting parameter *51.27 FBA A par refresh* to *Configure*.

11. Configure control locations EXT1 and EXT2 to allow control and reference signals to come from the fieldbus. Examples of appropriate values are shown in the tables below.

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■ **Parameter setting example: FPBA (PROFIBUS DP) with ABB Drives profile**

This example shows how to configure a basic speed control application that uses the ABB Drives communication profile with PPO Type 2. The start/stop commands and reference are according to the ABB Drives profile, speed control mode.

The reference values sent over the fieldbus have to be scaled within the drive so they have the desired effect. The reference value ±20000 corresponds to the range of speed set in parameter *46.01 Speed scaling* (both forward and reverse directions). For example, if *46.01* is set to 480 rpm, then 20000 sent over fieldbus will request 480 rpm.

| Direction | PZD1 | PZD2 | PZD3 | PZD4 | PZD5 | PZD6 |
|-----------|------|------|------|------|------|------|
| Out | Control word | Speed reference | Acc time 1 | | Dec time 1 | |
| In | Status word | Speed actual value | Motor current | | DC voltage | |

The table below gives the recommended drive parameter settings.

| Drive parameter | Setting for ACH480 drives | Description |
|-----------------|---------------------------|-------------|
| *50.01 FBA A enable* | **1** = [slot number] | s communication between the drive and the fieldbus adapter module. |
| *50.04 FBA A ref1 type* | **4** = *Speed* | Selects the fieldbus A reference 1 type and scaling. |
| *50.07 FBA A actual 1 type* | **0** = *Speed or frequency* | Selects the actual value type and scaling according to the currently active Ref1 mode defined in parameter *50.04*. |
| *51.01 FBA A type* | **1** = FPBA[1] | Displays the type of the fieldbus adapter module. |
| 51.02 Node address | 3[2] | Defines the PROFIBUS node address of the fieldbus adapter module. |
| 51.03 Baud rate | 12000[1] | Displays the current baud rate on the PROFIBUS network in kbit/s. |
| 51.04 MSG type | **1** = PPO2[1] | Displays the telegram type selected by the PLC configuration tool. |
| 51.05 Profile | **1** = ABB Drives | Selects the Control word according to the ABB Drives profile (speed control mode). |
| 51.07 RPBA mode | **0** = Disabled | Disables the RPBA emulation mode. |
| *52.01 FBA A data in1* | **4** = SW 16bit[1] | Status word |
| 52.02 FBA data in2 | **5** = Act1 16bit | Actual value 1 |
| 52.03 FBA data in3 | 01.07[2] | Motor current |
| 52.05 FBA data in5 | 01.11[2] | DC voltage |
| 53.01 FBA data out1 | **1** = CW 16bit[1] | Control word |
| 53.02 FBA data out2 | **2** = Ref1 16bit | Reference 1 (speed) |

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| Drive parameter | Setting for ACH480 drives | Description |
|---|---|---|
| 53.03 FBA data out3 | 23.12[2)] | Acceleration time 1 |
| 53.05 FBA data out5 | 23.13[2)] | Deceleration time 1 |
| *51.27 FBA A par refresh* | **1** = *Configure* | Validates the configuration parameter settings. |
| *20.01 Ext1 commands* | **12** = *Fieldbus A* | Selects fieldbus adapter A as the source of the start and stop commands for external control location EXT1. |
| *20.02 Ext1 start trigger type* | **1** = *Level* | Selects a level-triggered start signal for external control location EXT1. |
| *22.11 Ext1 speed ref1* | **4** = *FB A ref1* | Selects fieldbus A reference 1 as the source for speed reference 1. |

[1)] Read-only or automatically detected/set

[2)] Example

**11**

■ **Parameter setting example: FPBA (PROFIBUS DP) with PROFIdrive profile**

This example shows how to configure a basic speed control application that uses the PROFIdrive communication profile with PPO Type 2. The start/stop commands and reference are according to the PROFIdrive profile, speed control mode.

The reference values sent over the fieldbus have to be scaled within the drive so they have the desired effect. The reference value ±16384 (4000h) corresponds to the range of speed set in parameter *46.01 Speed scaling* (both forward and reverse directions). For example, if *46.01* is set to 480 rpm, then 4000h sent over fieldbus will request 480 rpm.

| Direction | PZD1 | PZD2 | PZD3 | PZD4 | PZD5 | PZD6 |
|-----------|------|------|------|------|------|------|
| Out | Control word | Speed reference | Acc time 1 | | Dec time 1 | |
| In | Status word | Speed actual value | Motor current | | DC voltage | |

The table below gives the recommended drive parameter settings.

| Drive parameter | Setting for ACH480 drives | Description |
|-----------------|---------------------------|-------------|
| *50.01 FBA A enable* | **1** = [slot number] | s communication between the drive and the fieldbus adapter module. |
| *50.04 FBA A ref1 type* | **4** = *Speed* | Selects the fieldbus A reference 1 type and scaling. |
| *50.07 FBA A actual 1 type* | **0** = *Speed or frequency* | Selects the actual value type and scaling according to the currently active Ref1 mode defined in parameter *50.04*. |
| *51.01 FBA A type* | **1** = FPBA[1] | Displays the type of the fieldbus adapter module. |
| 51.02 Node address | 3[2] | Defines the PROFIBUS node address of the fieldbus adapter module. |
| 51.03 Baud rate | 12000[1] | Displays the current baud rate on the PROFIBUS network in kbit/s. |
| 51.04 MSG type | **1** = PPO2[1] | Displays the telegram type selected by the PLC configuration tool. |
| 51.05 Profile | **0** = PROFIdrive | Selects the Control word according to the PROFIdrive profile (speed control mode). |
| 51.07 RPBA mode | **0** = Disabled | Disables the RPBA emulation mode. |
| *52.01 FBA A data in1* | **4** = SW 16bit[1] | Status word |
| 52.02 FBA data in2 | **5** = Act1 16bit | Actual value 1 |
| 52.03 FBA data in3 | 01.07[2] | Motor current |
| 52.05 FBA data in5 | 01.11[2] | DC voltage |
| 53.01 FBA data out1 | **1** = CW 16bit[1] | Control word |
| 53.02 FBA data out2 | **2** = Ref1 16bit | Reference 1 (speed) |

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| Drive parameter | Setting for ACH480 drives | Description |
|---|---|---|
| 53.03 FBA data out3 | 23.12[2)] | Acceleration time 1 |
| 53.05 FBA data out5 | 23.13[2)] | Deceleration time 1 |
| *51.27 FBA A par refresh* | **1** = *Configure* | Validates the configuration parameter settings. |
| *20.01 Ext1 commands* | **12** = *Fieldbus A* | Selects fieldbus adapter A as the source of the start and stop commands for external control location EXT1. |
| *20.02 Ext1 start trigger type* | **1** = *Level* | Selects a level-triggered start signal for external control location EXT1. |
| *22.11 Ext1 speed ref1* | **4** = *FB A ref1* | Selects fieldbus A reference 1 as the source for speed reference 1. |

[1)] Read-only or automatically detected/set

[2)] Example

The start and stop sequences for the parameter examples above are given below.

Control word:

Start:

- 1150 (476h) –> NOT READY TO SWITCH ON
- If MSW bit 0 = 1 then
    - 1150 (47Eh) –> READY TO SWITCH ON (Stopped)
    - 1151 (47Fh) –> OPERATION (Running)

Stop:

- 1150 (47Eh) = OFF1 ramp stop (Note: uninterruptable ramp stop)
- 1149 (47Dh) = coast to stop
- 1147 (47Bh) = emergency stop

Fault reset:

- Rising edge of MCW bit 7

Start after STO:

- If *31.22 STO indication run/stop* is not Fault/ Fault, check that *06.18 Start inhibit status word*, bit 7 STO = 0 before giving a start command.

# Automatic drive configuration for fieldbus control

The parameters set on module detection are shown in the table below. See also parameters *07.35 Drive configuration* and *07.36 Drive configuration 2*.

| Option | 10.24 RO1 source | 10.27 RO2 source | 10.30 RO3 source | 20.01 Ext1 commands | 20.03 Ext1 in1 source | 20.04 Ext1 in2 source |
|---|---|---|---|---|---|---|
| BMIO-01 | - | - | - | 2 (In1 Start, In2 Dir) | 2 (DI1) | 3 (DI2) |
| BIO-01 | - | - | - | 2 (In1 Start, In2 Dir) | 2 (DI1) | 3 (DI2) |
| RIIO-01 | - | - | - | 2 (In1 Start, In2 Dir) | 2 (DI1) | 3 (DI2) |
| FENA-21 | - | - | - | 12 (Fieldbus A) | 0 | 0 |
| FECA-01 | - | - | - | 12 (Fieldbus A) | 0 | 0 |
| FPBA-01 | - | - | - | 12 (Fieldbus A) | 0 | 0 |
| FCAN-01 | - | - | - | 12 (Fieldbus A) | 0 | 0 |
| FSCA-01 | - | - | - | 12 (Fieldbus A) | 0 | 0 |
| FEIP-21 | - | - | - | 12 (Fieldbus A) | 0 | 0 |
| FMBT-21 | - | - | - | 12 (Fieldbus A) | 0 | 0 |
| FBIP-21 | 40 (RO/DIO) control work bit 0 | 41 (RO/DIO) control work bit 1 | HVAC: 42 (RO/DIO) control work bit 2 | 12 (Fieldbus A) | 0 | 0 |
| FPNO-21 | - | - | - | 12 (Fieldbus A) | 0 | 0 |
| FEPL-02 | - | - | - | 12 (Fieldbus A) | 0 | 0 |
| FLON-01 | 40 (RO/DIO) control work bit 0 | 41 (RO/DIO) control work bit 1 | 42 (RO/DIO) control work bit 2 | 12 (Fieldbus A) | 0 | 0 |
| FDNA-01 | - | - | - | 12 (Fieldbus A) | 0 | 0 |
| FCNA-01 | - | - | - | 12 (Fieldbus A) | 0 | 0 |

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| Option | 20.05 Ext1 in3 source | 20.12 Run enable 1 | 22.11 Ext1 speed ref1 | 22.22 Constant speed sel1 | 22.23 Constant speed sel2 | 22.71 Motor potentiometer function |
|---|---|---|---|---|---|---|
| BMIO-01 | 0 | 1 (Selected) | 1 (AI1 scaled) | 4 (DI3) | 5 (DI4) | 0 |
| BIO-01 | 0 | 1 (Selected) | 1 (AI1 scaled) | 4 (DI3) | 5 (DI4) | 0 |
| RIIO-01 | 0 | 1 (Selected) | 1 (AI1 scaled) | 4 (DI3) | 5 (DI4) | 0 |

| Option | 20.05 Ext1 in3 source | 20.12 Run enable 1 | 22.11 Ext1 speed ref1 | 22.22 Constant speed sel1 | 22.23 Constant speed sel2 | 22.71 Motor potentiometer function |
|--------|------|------|------|------|------|------|
| FENA-21 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FECA-01 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FPBA-01 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FCAN-01 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FSCA-01 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FEIP-21 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FMBT-21 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FBIP-21 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FPNO-21 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FEPL-02 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FLON-01 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FDNA-01 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |
| FCNA-01 | 0 | 1 (Selected) | 4 (FB A ref1) | 0 | 0 | 0 |

| Option | 22.73 Motor potentiometer up source | 22.74 Motor potentiometer down source | 23.11 Ramp set selection | 28.11 Ext1 frequency ref1 | 28.22 Constant frequency sel1 | 28.23 Constant frequency sel2 |
|--------|------|------|------|------|------|------|
| BMIO-01 | 0 | 0 | 10 (DIO1) | 1 (AI1 scaled) | 4 (DI3) | 5 (DI4) |
| BIO-01 | 0 | 0 | 6 (DI5) | 1 (AI1 scaled) | 4 (DI3) | 5 (DI4) |
| RIIO-01 | 0 | 0 | 6 (DI5) | 1 (AI1 scaled) | 4 (DI3) | 5 (DI4) |
| FENA-21 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FECA-01 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FPBA-01 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FCAN-01 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FSCA-01 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FEIP-21 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FMBT-21 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FBIP-21 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FPNO-21 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FEPL-02 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FLON-01 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FDNA-01 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |
| FCNA-01 | 0 | 0 | 0 | 4 (FB A ref1) | 0 | 0 |

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| Option | 28.71 Freq ramp set selection | 31.11 Fault reset selection | 40.07 Process PID operation mode | 40.08 Set 1 feedback 1 source | 40.16 Set 1 setpoint 1 source | 40.17 Set 1 setpoint 2 source |
|--------|------|------|------|------|------|------|
| BMIO-01 | 10 (DIO1) | 0 | 0 | - | - | 0 |
| BIO-01 | 6 (DI5) | 0 | 0 | - | - | 0 |

| Option | 28.71 Freq ramp set selection | 31.11 Fault reset selection | 40.07 Process PID operation mode | 40.08 Set 1 feedback 1 source | 40.16 Set 1 setpoint 1 source | 40.17 Set 1 setpoint 2 source |
|---|---|---|---|---|---|---|
| RIIO-01 | 6 (DI5) | 0 | 0 | - | - | 0 |
| FENA-21 | 0 | 2 (DI1) | 0 | - | - | 0 |
| FECA-01 | 0 | 2 (DI1) | 0 | - | - | 0 |
| FPBA-01 | 0 | 2 (DI1) | 0 | - | - | 0 |
| FCAN-01 | 0 | 2 (DI1) | 0 | - | - | 0 |
| FSCA-01 | 0 | 2 (DI1) | 0 | - | - | 0 |
| FEIP-21 | 0 | 2 (DI1) | 0 | - | - | 0 |
| FMBT-21 | 0 | 2 (DI1) | 0 | - | - | 0 |
| FBIP-21 | 0 | 2 (DI1) | 1 (On) | 10 (Feedback data storage) | 24 (Setpoint data storage) | 0 |
| FPNO-21 | 0 | 2 (DI1) | 0 | - | - | 0 |
| FEPL-02 | 0 | 2 (DI1) | 0 | - | - | 0 |
| FLON-01 | 0 | 2 (DI1) | HVAC family: 1 (On) Others: 0 | HVAC family: 10 (Feedback data storage) | HVAC family: 24 (Setpoint data storage) | 0 |
| FDNA-01 | 0 | 2 (DI1) | 0 | - | - | 0 |
| FCNA-01 | 0 | 2 (DI1) | 0 | - | - | 0 |

| Option | 40.19 Set 1 internal setpoint sel1 | 40.20 Set 1 internal setpoint sel2 | 50.01 FBA A enable | 50.02 FBA A comm loss func | 51.02 BA A Par2 | 51.04 FBA A Par4 |
|---|---|---|---|---|---|---|
| BMIO-01 | 0 | 0 | - | 0 | - | - |
| BIO-01 | 0 | 0 | - | 0 | - | - |
| RIIO-01 | 0 | 0 | - | 0 | - | - |
| FENA-21 | 0 | 0 | 1 (Enable) | 1 (Fault) | 11 | 0 |
| FECA-01 | 0 | 0 | 1 (Enable) | 1 (Fault) | 0 | - |
| FPBA-01 | 0 | 0 | 1 (Enable) | 1 (Fault) | - | - |
| FCAN-01 | 0 | 0 | 1 (Enable) | 1 (Fault) | - | - |
| FSCA-01 | 0 | 0 | 1 (Enable) | 1 (Fault) | - | - |
| FEIP-21 | 0 | 0 | 1 (Enable) | 1 (Fault) | 100 | 0 |
| FMBT-21 | 0 | 0 | 1 (Enable) | 1 (Fault) | 0 | 0 |
| FBIP-21 | 0 | 0 | 1 (Enable) | 1 (Fault) | - | 0 |
| FPNO-21 | 0 | 0 | 1 (Enable) | 1 (Fault) | 11 | 0 |
| FEPL-02 | 0 | 0 | 1 (Enable) | 1 (Fault) | - | - |
| FLON-01 | 0 | 0 | 1 (Enable) | 1 (Fault) | - | - |
| FDNA-01 | 0 | 0 | 1 (Enable) | 1 (Fault) | - | - |
| FCNA-01 | 0 | 0 | 1 (Enable) | 1 (Fault) | - | - |

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| Option | 51.05 FBA A Par5 | 51.06 FBA A Par6 | 51.07 FBA A Par7 | 51.21 FBA A Par21 | 51.23 FBA A Par23 | 51.24 FBA A Par24 |
|---|---|---|---|---|---|---|
| BMIO-01 | - | - | - | - | - | - |
| BIO-01 | - | - | - | - | - | - |
| RIIO-01 | - | - | - | - | - | - |
| FENA-21 | - | - | - | - | - | - |
| FECA-01 | - | - | - | - | - | - |
| FPBA-01 | 1 | - | - | - | - | - |
| FCAN-01 | 0 | - | - | - | - | - |
| FSCA-01 | - | 10 | 1 | - | - | - |
| FEIP-21 | - | - | - | - | - | - |
| FMBT-21 | - | - | - | 1 | - | - |
| FBIP-21 | - | - | - | - | 128 | 128 |
| FPNO-21 | - | - | - | - | - | - |
| FEPL-02 | - | - | - | - | - | - |
| FLON-01 | - | - | - | - | - | - |
| FDNA-01 | - | - | - | - | - | - |
| FCNA-01 | - | - | - | - | - | - |

| Option | 52.01 FBA data in1 | 52.02 BA data in2 | 53.01 FBA data out1 | 53.02 FBA data out2 | 58.01 Protocol enable |
|---|---|---|---|---|---|
| BMIO-01 | - | - | - | - | - |
| BIO-01 | - | - | - | - | - |
| RIIO-01 | - | - | - | - | - |
| FENA-21 | 4 | 5 | 1 | 2 | 0 |
| FECA-01 | - | - | - | - | 0 |
| FPBA-01 | 4 | 5 | 1 | 2 | 0 |
| FCAN-01 | - | - | - | - | 0 |
| FSCA-01 | - | | | | 0 |
| FEIP-21 | - | - | - | - | 0 |
| FMBT-21 | - | - | - | - | 0 |
| FBIP-21 | - | - | - | - | 0 |
| FPNO-21 | 4 | 5 | 1 | 2 | 0 |
| FEPL-02 | - | - | - | - | 0 |
| FLON-01 | - | - | - | - | 0 |
| FDNA-01 | - | - | - | - | 0 |
| FCNA-01 | - | - | - | - | 0 |

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# Control chain diagrams

## Contents of this chapter

The chapter presents the reference chains of the drive. The control chain diagrams can be used to trace how parameters interact and where parameters have an effect within the drive parameter system.

For a more general diagram, see section *Operating modes of the drive* (page *87*).

# Frequency reference selection



**28.96 Frequency ref act 7** — Value

Direction Lock

Override reference — Value
70.1 bit 1 Override Active

Frequency reference safe command

OR

AND

AND

28.41 Frequency ref safe — Value

Network reference — Value
6.16 bit 9 Network control

03.01 Panel reference — Value

06.16 bit 8 Local control

49.05 Communication loss action = Speed ref safe
Panel comm loss active
Panel as local control device

50.02 FBA A comm loss func = Speed ref safe
Fieldbus comm loss active
Control from Fieldbus active

28.13 Ext1 frequency function — Selection

28.92 Frequency ref act 3 — Value

Constant frequency ref

Constant frequency command

Fieldbus:
ODVA CIP™

ADD SUB MUL MIN MAX

ADD SUB MUL MIN MAX

28.17 Ext2 frequency function — Selection

19.11 Ext1/Ext2 selection — Selection

CONSTANT FREQUENCY SELECTION ≠0

28.11 Ext1 frequency ref1 — Selection

28.12 Ext1 frequency ref2 — Selection

28.15 Ext2 frequency ref1 — Selection

28.16 Ext2 frequency ref2 — Selection

28.21 Const frequency function — Selection

28.22 Constant frequency sel1 — Selection
28.23 Constant frequency sel2 — Selection
28.24 Constant frequency sel3 — Selection

28.26 Constant frequency 1 — Value
28.27 Constant frequency 2 — Value
28.28 Constant frequency 3 — Value
28.29 Constant frequency 4 — Value
28.30 Constant frequency 5 — Value
28.31 Constant frequency 6 — Value
28.32 Constant frequency 7 — Value

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# Frequency reference modification

# Speed reference source selection I

# Speed reference source selection II

# Speed reference ramping and shaping

## Speed error calculation

## Speed feedback

# Speed controller



(25.01 Torque reference speed control)

30.18 Torq lim sel

30.20 Maximum torque

30.22 Max torque 2 source

(25.53 Torque prop reference)
(25.54 Torque integral reference)
(25.55 Torque deriv reference)
(25.56 Torque acc compensation)

30.19 Minimum torque

30.21 Min torque 2 source

30.18 Torq lim sel

Speed regulator

PID

24.03 Speed error filtered

25.02 Speed proportional gain
25.03 Speed integration time
25.04 Speed derivation time
25.05 Derivation filter time
25.15 Proportional gain em stop

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# Torque limitation



01.10 Motor torque — Value

30.02 Torque limit status

30.02 Torque limit status

Bit  Name
0 = Undervoltage
1 = Overvoltage
2 = Minimum torque
3 = Maximum torque
4 = Internal current
5 = Load angle
6 = Motor pull-out
7 = Reserved
8 = Thermal
9 = Max current
10 = User current
11 = Thermal IGBT
12 =
13 =
14 =
15 =

Torque Regulator

Current limiter

Motor pull-out limitation

Load angle limitation

Torque limiter

Power limiter

DC voltage limiter

30.17 Maximum current — Value

25.01 Torque reference speed control — Value

30.30 Overvoltage control — Value

30.31 Undervoltage control — Value

24.02 Used speed feedback — Value

30.26 Power motoring limit — Value

30.27 Power generating limit — Value

30.19 Minimum torque — Value

30.21 Min torque 2 source — Selection

30.18 Torq lim sel — Value

30.20 Maximum torque — Value

30.22 Max torque 2 source — Selection

# PID flow calculation

# PID setpoint compensation



40.70 Compensated setpoint

Value

y= Compensated setpoint

x2, y2

x, y

compensation input source
x= freq / speed / flow / AI2 / etc.

Setpoint compensation

40.71 Set 1 compensation input source

Selection  |  ∨  |  Value

40.72 Set 1 compensation input 1    Value

40.73 Set 1 compensated output 1    Value

40.74 Set 1 compensation input 2    Value

40.75 Set 1 compensated output 2    Value

40.76 Set 1 compensation non-linearity

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# Process PID setpoint and feedback source selection

## Process PID controller



PROCESS PID FUNCTION

# External PID setpoint and feedback source selection

# External PID controller

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## Direction lock



Output reference

AND

20.21 Direction = Request

Reference from FB
Reference from PID
Reference from Motor potentiometer
Reference from Panel
Reference from AI
Reference from AP program

Last/Safe reference
Constant reference

OR

AND

20.21 Direction = Request
Reverse command active
Input reference > 0

OR

Reference from FB
Reference from Motor potentiometer
Reference from Panel
Reference from AI
Last/Safe reference
Reference from AP program
Reference from Network

X

-1

X

-1

MAX

0

OR

AND

20.21 Direction = Reverse

20.21 Direction = Request
Reverse command active

Input reference

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# Override

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# Parameters

## What this chapter contains

The chapter describes the parameters, including actual signals, of the control program. At the end of the chapter, on page *549*, there is a separate list of the parameters whose default values are different between 50 Hz and 60 Hz supply frequency settings.

# Terms and abbreviations

| Term | Definition |
|------|-----------|
| Actual signal | Type of *parameter* that is the result of a measurement or calculation by the drive, or contains status information. Most actual signals are read-only, but some (especially counter-type actual signals) can be reset. |
| Def | (In the following table, shown on the same row as the parameter name) The default value of a *parameter* when used in the default configuration. For information on other macro-specific parameter values, see chapter *Default I/O configuration*. |
| FbEq16 | (In the following table, shown on the same row as the parameter range, or for each selection) 16-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 16-bit value is selected for transmission to an external system. A dash (-) indicates that the parameter is not accessible in 16-bit format. The corresponding 32-bit scalings are listed in chapter *Additional parameter data* (page *551*). |
| Other | The value is taken from another parameter. Choosing "Other" displays a parameter list in which the user can specify the source parameter. |
| Other [bit] | The value is taken from a specific bit in another parameter. Choosing "Other" displays a parameter list in which the user can specify the source parameter and bit. |
| Parameter | Either a user-adjustable operating instruction for the drive, or an *actual signal*. |
| p.u. | Per unit |
| [parameter number] | Value of the parameter |

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# Summary of parameter groups

| Group | Contents | Page |
|---|---|---|
| *01 Actual values* | Basic signals for monitoring the drive. | *325* |
| *03 Input references* | Values of references received from various sources. | *328* |
| *04 Warnings and faults* | Information on warnings and faults that occurred last. | *329* |
| *05 Diagnostics* | Various run-time-type counters and measurements related to drive maintenance. | *330* |
| *06 Control and status words* | Drive control and status words. | *333* |
| *07 System info* | Drive hardware and firmware information. | *340* |
| *10 Standard DI, RO* | Configuration of digital inputs and relay outputs. | *342* |
| *11 Standard DIO, FI, FO* | Configuration of the frequency inputs 1 and 2 as well as frequency output and digital output. | *352* |
| *12 Standard AI* | Configuration of standard analog inputs. | *360* |
| *13 Standard AO* | Configuration of standard analog outputs. | *365* |
| *19 Operation mode* | Selection of local and external control location sources and operating modes. | *370* |
| *20 Start/stop/direction* | Start/stop/direction and run/start enable signal source selection; positive/negative reference enable signal source selection. | *372* |
| *21 Start/stop mode* | Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings. | *380* |
| *22 Speed reference selection* | Speed reference selection; Floating point control (Motor potentiometer) settings. | *388* |
| *23 Speed reference ramp* | Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive). | *397* |
| *24 Speed reference conditioning* | Speed error calculation; speed error window control configuration; speed error step. | *400* |
| *25 Speed control* | Speed controller settings. | *401* |
| *28 Frequency reference chain* | Settings for the frequency reference chain. | *405* |
| *30 Limits* | Drive operation limits. | *415* |
| *31 Fault functions* | Configuration of external events; selection of behavior of the drive upon fault situations. | *423* |
| *32 Supervision* | Configuration of signal supervision functions 1…6. | *432* |
| *34 Timed functions* | Configuration of the timed functions. | *439* |
| *35 Motor thermal protection* | Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration; motor overload protection. | *447* |
| *36 Load analyzer* | Peak value and amplitude logger settings. | *457* |
| *37 User load curve* | Settings for user load curve. | *460* |
| *40 Process PID set 1* | Parameter values for process PID control. | *463* |
| *41 Process PID set 2* | A second set of parameter values for process PID control. | *480* |
| *43 Brake chopper* | Settings for the internal brake chopper. | *482* |
| *45 Energy efficiency* | Settings for the energy saving calculators as well as peak and energy loggers. | *484* |
| *46 Monitoring/scaling settings* | Speed supervision settings; actual signal filtering; general scaling settings. | *489* |

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| Group | Contents | Page |
|---|---|---|
| *47 Data storage* | Data storage parameters that can be written to and read from using other parameters' source and target settings. | *492* |
| *49 Panel port communication* | Communication settings for the control panel port on the drive. | *493* |
| *50 Fieldbus adapter (FBA)* | Fieldbus communication configuration. | *494* |
| *51 FBA A settings* | Fieldbus adapter A configuration. | *498* |
| *52 FBA A data in* | Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A. | *499* |
| *53 FBA A data out* | Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A. | *500* |
| *58 Embedded fieldbus* | Configuration of the embedded fieldbus (EFB) interface. | *500* |
| *70 Override* | Enabling/disabling of override function, override activation signal and override speed/frequency. | *509* |
| *71 External PID1* | Configuration of external PID. | *514* |
| *76 PFC configuration* | PFC (Pump and fan control) and Autochange configuration parameters. | *516* |
| *77 PFC maintenance and monitoring* | PFC (Pump and fan control) maintenance and monitoring parameters. | *523* |
| *80 Flow calculation and protection* | Actual flow calculation. | *524* |
| *95 HW configuration* | Various hardware-related settings. | *525* |
| *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. | *528* |
| *97 Motor control* | Switching frequency; slip gain; voltage reserve; flux braking; anti-cogging (signal injection); IR compensation. | *538* |
| *98 User motor parameters* | Motor values supplied by the user that are used in the motor model. | *541* |
| *99 Motor data* | Motor configuration settings. | *543* |

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## Parameter listing

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *01 Actual values* | | Basic signals for monitoring the drive.<br>All parameters in this group are read-only unless otherwise noted.<br>**Note:** Values of these actual signals are filtered with the filter time defined in group *46 Monitoring/scaling settings*. The selection lists for parameters in other groups mean the raw value of the actual signal instead. For example, if a selection is "Output frequency" it does not point to the value of parameter *01.06 Output frequency* but to the raw value. | |
| *01.01* | *Motor speed used* | Estimated motor speed. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*. | - |
| | -30000.00… 30000.00 rpm | Estimated motor speed. | See par. *46.01* |
| *01.02* | *Motor speed estimated* | Estimated motor speed in rpm. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*. | - |
| | -30000.00… 30000.00 rpm | Estimated motor speed. | See par. *46.01* |
| *01.03* | *Motor speed %* | Motor speed in percent of the synchronous motor speed. | - |
| | -1000.00… 1000.00% | Motor speed. | 10 = 1% |
| *01.06* | *Output frequency* | Estimated drive output frequency in Hz. A filter time constant for this signal can be defined by parameter *46.12 Filter time output frequency*. | - |
| | -500.00…500.00 Hz | Estimated output frequency. | See par. *46.02* |
| *01.07* | *Motor current* | Measured (absolute) motor current in A. | - |
| | 0.00…30000.00 A | Motor current. | See par. *46.05* |
| *01.08* | *Motor current % of motor nom* | Motor current (drive output current) in percent of the nominal motor current. | - |
| | 0.0…1000.0% | Motor current. | 1 = 1% |
| *01.09* | *Motor current % of drive nom* | Motor current (drive output current) in percent of the nominal drive current. | - |
| | 0.0…1000.0% | Motor current. | 1 = 1% |
| *01.10* | *Motor torque* | Motor torque in percent of the nominal motor torque. See also parameter *01.30 Nominal torque scale*.<br>A filter time constant for this signal can be defined by parameter *46.13 Filter time motor torque*. | - |
| | -1600.0…1600.0% | Motor torque. | See par. *46.03* |
| *01.11* | *DC voltage* | Measured DC link voltage. | - |
| | 0.00…2000.00 V | DC link voltage. | 10 = 1 V |
| *01.13* | *Output voltage* | Calculated motor voltage in V AC. | - |
| | 0…2000 V | Motor voltage. | 1 = 1 V |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *01.14* | *Output power* | Drive output power. The unit is selected by parameter *96.16 Unit selection*. A filter time constant for this signal can be defined by parameter *46.14 Filter time power*. | - |
| | -32768.00… 32767.00 kW or hp | Output power. | See par. *46.04* |
| *01.15* | *Output power % of motor nom* | Output power in percent of the nominal motor power. | - |
| | -300.00… 300.00% | Output power. | 1 = 1% |
| *01.16* | *Output power % of drive nom* | Output power in percent of the nominal drive power. | - |
| | -300.00… 300.00% | Output power. | 1 = 1% |
| *01.17* | *Motor shaft power* | Estimated mechanical power at motor shaft. | - |
| | -32768.00… 32767.00 kW or hp | Motor shaft power. | 1 = 1 unit |
| *01.18* | *Inverter GWh counter* | Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero. | - |
| | 0…65535 GWh | Energy in GWh. | 1 = 1 GWh |
| *01.19* | *Inverter MWh counter* | Amount of energy that has passed through the drive (in either direction) in full megawatt-hours. Whenever the counter rolls over, *01.18 Inverter GWh counter* is incremented. The minimum value is zero. | - |
| | 0…1000 MWh | Energy in MWh. | 1 = 1 MWh |
| *01.20* | *Inverter kWh counter* | Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. Whenever the counter rolls over, *01.19 Inverter MWh counter* is incremented. The minimum value is zero. | - |
| | 0…1000 kWh | Energy in kWh. | 10 = 1 kWh |
| *01.24* | *Flux actual %* | Used flux reference in percent of nominal flux of motor. | - |
| | 0…200% | Flux reference. | 1 = 1% |
| *01.30* | *Nominal torque scale* | Torque that corresponds to 100% of nominal motor torque. The unit is selected by parameter *96.16 Unit selection*.<br>**Note:** This value is copied from parameter *99.12 Motor nominal torque* if entered. Otherwise the value is calculated from other motor data. | - |
| | 0.000…4000000 N·m or lb·ft | Nominal torque. | 1 = 100 unit |
| *01.50* | *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.<br>If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle. | - |
| | 0.00 … 1000000.00 kWh | Energy. | 1 = 1 kWh |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *01.51* | *Previous hour kWh* | Previous hour energy consumption. The value *01.50 Current hour kWh* is stored here when its values has been cumulated for 60 minutes.<br>If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle. | - |
| | 0.00… 1000000.00 kWh | Energy. | 1 = 1 kWh |
| *01.52* | *Current day kWh* | Current day energy consumption. This is the energy of the last 24 hours (not necessarily continuous) the drive has been running, not the energy of a calendar day.<br>If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle. | - |
| | 0.00… 1000000.00 kWh | Energy. | 1 = 1 kWh |
| *01.53* | *Previous day kWh* | Previous day energy consumption. The value *01.52 Current day kWh* is stored here when its value has been cumulated for 24 hours.<br>If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle. | - |
| | 0.00… 1000000.00 kWh | Energy. | 1 = 1 kWh |
| *01.54* | *Cumulative inverter energy* | Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. The minimum value is zero. | - |
| | -200000000.0… 200000000.0 kWh | Energy in kWh. | 10 = 1 kWh |
| *01.55* | *Inverter GWh counter (resettable)* | Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero.<br>You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters *01.55*…*01.58* resets all of them. | - |
| | 0…65535 GWh | Energy in GWh. | 1 = 1 GWh |
| *01.56* | *Inverter MWh counter (resettable)* | Amount of energy that has passed through the drive (in either direction) in full megawatt-hours. Whenever the counter rolls over, *01.55 Inverter GWh counter (resettable)* is incremented. The minimum value is zero.<br>You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters *01.55*…*01.58* resets all of them. | - |
| | 0…1000 MWh | Energy in MWh. | 1 = 1 MWh |
| *01.57* | *Inverter kWh counter (resettable)* | Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. Whenever the counter rolls over, *01.56 Inverter MWh counter (resettable)* is incremented. The minimum value is zero.<br>You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters *01.55*…*01.58* resets all of them. | - |
| | 0…1000 kWh | Energy in kWh. | 10 = 1 kWh |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *01.58* | *Cumulative inverter energy (resettable)* | Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. The minimum value is zero. You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters *01.55*…*01.58* resets all of them. | - |
| | -200000000.0… 200000000.0 kWh | Energy in kWh. | 10 = 1 kWh |
| *01.61* | *Abs motor speed used* | Absolute value of parameter *01.01 Motor speed used*. | - |
| | 0.00… 30000.00 rpm | Estimated motor speed. | See par. *46.01* |
| *01.62* | *Abs motor speed %* | Absolute value of parameter *01.03 Motor speed %*. | - |
| | 0.00… 1000.00% | Estimated motor speed. | 10 = 1% |
| *01.63* | *Abs output frequency* | Absolute value of parameter *01.06 Output frequency*. | - |
| | 0.00…500.00 Hz | Estimated output frequency. | See par. *46.02* |
| *01.64* | *Abs motor torque* | Absolute value of parameter *01.10 Motor torque*. | - |
| | 0.0…1600.0% | Motor torque. | See par. *46.03* |
| *01.65* | *Abs output power* | Absolute value of parameter *01.14 Output power*. | - |
| | 0.00… 32767.00 kW or hp | Output power. | 1 = 1 kW |
| *01.66* | *Abs output power % motor nom* | Absolute value of parameter *01.15 Output power % of motor nom*. | - |
| | 0.00… 300.00% | Output power. | 1 = 1% |
| *01.67* | *Abs output power % drive nom* | Absolute value of parameter *01.16 Output power % of drive nom*. | - |
| | 0.00… 300.00% | Output power. | 1 = 1% |
| *01.68* | *Abs motor shaft power* | Absolute value of parameter *01.17 Motor shaft power*. | - |
| | 0.00… 32767.00 kW or hp | Motor shaft power. | 1 = 1 kW |
| *03 Input references* | | Values of references received from various sources. All parameters in this group are read-only unless otherwise noted. | |
| *03.01* | *Panel reference* | Reference 1 given from the control panel or PC tool. | - |
| | -100000.00… 100000.00 | Control panel or PC tool reference. | 1 = 10 |
| *03.02* | *Panel reference remote* | Reference 2 given from the control panel or PC tool. | - |
| | -100000.00… 100000.00 | Control panel or PC tool reference. | 1 = 10 |
| *03.05* | *FB A reference 1* | Reference 1 received through fieldbus adapter A. See also chapter *Fieldbus control through a fieldbus adapter* | - |
| | -100000.00… 100000.00 | Reference 1 from fieldbus adapter A. | 1 = 10 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *03.06* | *FB A reference 2* | Reference 2 received through fieldbus adapter A. | - |
| | -100000.00… 100000.00 | Reference 2 from fieldbus adapter A. | 1 = 10 |
| *03.09* | *EFB reference 1* | Scaled reference 1 received through the embedded fieldbus interface. | 1 = 10 |
| | -30000.00… 30000.00 | Scaled reference 1 received through the embedded fieldbus interface. | 1 = 10 |
| *03.10* | *EFB reference 2* | Scaled reference 2 received through the embedded fieldbus interface. | 1 = 10 |
| | -30000.00… 30000.00 | Scaled reference 2 received through the embedded fieldbus interface. | 1 = 10 |
| **04 Warnings and faults** | | Information on warnings and faults that occurred last. For explanations of individual warning and fault codes, see chapter *Fault tracing*. All parameters in this group are read-only unless otherwise noted. Fault and event logs can be cleared with parameter *96.51 Clear fault and event logger*. | |
| *04.01* | *Tripping fault* | Code of the 1st active fault (the fault that caused the current trip). | - |
| | 0000h…FFFFh | 1st active fault. | 1 = 1 |
| *04.02* | *Active fault 2* | Code of the 2nd active fault. | - |
| | 0000h…FFFFh | 2nd active fault. | 1 = 1 |
| *04.03* | *Active fault 3* | Code of the 3rd active fault. | - |
| | 0000h…FFFFh | 3rd active fault. | 1 = 1 |
| *04.06* | *Active warning 1* | Code of the 1st active warning. | - |
| | 0000h…FFFFh | 1st active warning. | 1 = 1 |
| *04.07* | *Active warning 2* | Code of the 2nd active warning. | - |
| | 0000h…FFFFh | 2nd active warning. | 1 = 1 |
| *04.08* | *Active warning 3* | Code of the 3rd active warning. | - |
| | 0000h…FFFFh | 3rd active warning. | 1 = 1 |
| *04.11* | *Latest fault* | Code of the 1st stored (non-active) fault. | - |
| | 0000h…FFFFh | 1st stored fault. | 1 = 1 |
| *04.12* | *2nd latest fault* | Code of the 2nd stored (non-active) fault. | - |
| | 0000h…FFFFh | 2nd stored fault. | 1 = 1 |
| *04.13* | *3rd latest fault* | Code of the 3rd stored (non-active) fault. | - |
| | 0000h…FFFFh | 3rd stored fault. | 1 = 1 |
| *04.16* | *Latest warning* | Code of the 1st stored (non-active) warning. | - |
| | 0000h…FFFFh | 1st stored warning. | 1 = 1 |
| *04.17* | *2nd latest warning* | Code of the 2nd stored (non-active) warning. | - |
| | 0000h…FFFFh | 2nd stored warning. | 1 = 1 |
| *04.18* | *3rd latest warning* | Code of the 3rd stored (non-active) warning. | - |
| | 0000h…FFFFh | 3rd stored warning. | 1 = 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| *04.40* | *Event word 1* | User-defined event word. This word collects the status of the events (warnings, faults or pure events) selected by parameters *04.41*…*04.71*.<br>This parameter is read-only. | - |

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

| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| | 0000h…FFFFh | User-defined event word. | 1 = 1 |
| *04.41* | *Event word 1 bit 0 code* | Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 0 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *185*). | 0000h |
| | 0000h…FFFFh | Code of event. | 1 = 1 |
| *04.43* | *Event word 1 bit 1 code* | Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 1 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *185*). | 0000h |
| | 0000h…FFFFh | Code of event. | 1 = 1 |
| 04.45, 04.47, 04.49, … | … | … | … |
| *04.71* | *Event word 1 bit 15 code* | Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 15 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *185*). | 0000h |
| | 0000h…FFFFh | Code of event. | 1 = 1 |
| *05 Diagnostics* | | Various run-time-type counters and measurements related to drive maintenance.<br>All parameters in this group are read-only unless otherwise noted. | |
| *05.01* | *On-time counter* | On-time counter. The counter runs when the drive is powered | - |
| | 0…65535 d | On-time counter. | 1 = 1 d |
| *05.02* | *Run-time counter* | Motor run-time counter in full days. The counter runs when the inverter modulates. | - |
| | 0…65535 d | Motor run-time counter. | 1 = 1 d |
| *05.03* | *Hours run* | Corresponding parameter to *05.02 Run-time counter* in hours, that is, 24 * *05.02* value + fractional part of a day. | - |
| | 0.0…429496729.5 h | Hours. | 1 = 1 h |
| *05.04* | *Fan on-time counter* | Running time of the drive cooling fan. Can be reset from the control panel by pressing the Reset softkey for 3 seconds. | - |
| | 0…65535 d | Cooling fan run-time counter. | 1 = 1 d |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *05.10* | *Control board temperature* | Measured temperature of the control board | - |
| | -100… 300 °C or °F | Control board temperature in degrees Celsius or Fahrenheit. | 1 = unit |
| *05.11* | *Inverter temperature* | Estimated drive temperature in percent of fault limit. The fault limit varies according to the type of the drive.<br>0.0% = 0 °C (32 °F)<br>100.0% = Fault limit | - |
| | -40.0…160.0% | Drive temperature in percent. | 1 = 1% |
| *05.20* | *Diagnostic word 1* | Diagnostic word 1. For possible causes and remedies, see chapter *Fault tracing*. | - |

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

| | | | |
|---|---|---|---|
| | 0000h…FFFFh | Diagnostic word 1. | 1 = 1 |
| *05.21* | *Diagnostic word 2* | Diagnostic word 2. For possible causes and remedies, see chapter *Fault tracing*. | - |

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

| | | | |
|---|---|---|---|
| | 0000h…FFFFh | Diagnostic word 2. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *05.22* | *Diagnostic word 3* | Diagnostic word 3. | - |

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

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h…FFFFh | Diagnostic word 3. | 1 = 1 |
| *05.80* | *Motor speed at fault* | Copy of parameter *01.01 Motor speed used* at the occurrence of the latest fault. Parameters *05.80*… are shown for each fault in the fault log. | - |
| | -30000.00… 30000.00 rpm | Estimated motor speed. | |
| *05.81* | *Output frequency at fault* | Copy of parameter *01.06 Output frequency* at the occurrence of the latest fault. | - |
| | -500.00…500.00 Hz | Estimated output frequency. | |
| *05.82* | *DC voltage at fault* | Copy of parameter *01.11 DC voltage* at the occurrence of the latest fault. | - |
| | 0.00…2000.00 V | DC link voltage. | 10 = 1 V |
| *05.83* | *Motor current at fault* | Copy of parameter *01.07 Motor current* at the occurrence of the latest fault. | - |
| | 0.00…30000.00 A | Motor current. | 10 = 1 V |
| *05.84* | *Motor torque at fault* | Copy of parameter *01.10 Motor torque* at the occurrence of the latest fault. | - |
| | -1600.0…1600.0% | Motor torque. | |
| *05.85* | *Main status word at fault* | Copy of parameter *06.11 Main status word* at the occurrence of the latest fault. | - |
| | 0000h…FFFFh | Main status word. | 1 = 1 |
| *05.86* | *DI delayed status at fault* | Copy of parameter *10.02 DI delayed status* at the occurrence of the latest fault. | - |
| | 0000h…FFFFh | Delayed status for digital inputs. | 1 = 1 |
| *05.87* | *Inverter temperature at fault* | Copy of parameter *05.11 Inverter temperature* at the occurrence of the latest fault. | - |
| | -40…160 °C | Drive temperature in °C. | 1 = 1 |
| *05.88* | *Reference used at fault* | Copy of parameter *28.01 Frequency ref ramp input* (in scalar control mode) or *23.01 Speed ref ramp input* (in speed control mode) at the occurrence of the latest fault. | - |
| | -500.00…500.00 Hz or -30000.00…30000.00 rpm | Frequency or speed reference | 1 = 1 |
| *05.89* | *HVAC status word at fault* | Copy of parameter *06.22 HVAC status word* at the occurrence of the latest fault. | - |
| | 0000h…FFFFh | | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| **06 Control and status words** | | Drive control and status words. | |
| *06.01* | *Main control word* | The main control word of the drive. This parameter shows the control signals as received from the selected sources (such as digital inputs, the fieldbus interfaces and the application program). For the control word bit descriptions see page *291*. The related status word and state diagram are presented on pages *292* and *293* respectively. This parameter is read-only. **Note:** When using fieldbus control, this parameter value is not the same as the Control word value that the drive receives from the PLC. For the exact value, see *50.12 FBA A debug mode*. | - |

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

| | 0000h…FFFFh | Main control word. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *06.11* | *Main status word* | Main status word of the drive.<br>For the status word bit descriptions see page *292*. The related control word and state diagram are presented on pages *291* and *293* respectively.<br>This parameter is read-only.<br>**Note:** When using fieldbus control, this parameter value is not the same as the Status word value that the drive sends to the PLC. For the exact value, see *50.12 FBA A debug mode*. | - |

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

| | 0000h…FFFFh | Main status word. | 1 = 1 |
|---|---|---|---|

**13**

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

| Bit | Name | Description |
|---|---|---|
| 0 | Enabled | 1 = If start interlock signals (par. *20.41…20.44*) signals are all present.<br>**Note:** This bit is not affected by the presence of a fault. |
| 1 | Inhibited | 1 = Start inhibited. To start the drive, the inhibiting signal (see par. *06.18*) must be removed and the start signal cycled. |
| 2 | DC charged | 1 = DC circuit has been charged |
| 3 | Ready to start | 1 = Drive is ready to receive a start command |
| 4 | Following reference | 1 = Drive is ready to follow given reference |
| 5 | Started | 1 = Drive has been started |
| 6 | Modulating | 1 = Drive is modulating (output stage is being controlled) |
| 7 | Limiting | 1 = Any operating limit (speed, torque, etc.) is active |
| 8 | Local control | 1 = Drive is in local control |
| 9 | Network control | 1 = Drive is in *network control* (see page *18*). |
| 10 | Ext1 active | 1 = Control location EXT1 active |
| 11 | Ext2 active | 1 = Control location EXT2 active |
| 12 | Reserved | |
| 13 | Start request | 1 = If Start requested. 0 = When Run permissive signal (see par. *20.40*) is 0. |
| 14 | Running | 1 = Drive is controlling speed or frequency, in PID sleep or pre-magnetization. |
| 15 | Reserved | |

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

**13**

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

| Bit | Name | Description |
|---|---|---|
| 0 | Identification run done | 1 = Motor identification (ID) run has been performed |
| 1 | Magnetized | 1 = The motor has been magnetized |
| 2 | Reserved | |
| 3 | Speed control | 1 = Speed control mode active |
| 4 | Reserved | |
| 5 | Safe reference active | 1 = A "safe" reference is applied by functions such as parameters *49.05* and *50.02* |
| 6 | Last speed active | 1 = A "last speed" reference is applied by functions such as parameters *49.05* and *50.02* |
| 7 | Reserved | |
| 8 | Emergency stop failed | 1 = Emergency stop failed (see parameters *31.32* and *31.33*) |
| 9 | Reserved | |
| 10 | Above limit | 1 = Actual speed or frequency equals or exceeds limit (defined by parameters *46.31…46.32*). Valid in both directions of rotation. |
| 11…12 | Reserved | |
| 13 | Start delay active | 1 = Start delay (par. *21.22*) active. |
| 14…15 | Reserved | |

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

**13**

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

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

| | | | |
|-----|------------|-------------|------------|
| | 0000h…FFFFh | Start inhibit status word. | 1 = 1 |
| *06.19* | *Speed control status word* | Speed control status word. This parameter is read-only. | - |

| Bit | Name | Description |
|-----|------|-------------|
| 0 | Zero speed | 1 = Drive has been running below zero speed limit (par. *21.06*) for a time defined by parameter *21.07 Zero speed delay* |
| 1 | Forward | 1 = Drive is running in forward direction above zero speed limit (par. *21.06*) |
| 2 | Reverse | 1 = Drive is running in reverse direction above zero speed limit (par. *21.06*) |
| 3…6 | Reserved | |
| 7 | Any constant speed request | 1 = A constant speed or frequency has been selected; see par. *06.20*. |
| 8…15 | Reserved | |

| | | | |
|-----|------------|-------------|------------|
| | 0000h…FFFFh | Speed control status word. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *06.20* | *Constant speed status word* | Constant speed/frequency status word. Indicates which constant speed or frequency is active (if any). See also parameter *06.19 Speed control status word*, bit 7, and section *Constant speeds/frequencies* (page *179*).<br>This parameter is read-only. | - |

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

| | | | |
|---|---|---|---|
| | 0000h…FFFFh | Constant speed/frequency status word. | 1 = 1 |
| *06.21* | *Drive status word 3* | Drive status word 3.<br>This parameter is read-only. | - |

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

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

**13**

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

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

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h…FFFFh | | 1 = 1 |
| *06.29* | *MSW bit 10 selection* | Selects a binary source whose status is transmitted as bit 10 (User bit 0) of *06.11 Main status word*. | *Above limit* |
| | False | 0. | 0 |
| | True | 1. | 1 |
| | Above limit | Bit 10 of *06.17 Drive status word 2* (see page *336*). | 2 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *06.30* | *MSW bit 11 selection* | Selects a binary source whose status is transmitted as bit 11 (User bit 0) of *06.11 Main status word*. | *Ext ctrl loc* |
| | False | 0. | 0 |
| | True | 1. | 1 |
| | Ext ctrl loc | Bit 11 of *06.01 Main control word* (see page *334*). | 2 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *06.31* | *MSW bit 12 selection* | Selects a binary source whose status is transmitted as bit 12 (User bit 1) of *06.11 Main status word*. | *Run permissive* |
| | False | 0. | 0 |
| | True | 1. | 1 |
| | Run permissive | Status of the external run permissive signal (see parameter *20.40 Run permissive*). | 3 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *06.32* | *MSW bit 13 selection* | Selects a binary source whose status is transmitted as bit 13 (User bit 2) of *06.11 Main status word*. | *False* |
| | False | 0. | 0 |
| | True | 1. | 1 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *06.33* | *MSW bit 14 selection* | Selects a binary source whose status is transmitted as bit 14 (User bit 3) of *06.11 Main status word*. | *False* |
| | False | 0. | 0 |
| | True | 1. | 1 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| **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.) | - |
| *07.04* | *Firmware name* | Firmware identification. | - |
| *07.05* | *Firmware version* | Version number of the firmware. | - |
| *07.06* | *Loading package name* | Name of the firmware loading package. | - |
| *07.07* | *Loading package version* | Version number of the firmware loading package. | - |
| *07.11* | *Cpu usage* | Microprocessor load in percent. | - |
| | 0…100% | Microprocessor load. | 1 = 1% |
| *07.25* | *Customization package name* | First five ASCII letters of the name given to the customization package. The full name is visible under System info on the control panel or the Drive composer PC tool. _N/A_ = None. | - |
| *07.26* | *Customization package version* | Customization package version number. Also visible under System info on the control panel or the Drive composer PC tool. | - |
| *07.30* | *Adaptive program status* | Shows the status of the adaptive program. See section *Adaptive programming* (page *89*). | - |

| Bit | Name | Description |
|-----|------|-------------|
| 0 | Initialized | 1 = Adaptive program initialized |
| 1 | Editing | 1 = Adaptive program is being edited |
| 2 | Edit done | 1 = Editing of adaptive program finished |
| 3 | Running | 1 = Adaptive program running |
| 4…13 | Reserved | |
| 14 | State changing | 1 = State change in progress in adaptive programming engine |
| 15 | Faulted | 1 = Error in adaptive program |

| | | |
|---|---|---|
| 0000h…FFFFh | Adaptive program status. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| *07.31* | *AP sequence state* | Shows the number of the active state of the sequence program part of the adaptive program (AP). If adaptive programming is not running, or it does not contain a sequence program, the parameter is zero. | |
| | 0…20 | | 1 = 1 |
| *07.35* | *Drive configuration* | Plug 'n' play configuration. Performs HW initialization, and shows the detected module configuration of the drive. During the HW initialization, if the drive is not able to detect any module, the value is set to 1, Base unit.<br>For information on automatic setting of parameters after detecting a module, see section *Automatic drive configuration for fieldbus control* on page *299*. | 0000h |

| Bit | Name | Description |
|-----|------|-------------|
| 0 | Not initialized | 1 = Drive configuration has not been initialized |
| 1 | Base unit | 1 = Drive has not detected any modules. |
| 2 | Reserved | |
| 3 | FENA-21 | 1 = FENA-21 Two-port Ethernet adapter module included |
| 4 | FECA-01 | 1 = FECA-01 EtherCAT adapter module included |
| 5 | FPBA-01 | 1 = FPBA-01 PROFIBUS DP adapter module included |
| 6 | FCAN-01 | 1 = FCAN-01 CANopen adapter module included |
| 7 | Reserved | |
| 8 | BIO-01 | 1 = Frontal I/O extension |
| 9 | RIIO-01 | 1 = Frontal standard I/O extension |
| 10 | FSCA-01 | 1 = FSCA-01 Modbus/RTU adapter module included |
| 11 | FEIP-21 | 1 = FEIP-21 Two-port EtherNet/IP adapter module included |
| 12 | FMBT-21 | 1 = FMBT-21 Two-port Modbus/TCP adapter module included |
| 13 | FBIP-21 | 1 = FBIP-21 BACnet/IP (2-port) adapter module included |
| 14 | FBNO-21 | 1 = FPNO-21 Two-port PROFINET IO adapter module included |
| 15 | FEPL-02 | 1 = FEPL-02 Ethernet POWERLINK adapter module included |

| | | | |
|-----|------------|-------------|------------|
| | 0000h…FFFFh | Drive configuration. | 1 = 1 |
| *07.36* | *Drive configuration 2* | Shows the detected module configuration. See parameter *07.35 Drive configuration.* | |

| Bit | Name | Description |
|-----|------|-------------|
| 0 | Reserved | |
| 1 | FDNA-01 | 1 = FDNA-01 DeviceNet™ adapter module include |
| 2 | FCNA-01 | 1 = FCNA-01 ControlNet™ adapter module include |
| 3…15 | Reserved | |

| | | | |
|-----|------------|-------------|------------|
| | 0000h…FFFFh | Drive configuration. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| **10 Standard DI, RO** | | Configuration of digital inputs and relay outputs. | |
| 10.01 | DI status | Displays the electrical status of digital inputs DI1…DI6. The activation/deactivation delays of the inputs (if any are specified) are ignored.<br>Bits 0…5 reflect the delayed status of DI1…DI6.<br>**Example:** 0000000000010011b = DI5, DI2 and DI1 are on, DI3, DI4 and DI6 are off.<br>This parameter is read-only. | - |
| | 0000h…FFFFh | Status of digital inputs. | 1 = 1 |
| 10.02 | DI delayed status | Displays the status of digital inputs DI1…DI6. Bits 0…5 reflect the delayed status of DI1…DI6.<br>**Example:** 0000000000010011b = DI5, DI2 and DI1 are on, DI3, DI4 and DI6 are off.<br>This word is updated only after a 2 ms activation/deactivation delay. When the value of a digital input changes, it must remain the same in two consecutive samples, that is for 2 ms, for the new value to be accepted.<br>This parameter is read-only. | - |

| Bit | Name | Description |
|---|---|---|
| 0 | DI1 | 1 = Digital input 1 is ON. |
| 1 | DI2 | 1 = Digital input 2 is ON. |
| 2 | DI3 | 1 = Digital input 3 is ON. |
| 3 | DI4 | 1 = Digital input 4 is ON. |
| 4 | DI5 | 1 = Digital input 5 is ON. |
| 5 | DI6 | 1 = Digital input 6 is ON. |
| 6…15 | Reserved | |

| | | | |
|---|---|---|---|
| | 0000h…FFFFh | Delayed status for digital inputs. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *10.03* | *DI force selection* | The electrical statuses of the digital inputs can be overridden, for example, testing purposes. A bit in parameter *10.04 DI forced data* is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1.<br>**Note:** Boot and power cycle reset the force selections (parameters *10.03* and *10.04*). | 0000h |

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

| | | | |
|---|---|---|---|
| | 0000h…FFFFh | Override selection for digital inputs. | 1 = 1 |
| *10.04* | *DI forced data* | Allows the data value of a forced digital input to be changed from 0 to 1. It is only possible to force an input that has been selected in parameter *10.03 DI force selection*.<br>Bit 0 is the forced value for DI1; bit 5 is the forced value for the DI6. | 0000h |

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

| | | | |
|---|---|---|---|
| | 0000h…FFFFh | Forced values of digital inputs. | 1 = 1 |
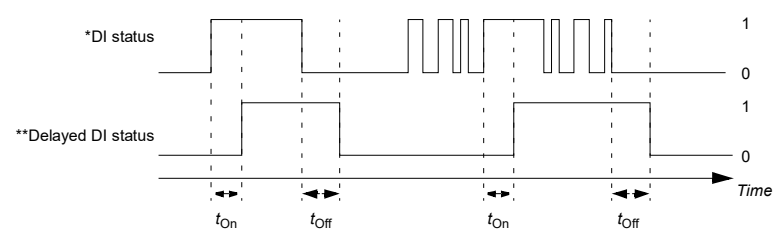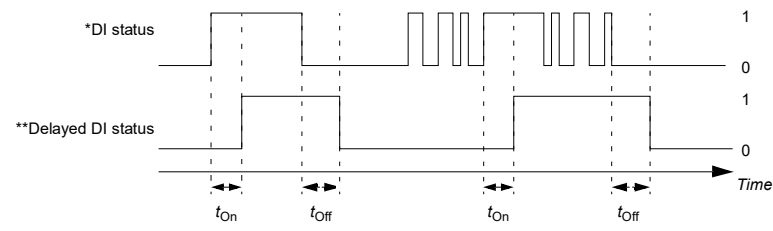
**13**

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

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

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

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

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

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *10.09* | *DI3 ON delay* | Defines the activation delay for digital input DI3. | 0.00 s |
| | | <br><br>$t_{On}$ = *10.09 DI3 ON delay*<br>$t_{Off}$ = *10.10 DI3 OFF delay*<br>*Electrical status of digital input. Indicated by *10.01 DI status*.<br>**Indicated by *10.02 DI delayed status*. | |
| | 0.00 … 3000.00 s | Activation delay for DI3. | 10 = 1 s |
| *10.10* | *DI3 OFF delay* | Defines the deactivation delay for digital input DI3. See parameter *10.09 DI3 ON delay*. | 0.00 s |
| | 0.00 … 3000.00 s | Deactivation delay for DI3. | 10 = 1 s |
| *10.11* | *DI4 ON delay* | Defines the activation delay for digital input DI4. | 0.00 s |
| | | <br><br>$t_{On}$ = *10.11 DI4 ON delay*<br>$t_{Off}$ = *10.12 DI4 OFF delay*<br>*Electrical status of digital input. Indicated by *10.01 DI status*.<br>**Indicated by *10.02 DI delayed status*. | |
| | 0.00 … 3000.00 s | Activation delay for DI4. | 10 = 1 s |
| *10.12* | *DI4 OFF delay* | Defines the deactivation delay for digital input DI4. See parameter *10.11 DI4 ON delay*. | 0.00 s |
| | 0.00 … 3000.00 s | Deactivation delay for DI4. | 10 = 1 s |

**13**

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



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

| | | | |
|-----|------------|-------------|------------|
| | 0.00 … 3000.00 s | Activation delay for DI5. | 10 = 1 s |
| *10.14* | *DI5 OFF delay* | Defines the deactivation delay for digital input DI5. See parameter *10.13 DI5 ON delay*. | 0.00 s |
| | 0.00 … 3000.00 s | Deactivation delay for DI5. | 10 = 1 s |
| *10.15* | *DI6 ON delay* | Defines the activation delay for digital input DI6. | 0.00 s |



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

| | | | |
|-----|------------|-------------|------------|
| | 0.00 … 3000.00 s | Activation delay for DI6. | 10 = 1 s |
| *10.16* | *DI6 OFF delay* | Defines the deactivation delay for digital input DI6. See parameter *10.15 DI6 ON delay*. | 0.00 s |
| | 0.00 … 3000.00 s | Deactivation delay for DI6. | 10 = 1 s |
| *10.21* | *RO status* | Status of relay outputs RO3…RO1. | - |

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

| | | | |
|-----|------------|-------------|------------|
| | 0000h…FFFFh | Status of relay outputs. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *10.22* | *RO force selection* | The signals connected to the relay outputs can be overridden for, for example, testing purposes. A bit in parameter *10.23 RO forced data* is provided for each relay output, and its value is applied whenever the corresponding bit in this parameter is 1. <br>**Note:** Boot and power cycle reset the force selections (parameters *10.22* and *10.23*). | 0000h |

| Bit | Value |
|-----|-------|
| 0 | 1 = Force RO1 to value of bit 0 of parameter *10.23 RO forced data*. (0 = Normal mode) |
| 1 | 1 = Force RO2 to value of bit 1 of parameter *10.23 RO forced data*. (0 = Normal mode) |
| 2 | 1 = Force RO3 to value of bit 2 of parameter *10.23 RO forced data*. (0 = Normal mode) |
| 3…15 | Reserved |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | 0000h…FFFFh | Override selection for relay outputs. | 1 = 1 |
| *10.23* | *RO forced data* | Contains the values of relay outputs that are used instead of the connected signals if selected in parameter *10.22 RO force selection*. Bit 0 is the forced value for RO1. | 0000h |

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

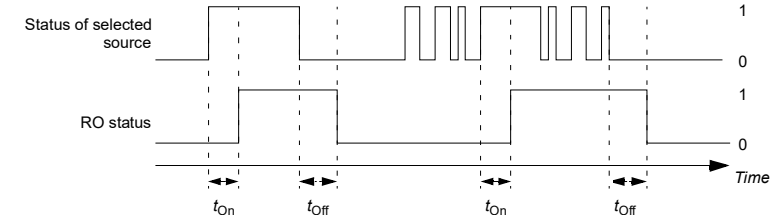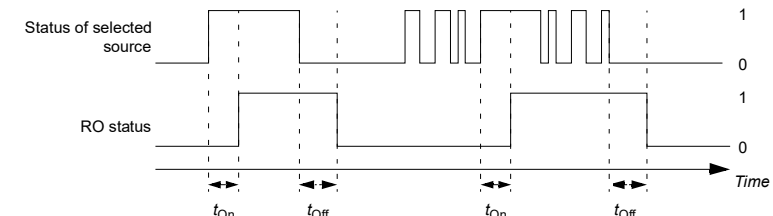| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | 0000h…FFFFh | Forced RO values. | 1 = 1 |
| *10.24* | *RO1 source* | Selects a drive signal to be connected to relay output RO1. | *Damper control* |
| | Not energized | Output is not energized. | 0 |
| | Energized | Output is energized. | 1 |
| | Ready run | Bit 1 of *06.11 Main status word* (see page *334*). | 2 |
| | Enabled | Bit 0 of *06.16 Drive status word 1* (see page *335*). | 4 |
| | Started | Bit 5 of *06.16 Drive status word 1* (see page *335*). | 5 |
| | Magnetized | Bit 1 of *06.17 Drive status word 2* (see page *336*). | 6 |
| | Running | Bit 6 of *06.16 Drive status word 1* (see page *335*). | 7 |
| | Ready ref | Bit 2 of *06.11 Main status word* (see page *334*). | 8 |
| | At setpoint | Bit 8 of *06.11 Main status word* (see page *334*). | 9 |
| | Reverse | Bit 2 of *06.19 Speed control status word* (see page *337*). | 10 |
| | Zero speed | Bit 0 of *06.19 Speed control status word* (see page *337*). | 11 |
| | Above limit | Bit 10 of *06.17 Drive status word 2* (see page *336*). | 12 |
| | Warning | Bit 7 of *06.11 Main status word* (see page *334*). | 13 |
| | Fault | Bit 3 of *06.11 Main status word* (see page *334*). | 14 |
| | Fault (-1) | Inverted bit 3 of *06.11 Main status word* (see page *334*). | 15 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Fault/Warning | Bit 3 of *06.11 Main status word* OR bit 7 of *06.11 Main status word* (see page *334*). | 16 |
| | Overcurrent | Fault *2310 Overcurrent* has occurred. | 17 |
| | Overvoltage | Fault *3210 DC link overvoltage* has occurred. | 18 |
| | Drive temp | Fault *2381 IGBT overload*, *4110 Control board temperature*, *4210 IGBT overtemperature*, *4290 Cooling*, *42F1 IGBT temperature*, *4310 Excess temperature* or *4380 Excess temperature difference* has occurred. | 19 |
| | Undervoltage | Fault *3220 DC link undervoltage* has occurred. | 20 |
| | Motor temp | Fault *4981 External temperature 1* or *4982 External temperature 2* has occurred. | 21 |
| | Reserved | | 22 |
| | Ext2 active | Bit 11 of *06.16 Drive status word 1* (see page *335*). | 23 |
| | Remote control | Bit 9 of *06.11 Main status word* (see page *334*). | 24 |
| | Reserved | | 25…26 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 27 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 28 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 29 |
| | Reserved | | 30…32 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 33 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 34 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 35 |
| | Reserved | | 36…38 |
| | Start delay | Bit 13 of *06.17 Drive status word 2* (see page *336*). | 39 |
| | RO/DIO control word bit0 | Bit 0 of *10.99 RO/DIO control word* (see page *351*). | 40 |
| | RO/DIO control word bit1 | Bit 1 of *10.99 RO/DIO control word* (see page *351*). | 41 |
| | RO/DIO control word bit2 | Bit 2 of *10.99 RO/DIO control word* (see page *351*). | 42 |
| | Reserved | | 43…44 |
| | PFC1 | Bit 0 of *76.01 PFC status* (see page *516*). | 45 |
| | PFC2 | Bit 1 of *76.01 PFC status* (see page *516*). | 46 |
| | PFC3 | Bit 2 of *76.01 PFC status* (see page *516*). | 47 |
| | PFC4 | Bit 3 of *76.01 PFC status* (see page *516*). | 48 |
| | Reserved | | 49…52 |
| | Event word 1 | Event word 1 = 1 if any bit of *04.40 Event word 1* (see page *330*) is 1, that is, if any warning, fault or pure event that has been defined with parameters *04.41…04.71* is on. | 53 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Damper control | See the figure below. | 54 |



| | Run permissive | Bit 7 of *06.22 HVAC status word*. | 55 |
| | Start interlock 1 | Bit 8 of *06.22 HVAC status word*. | 56 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Start interlock 2 | Bit 9 of *06.22 HVAC status word*. | 57 |
| | Start interlock 3 | Bit 10 of *06.22 HVAC status word*. | 58 |
| | Start interlock 4 | Bit 11 of *06.22 HVAC status word*. | 59 |
| | All start interlocks | Bit 12 of *06.22 HVAC status word*. | 60 |
| | User load curve | Bit 3 (Outside load limit) of *37.01 ULC output status word* (see page *460*). | 61 |
| | RO/DIO control word | For *10.24 RO1 source*: Bit 0 (RO1) of *10.99 RO/DIO control word* (see page *351*). For *10.27 RO2 source*: Bit 1 (RO2) of *10.99 RO/DIO control word* (see page *351*). For *10.30 RO3 source*: Bit 2 (RO3) of *10.99 RO/DIO control word* (see page *351*). | |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *10.25* | *RO1 ON delay* | Defines the activation delay for relay output RO1. | 0.0 s |



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

| | 0.0 … 3000.0 s | Activation delay for RO1. | 10 = 1 s |
| *10.26* | *RO1 OFF delay* | Defines the deactivation delay for relay output RO1. See parameter *10.25 RO1 ON delay*. | 0.0 s |
| | 0.0 … 3000.0 s | Deactivation delay for RO1. | 10 = 1 s |
| *10.27* | *RO2 source* | Selects a drive signal to be connected to relay output RO2. For the available selections, see parameter *10.24 RO1 source*. | *Running* |
| *10.28* | *RO2 ON delay* | Defines the activation delay for relay output RO2. | 0.0 s |



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

| | 0.0 … 3000.0 s | Activation delay for RO2. | 10 = 1 s |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *10.29* | *RO2 OFF delay* | Defines the deactivation delay for relay output RO2. See parameter *10.28 RO2 ON delay*. | 0.0 s |
| | 0.0 … 3000.0 s | Deactivation delay for RO2. | 10 = 1 s |
| *10.30* | *RO3 source* | Selects a drive signal to be connected to relay output RO3. For the available selections, see parameter *10.24 RO1 source*. | *Fault (-1)* |
| *10.31* | *RO3 ON delay* | Defines the activation delay for relay output RO3. | 0.0 s |



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

| | | | |
|---|---|---|---|
| | 0.0 … 3000.0 s | Activation delay for RO3. | 10 = 1 s |
| *10.32* | *RO3 OFF delay* | Defines the deactivation delay for relay output RO3. See parameter *10.31 RO3 ON delay*. | 0.0 s |
| | 0.0 … 3000.0 s | Deactivation delay for RO3. | 10 = 1 s |
| *10.99* | *RO/DIO control word* | Storage parameter for controlling the relay outputs, for example, through the embedded fieldbus interface. To control the relay outputs (RO) of the drive, send a control word with the bit assignments shown below as Modbus I/O data. Set the target selection parameter of that particular data (*58.101…58.114*) to *RO/DIO control word*. In the source selection parameter of the desired output, select the appropriate bit of this word. | 0000h |

| Bit | Name | Description |
|---|---|---|
| 0 | RO1 | Source bits for relay outputs RO1…RO3. See parameters *10.24*, *10.27* and *10.30*. |
| 1 | RO2 | |
| 2 | RO3 | |
| 5…15 | Reserved | |

| | | | |
|---|---|---|---|
| | 0000h…FFFFh | RO/DIO control word. | 1 = 1 |
| *10.101* | *RO1 toggle counter* | Displays the number of times relay output RO1 has changed states. Can be reset from the control panel by pressing the Reset softkey for 3 seconds. | 5 |
| | 0…4294967000 | State change count. | 1 = 1 |
| *10.102* | *RO2 toggle counter* | Displays the number of times relay output RO2 has changed states. Can be reset from the control panel by pressing the Reset softkey for 3 seconds. | 0 |
| | 0…4294967000 | State change count. | 1 = 1 |

**13**

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

| **11 Standard DIO, FI, FO** | Configuration of the frequency inputs 1 and 2 as well as frequency output and digital output. | |
|---|---|---|
| *11.02* | *DIO delayed status* | Displays the status of digital or frequency output DIO1 (terminal DO1 on BIO-01). Bit 0 reflects the delayed status of DIO1.<br>**Example:** 0000000000000001b = DIO1 is on.<br>This word is updated only after a 2 ms activation/deactivation delay. When the value of a digital input changes, it must remain the same in two consecutive samples, that is for 2 ms, for the new value to be accepted.<br>This parameter is read-only. | - |

| Bit | Name | Description |
|---|---|---|
| 0 | DIO1 | 1 = Digital or frequency output DIO1 is ON. |
| 1…15 | Reserved | |

| | 0000h…FFFFh | Delayed status for digital or frequency output DIO1. | 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 or frequency output DIO1 (terminal DO1 on BIO-01), and its value is applied whenever the corresponding bit in this parameter is 1.<br>**Note:** Boot and power cycle reset the force selections (parameters *10.22* and *10.23*). | 0000h |

| Bit | Value |
|---|---|
| 0 | 1 = Force DIO1 to value of bit 0 of parameter *11.04 DIO force data*. (0 = Normal mode) |
| 1…15 | Reserved |

| | 0000h…FFFFh | Override selection for digital or frequency output DIO1. | 1 = 1 |
|---|---|---|---|
| *11.04* | *DIO force data* | Contains the value of for digital or frequency output DIO1 (terminal DO1 on BIO-01) that is used instead of the connected signals if selected in parameter *11.04 DIO force data*. Bit 0 is the forced value for DIO1. | 0000h |

| Bit | Value |
|---|---|
| 0 | 1 = Force the value of this bit to DIO1, if so defined in parameter *11.04 DIO force data*. |
| 1…15 | Reserved |

| | 0000h…FFFFh | Forced value of digital or frequency output DIO1. | 1 = 1 |
|---|---|---|---|
| *11.06* | *DIO1 configuration* | Selects whether output DIO1 (terminal DO1 on BIO-01) is used as a digital output or frequency output. | *Digital output* |
| | Digital output | DIO1 is used as a digital output. | 0 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Frequency output | DIO1 is used as a frequency output. | 2 |
| *11.06* | *DIO1 configuration* | Selects a drive signal to be connected to output DIO1 (terminal DO1 on BIO-01) when it is configured to digital output by parameter *11.06 DIO1 configuration*. | *Not energized* |
| | Not energized | Output is not energized. | 0 |
| | Energized | Output is energized. | 1 |
| | Ready run | Bit 1 of *06.11 Main status word* (see page *334*). | 2 |
| | Enabled | Bit 0 of *06.16 Drive status word 1* (see page *335*). | 4 |
| | Started | Bit 5 of *06.16 Drive status word 1* (see page *335*). | 5 |
| | Magnetized | Bit 1 of *06.17 Drive status word 2* (see page *336*). | 6 |
| | Running | Bit 6 of *06.16 Drive status word 1* (see page *335*). | 7 |
| | Ready ref | Bit 2 of *06.11 Main status word* (see page *334*). | 8 |
| | At setpoint | Bit 8 of *06.11 Main status word* (see page *334*). | 9 |
| | Reverse | Bit 2 of *06.19 Speed control status word* (see page *337*). | 10 |
| | Zero speed | Bit 0 of *06.19 Speed control status word* (see page *337*). | 11 |
| | Above limit | Bit 10 of *06.17 Drive status word 2* (see page *336*). | 12 |
| | Warning | Bit 7 of *06.11 Main status word* (see page *334*). | 13 |
| | Fault | Bit 3 of *06.11 Main status word* (see page *334*). | 14 |
| | Fault (-1) | Inverted bit 3 of *06.11 Main status word* (see page *334*). | 15 |
| | Fault/Warning | Bit 3 of *06.11 Main status word* OR bit 7 of *06.11 Main status word* (see page *334*). | 16 |
| | Overcurrent | Fault *2310 Overcurrent* has occurred. | 17 |
| | Overvoltage | Fault *3210 DC link overvoltage* has occurred. | 18 |
| | Drive temp | Fault *2381 IGBT overload*, *4110 Control board temperature*, *4210 IGBT overtemperature*, *4290 Cooling*, *42F1 IGBT temperature*, *4310 Excess temperature* or *4380 Excess temperature difference* has occurred. | 19 |
| | Undervoltage | Fault *3220 DC link undervoltage* has occurred. | 20 |
| | Motor temp | Fault *4981 External temperature 1* or *4982 External temperature 2* has occurred. | 21 |
| | Reserved | | 22 |
| | Ext2 active | Bit 11 of *06.16 Drive status word 1* (see page *335*). | 23 |
| | Remote control | Bit 9 of *06.11 Main status word* (see page *334*). | 24 |
| | Reserved | | 25…26 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 27 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 28 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 29 |
| | Reserved | | 30…32 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 33 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 34 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 35 |
| | Reserved | | 36…38 |
| | Start delay | Bit 13 of *06.17 Drive status word 2* (see page *336*). | 39 |

**13**

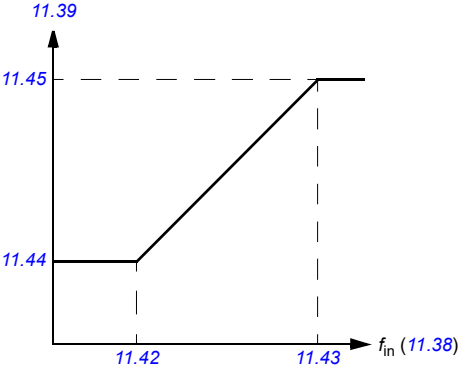| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|-----------|
| | RO/DIO control word bit0 | Bit 0 of *10.99 RO/DIO control word* (see page *351*). | 40 |
| | RO/DIO control word bit1 | Bit 1 of *10.99 RO/DIO control word* (see page *351*). | 41 |
| | RO/DIO control word bit2 | Bit 2 of *10.99 RO/DIO control word* (see page *351*). | 42 |
| | Reserved | | 43…44 |
| | PFC1 | Bit 0 of *76.01 PFC status* (see page *516*). | 45 |
| | PFC2 | Bit 1 of *76.01 PFC status* (see page *516*). | 46 |
| | PFC3 | Bit 2 of *76.01 PFC status* (see page *516*). | 47 |
| | PFC4 | Bit 3 of *76.01 PFC status* (see page *516*). | 48 |
| | Reserved | | 49…52 |
| | Event word 1 | Event word 1 = 1 if any bit of *04.40 Event word 1* (see page *330*) is 1, that is, if any warning, fault or pure event that has been defined with parameters *04.41…04.71* is on. | 53 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Damper control | See the figure below. | 54 |



| | | | |
|---|---|---|---|
| | Run permissive | Bit 7 of *06.22 HVAC status word*. | 55 |
| | Start interlock 1 | Bit 8 of *06.22 HVAC status word*. | 56 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Start interlock 2 | Bit 9 of *06.22 HVAC status word*. | 57 |
| | Start interlock 3 | Bit 10 of *06.22 HVAC status word*. | 58 |
| | Start interlock 4 | Bit 11 of *06.22 HVAC status word*. | 59 |
| | All start interlocks | Bit 12 of *06.22 HVAC status word*. | 60 |
| | User load curve | Bit 3 (Outside load limit) of *37.01 ULC output status word* (see page *460*). | 61 |
| | RO/DIO control word | For *10.24 RO1 source*: Bit 0 (RO1) of *10.99 RO/DIO control word* (see page *351*).<br>For *10.27 RO2 source*: Bit 1 (RO2) of *10.99 RO/DIO control word* (see page *351*).<br>For *10.30 RO3 source*: Bit 2 (RO3) of *10.99 RO/DIO control word* (see page *351*). | 62 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *11.07* | *DIO1 ON delay* | Defines the activation delay for DO1 on BIO-01 when it is used as a digital output. | 0.00 s |
| | 0.0…3000.0 s | Activation delay for DO1. | 10 = 1 s |
| *11.08* | *DIO1 OFF delay* | Defines the deactivation delay for DO1 on BIO-01 when it is used as a digital output. | 0.00 s |
| | 0.0…3000.0 s | Deactivation delay for DO1. | 10 = 1 s |
| *11.17* | *DI4 configuration* | Selects how digital input 4 is used. | *Digital input* |
| | 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. | *Digital input* |
| | Digital input | DI5 is used as a digital input. | 0 |
| | Frequency input | DI5 is used as a frequency input 2. | 1 |
| *11.38* | *Freq in 1 actual value* | Displays the value of frequency input 1 (via DI4 when it is used as a frequency input) before scaling. See parameter *11.42 Freq in 1 min*.<br>This parameter is read-only. | - |
| | 0 … 16000 Hz | Unscaled value of frequency input 1 (DI4). | 1 = 1 Hz |
| *11.39* | *Freq in 1 scaled value* | Displays the value of frequency input 1 (via DI4 when it is used as a frequency input) after scaling. See parameter *11.42 Freq in 1 min*.<br>This parameter is read-only. | - |
| | -32768.000…32767.000 | Scaled value of frequency input 1 (DI4). | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *11.42* | *Freq in 1 min* | Defines the minimum for the frequency actually arriving at frequency input 1 (DI4) when it is used as a frequency input). The incoming frequency signal (*11.38 Freq in 1 actual value*) is scaled into an internal signal (*11.39 Freq in 1 scaled value*) by parameters *11.42*…*11.45* as follows:<br> | 0 Hz |
| | 0 … 16000 Hz | Minimum frequency of frequency input 1 (DI4). | 1 = 1 Hz |
| *11.43* | *Freq in 1 max* | Defines the maximum for the frequency actually arriving at frequency input 1 (DI4) when it is used as a frequency input). See parameter *11.42 Freq in 1 min*. | 16000 Hz |
| | 0 … 16000 Hz | Maximum frequency for frequency input 1 (DI4). | 1 = 1 Hz |
| *11.44* | *Freq in 1 at scaled min* | Defines the value that is required to correspond internally to the minimum input frequency defined by parameter *11.42 Freq in 1 min*. See diagram at parameter *11.42 Freq in 1 min*. | 0.000 |
| | -32768.000… 32767.000 | Value corresponding to minimum of frequency input 1. | 1 = 1 |
| *11.45* | *Freq in 1 at scaled max* | Defines the value that is required to correspond internally to the maximum input frequency defined by parameter *11.43 Freq in 1 max*. See diagram at parameter *11.42 Freq in 1 min*. | 1500.000; 1800.000 (*95.20* b0) |
| | -32768.000… 32767.000 | Value corresponding to maximum of frequency input 1. | 1 = 1 |
| *11.46* | *Freq in 2 actual value* | Displays the value of frequency input 2 (via DI5 when it is used as a frequency input) before scaling. See parameter *11.50 Freq in 2 min*.<br>This parameter is read-only. | - |
| | 0 … 16000 Hz | Unscaled value of frequency input 2. | 1 = 1 Hz |
| *11.47* | *Freq in 2 scaled value* | Displays the value of frequency input 2 (via DI5 when it is used as a frequency input) after scaling. See parameter *11.50 Freq in 2 min*.<br>This parameter is read-only. | - |
| | -32768.000… 32767.000 | Scaled value of frequency input 2 (DI5). | 1 = 1 |

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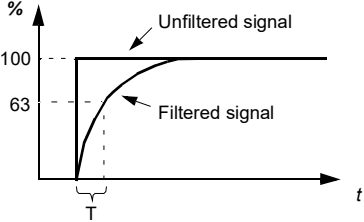| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *11.50* | *Freq in 2 min* | Defines the minimum for the frequency actually arriving at frequency input 1 (DI5) when it is used as a frequency input). The incoming frequency signal (*11.46 Freq in 2 actual value*) is scaled into an internal signal (*11.47 Freq in 2 scaled value*) by parameters *11.50*…*11.53* as follows:<br><br>*11.47*<br><br>*11.53*<br><br>*11.52*<br><br>*11.50*    *11.51*    $f_{in}$ (*11.46*) | 0 Hz |
| | 0 … 16000 Hz | Minimum frequency of frequency input 1 (DI5). | 1 = 1 Hz |
| *11.51* | *Freq in 2 max* | Defines the maximum for the frequency actually arriving at frequency input 1 (DI5) when it is used as a frequency input). See parameter *11.50 Freq in 2 min*. | 16000 Hz |
| | 0 … 16000 Hz | Maximum frequency for frequency input 2 (DI5). | 1 = 1 Hz |
| *11.52* | *Freq in 2 at scaled min* | Defines the value that is required to correspond internally to the minimum input frequency defined by parameter *11.50 Freq in 2 min*. See diagram at parameter *11.50 Freq in 2 min*. | 0.000 |
| | -32768.000… 32767.000 | Value corresponding to minimum of frequency input 2. | 1 = 1 |
| *11.53* | *Freq in 2 at scaled max* | Defines the value that is required to correspond internally to the maximum input frequency defined by parameter *11.51 Freq in 2 max*. See diagram at parameter *11.50 Freq in 2 min*. | 1500.000; 1800.000 (*95.20* b0) |
| | -32768.000… 32767.000 | Value corresponding to maximum of frequency input 1. | 1 = 1 |
| *11.54* | *Freq out 1 actual value* | Displays the value of frequency output 1 (terminal DO1 on BIO-01) after scaling. See parameter *11.58 Freq out 1 src min*.<br>This applies when parameter *11.06 DIO1 configuration* is set to *Frequency output*.<br>This parameter is read-only. | - |
| | 0 … 16000 Hz | Unscaled value of frequency output 1. | 1 = 1 Hz |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *11.55* | *Freq out 1 source* | Selects a signal to be connected to frequency output 1 (terminal DO1 on BIO-01) when parameter *11.06 DIO1 configuration* is set to *Frequency output*. | *Not energized* |
| | Not selected | None. | 0 |
| | Motor speed used | *01.01 Motor speed used* (page *325*). | 1 |
| | Reserved | | 2 |
| | Output frequency | *01.06 Output frequency* (page *325*). | 3 |
| | Motor current | *01.07 Motor current* (page *325*). | 4 |
| | Reserved | | 5 |
| | Motor torque | *01.10 Motor torque* (page *325*). | 6 |
| | DC voltage | *01.11 DC voltage* (page *325*). | 7 |
| | Output power | *01.14 Output power* (page *326*). | 8 |
| | Reserved | | 9 |
| | Speed ref ramp in | *23.01 Speed ref ramp input* (page *397*). | 10 |
| | Speed ref ramp out | *23.02 Speed ref ramp output* (page *397*). | 11 |
| | Speed ref used | *24.01 Used speed reference* (page *400*). | 12 |
| | Reserved | | 13 |
| | Freq ref used | *28.02 Frequency ref ramp output* (page *405*). | 14 |
| | Reserved | | 15 |
| | Process PID out | *40.01 Process PID output actual* (page *463*). | 16 |
| | Reserved | | 17…19 |
| *11.58* | *Freq out 1 src min* | Defines the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the minimum value of frequency output 1 (defined by parameter *11.60 Freq out 1 src min*).<br>This applies when parameter *11.06 DIO1 configuration* is set to *Frequency output*.<br> | 0.000 |
| | -32768.000…<br>32767.000 | Real signal value corresponding to minimum value of frequency output 1. | 1 = 1 |

**13**

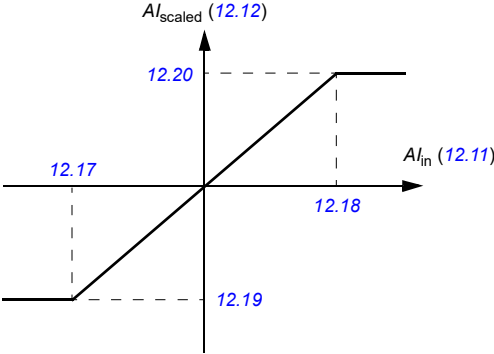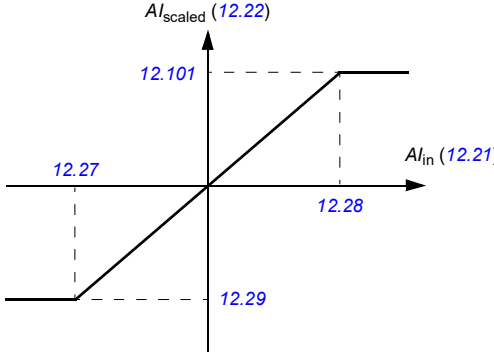| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| *11.59* | *Freq out 1 src max* | the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the maximum value of frequency output 1 (defined by parameter *11.61 Freq out 1 src max*). See parameter *11.58 Freq out 1 src min*.<br>This applies when parameter *11.06 DIO1 configuration* is set to *Frequency output*. | 1500.000 |
| | -32768.000… 32767.000 | Real signal value corresponding to maximum value of frequency output 1. | 1 = 1 |
| *11.60* | *Freq out 1 at src min* | Defines the minimum value of frequency output 1. See diagram at *11.58 Freq out 1 src min*. | 0 Hz |
| | 0 … 16000 Hz | Minimum value of frequency output 1. | 1 = 1 Hz |
| *11.61* | *Freq out 1 at src max* | Defines the maximum value of frequency output 1. See diagram at *11.58 Freq out 1 src min*. | 16000 Hz |
| | 0 … 16000 Hz | Maximum value of frequency output 1. | 1 = 1 Hz |
| **12 Standard AI** | | Configuration of standard analog inputs. | |
| *12.02* | *AI force selection* | The true readings of the analog inputs can be overridden, for 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.<br>**Notes:**<br>• AI filter times (parameters *12.16 AI1 filter time* and *12.26 AI2 filter time*) have no effect on forced AI values (parameters *12.13 AI1 forced value* and *12.23 AI2 forced value*).<br>• Boot and power cycle reset the force selections (parameters *12.02* and *12.03*). | 0000h |

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

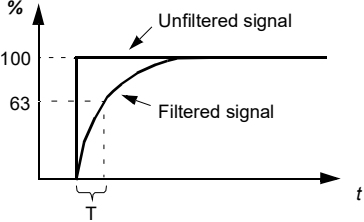| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| | 0000h…FFFFh | Forced values selector for analog inputs AI1 and AI2. | 1 = 1 |
| *12.03* | *AI supervision function* | Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input.<br>The supervision applies a margin of 0.5 V or 1.0 mA to the limits. For example, if the maximum limit for the input is 7.000 V, the maximum limit supervision activates at 7.500 V. The inputs and the limits to be observed are selected by parameter *12.04 AI supervision selection*. | *No action* |
| | No action | No action taken. | 0 |
| | Fault | Drive trips on fault *80A0 AI supervision*. | 1 |
| | Warning | Drive generates warning *A8A0 AI supervision*. | 2 |
| | Last speed | Drive generates warning *A8A0 AI supervision* and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering.<br>⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break. | 3 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Speed ref safe | Drive generates warning *A8A0 AI supervision* and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). <br>⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break. | 4 |
| *12.04* | *AI supervision selection* | Specifies the analog input limits to be supervised. See parameter *12.03 AI supervision function*. | 0000h |

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

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h…FFFFh | Activation of analog input supervision. | 1 = 1 |
| *12.11* | *AI1 actual value* | Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). <br>This parameter is read-only. | - |
| | 0.000…22.000 mA or 0.000…11.000 V | Value of analog input AI1. | 1000 = 1 unit |
| *12.12* | *AI1 scaled value* | Displays the value of analog input AI1 after scaling. See parameters *12.19 AI1 scaled at AI1 min* and *12.20 AI1 scaled at AI1 max*. <br>This parameter is read-only. | - |
| | -32768.000… 32767.000 | Scaled value of analog input AI1. | 1 = 1 |
| *12.13* | *AI1 forced value* | Forced value that can be used instead of the true reading of the input. See parameter *12.02 AI force selection*. | - |
| | 0.000…22.000 mA or 0.000…11.000 V | Forced value of analog input AI1. | 1000 = 1 unit |
| *12.15* | *AI1 unit selection* | Selects the unit for readings and settings related to analog input AI1. | *V* |
| | V | Volts. | 2 |
| | mA | Milliamperes. | 10 |

**13**
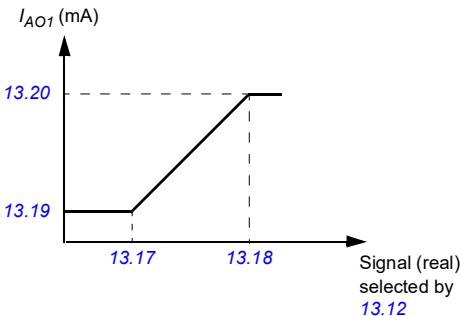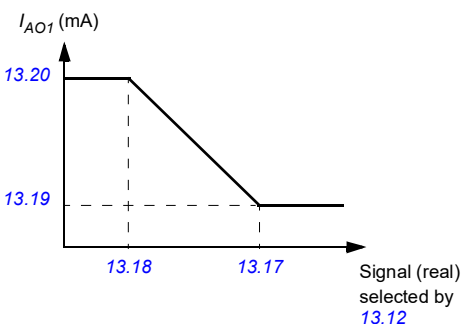
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *12.16* | *AI1 filter time* | Defines the filter time constant for analog input AI1.<br><br><br><br>$$O = I \times (1 - e^{-t/T})$$<br><br>I = filter input (step)<br>O = filter output<br>*t* = time<br>T = filter time constant<br><br>**Note:** The signal is also filtered due to the signal interface hardware (approximately 0.25 ms time constant). This cannot be changed by any parameter. | 0.100 s |
| | 0.000…30.000 s | Filter time constant. | 1000 = 1 s |
| *12.17* | *AI1 min* | Defines the minimum site value for analog input AI1.<br>Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.<br>See also parameter *12.19 AI1 scaled at AI1 min*. | 4.000 mA or 0.000 V |
| | 0.000…22.000 mA or 0.000…11.000 V | Minimum value of AI1. | 1000 = 1 unit |
| *12.18* | *AI1 max* | Defines the maximum site value for analog input AI1.<br>Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting.<br>See also parameter *12.19 AI1 scaled at AI1 min*. | 20.000 mA or 10.000 V |
| | 0.000…22.000 mA or 0.000…11.000 V | Maximum value of AI1. | 1000 = 1 unit |

**13**

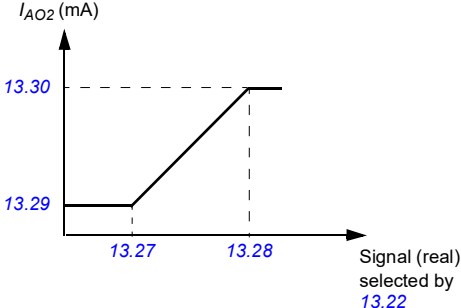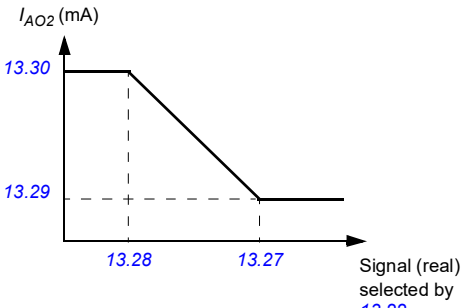| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *12.19* | *AI1 scaled at AI1 min* | Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter *12.17 AI1 min*. (Changing the polarity settings of *12.19* and *12.20* can effectively invert the analog input.) <br><br>  | 0.000 |
| | -32768.000… 32767.000 | Real value corresponding to minimum AI1 value. | 1 = 1 |
| *12.20* | *AI1 scaled at AI1 max* | Defines the real internal value that corresponds to the maximum analog input AI1 value defined by parameter *12.18 AI1 max*. See the drawing at parameter *12.19 AI1 scaled at AI1 min*. | 50.000; 60.000 (*95.20* b0) |
| | -32768.000… 32767.000 | Real value corresponding to maximum AI1 value. | 1 = 1 |
| *12.21* | *AI2 actual value* | Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). <br> This parameter is read-only. | - |
| | 0.000…22.000 mA or 0.000…11.000 V | Value of analog input AI2. | 1000 = 1 unit |
| *12.22* | *AI2 scaled value* | Displays the value of analog input AI2 after scaling. See parameters *12.29 AI2 scaled at AI2 min* and *12.101 AI1 percent value*. <br> This parameter is read-only. | - |
| | -32768.000… 32767.000 | Scaled value of analog input AI2. | 1 = 1 |
| *12.23* | *AI2 forced value* | Forced value that can be used instead of the true reading of the input. See parameter *12.02 AI force selection*. | - |
| | 0.000…22.000 mA or 0.000…11.000 V | Forced value of analog input AI2. | 1000 = 1 unit |
| *12.25* | *AI2 unit selection* | Selects the unit for readings and settings related to analog input AI2. | *mA* |
| | V | Volts. | 2 |
| | mA | Milliamperes. | 10 |
| *12.26* | *AI2 filter time* | Defines the filter time constant for analog input AI2. See parameter *12.16 AI1 filter time*. | 0.100 s |
| | 0.000…30.000 s | Filter time constant. | 1000 = 1 s |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *12.27* | *AI2 min* | Defines the minimum site value for analog input AI2.<br>Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting. | 4.000 mA |
| | 0.000…22.000 mA<br>or 0.000…11.000 V | Minimum value of AI2. | 1000 = 1 unit |
| *12.28* | *AI2 max* | Defines the maximum site value for analog input AI2.<br>Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. | 20.000 mA |
| | 0.000…22.000 mA<br>or 0.000…11.000 V | Maximum value of AI2. | 1000 = 1 unit |
| *12.29* | *AI2 scaled at AI2 min* | Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter *12.27 AI2 min*. (Changing the polarity settings of *12.29* and *12.101* can effectively invert the analog input.)<br><br>$AI_{scaled}$ (*12.22*)<br>*12.101*<br>*12.27*<br>$AI_{in}$ (*12.21*)<br>*12.28*<br>*12.29* | 0.000 |
| | -32768.000…32767.000 | Real value corresponding to minimum AI2 value. | 1 = 1 |
| *12.30* | *AI2 scaled at AI2 max* | Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter *12.28 AI2 max*.<br>See the drawing at parameter of *12.29 AI2 scaled at AI2 min*. | 50.000 |
| | -32768.000…32767.000 | Real value corresponding to maximum AI2 value. | 1 = 1 |
| *12.101* | *AI1 percent value* | Value of analog input AI1 in percent of AI1 scaling (*12.18 AI1 max* - *12.17 AI1 min*). | - |
| | 0.00…100.00% | AI1 value | 100 = 1% |
| *12.102* | *AI2 percent value* | Value of analog input AI2 in percent of AI2 scaling (*12.28 AI2 max* - *12.27 AI2 min*). | - |
| | 0.00…100.00% | AI2 value | 100 = 1% |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| **13 Standard AO** | | Configuration of standard analog outputs. | |
| *13.02* | *AO force selection* | The source signals of the analog outputs can be overridden, for example, for testing purposes. A forced value parameter is provided for each analog output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *13.02* and *13.11*). | 0000h |

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

| | | | |
|---|---|---|---|
| | 0000h…FFFFh | Forced values selector for analog outputs AO1 and AO2. | 1 = 1 |
| *13.11* | *AO1 actual value* | Displays the value of AO1 in mA or V. This parameter is read-only. | - |
| | 0.000…11.000 V | Value of AO1. | 1 = 1 mA |
| *13.12* | *AO1 source* | Selects a signal to be connected to analog output AO1. | *Output frequency* |
| | Zero | None. | 0 |
| | Motor speed used | *01.01 Motor speed used* (page *325*). | 1 |
| | Reserved | | 2 |
| | Output frequency | *01.06 Output frequency* (page *325*). | 3 |
| | Motor current | *01.07 Motor current* (page *325*). | 4 |
| | Motor current % of motor nominal | *01.08 Motor current % of motor nom* (page *325*). | 5 |
| | Motor torque | *01.10 Motor torque* (page *325*). | 6 |
| | DC voltage | *01.11 DC voltage* (page *325*). | 7 |
| | Output power | *01.14 Output power* (page *326*). | 8 |
| | Reserved | | 9 |
| | Speed ref ramp in | *23.01 Speed ref ramp input* (page *397*). | 10 |
| | Speed ref ramp out | *23.02 Speed ref ramp output* (page *397*). | 11 |
| | Speed ref used | *24.01 Used speed reference* (page *400*). | 12 |
| | Reserved | | 13 |
| | Freq ref used | *28.02 Frequency ref ramp output* (page *405*). | 14 |
| | Reserved | | 15 |
| | Process PID out | *40.01 Process PID output actual* (page *463*). | 16 |
| | Reserved | | 17…19 |
| | Temp sensor 1 excitation | The output is used to feed an excitation current to the temperature sensor 1, see parameter *35.11 Temperature 1 source*. See also section *Programmable protection functions* (page *176*). | 20 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Temp sensor 2 excitation | The output is used to feed an excitation current to the temperature sensor 2, see parameter *35.21 Temperature 2 source*. See also section *Programmable protection functions* (page *176*). | 21 |
| | Reserved | | 21…25 |
| | Abs motor speed used | *01.61 Abs motor speed used* (page *328*). | 26 |
| | Abs motor speed % | *01.62 Abs motor speed %* (page *328*). | 27 |
| | Abs output frequency | *01.63 Abs output frequency* (page *328*). | 28 |
| | Reserved | | 29 |
| | Abs motor torque | *01.64 Abs motor torque* (page *328*). | 30 |
| | Abs output power | *01.65 Abs output power* (page *328*). | 31 |
| | Abs motor shaft power | *01.68 Abs motor shaft power* (page *328*). | 32 |
| | External PID1 out | *71.01 External PID act value* (page *514*). | 33 |
| | Reserved | | 34…36 |
| | AO1 data storage | *13.91 AO1 data storage* (page *370*). | 37 |
| | AO2 data storage | *13.92 AO2 data storage* (page *370*). | 38 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *13.13* | *AO1 forced value* | Forced value that can be used instead of the selected output signal. See parameter *13.02 AO force selection*. | 0.000 V |
| | 0.000…22.000 mA / 0.000…11.000 V | Forced value for AO1. | 1 = 1 unit |
| *13.15* | *AO1 unit selection* | Selects the unit for readings and settings related to analog input AO1. | *V* |
| | V | Volts. | 2 |
| | mA | Milliamperes. | 10 |
| *13.16* | *AO1 filter time* | Defines the filtering time constant for analog output AO1.  $$O = I \times (1 - e^{-t/T})$$ I = filter input (step)<br>O = filter output<br>*t* = time<br>T = filter time constant | 0.100 s |
| | 0.000 … 30.000 s | Filter time constant. | 1000 = 1 s |

**13**

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

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | | AO has automatic scaling. Every time the source for the AO is changed, the scaling range is changed accordingly. User given minimum and maximum values override the automatic values. | |

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

| | | | |
|---|---|---|---|
| | -32768.0…32767.0 | Real signal value corresponding to minimum AO1 output value. | 1 = 1 |
| *13.18* | *AO1 source max* | Defines the real maximum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the maximum required AO1 output value (defined by parameter *13.20 AO1 out at AO1 src max*). See parameter *13.17 AO1 source min*. | 50.0; 60.0 (*95.20* b0) |
| | -32768.0…32767.0 | Real signal value corresponding to maximum AO1 output value. | 1 = 1 |
| *13.19* | *AO1 out at AO1 src min* | Defines the minimum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*. | 0.000 V |
| | 0.000…22.000 mA / 0.000…11.000 V | Minimum AO1 output value. | 1000 = 1 unit |
| *13.20* | *AO1 out at AO1 src max* | Defines the maximum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*. | 10.000 V |
| | 0.000…22.000 mA / 0.000…11.000 V | Maximum AO1 output value. | 1000 = 1 unit |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *13.21* | *AO2 actual value* | Displays the value of AO2 in mA.<br>This parameter is read-only. | - |
| | 0.000 … 22.000 mA | Value of AO2. | 1000 = 1 mA |
| *13.22* | *AO2 source* | Selects a signal to be connected to analog output AO2.<br>Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.<br>For the selections, see parameter *13.12 AO1 source*. | *Motor current* |
| *13.23* | *AO2 forced value* | Forced value that can be used instead of the selected output signal. See parameter *13.02 AO force selection*. | 0.000 mA |
| | 0.000 … 22.000 mA | Forced value for AO2. | 1000 = 1 mA |
| *13.26* | *AO2 filter time* | Defines the filtering time constant for analog output AO2. See parameter *13.16 AO1 filter time*. | 0.100 s |
| | 0.000 … 30.000 s | Filter time constant. | 1000 = 1 s |
| *13.27* | *AO2 source min* | Defines the real minimum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the minimum required AO2 output value (defined by parameter *13.29 AO2 out at AO2 src min*). See parameter *13.17 AO1 source min* about the AO automatic scaling.<br><br><br><br>Programming *13.27* as the maximum value and *13.28* as the minimum value inverts the output.<br><br> | 0.0 |
| | -32768.0…32767.0 | Real signal value corresponding to minimum AO2 output value. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *13.28* | *AO2 source max* | Defines the real maximum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the maximum required AO2 output value (defined by parameter *13.30 AO2 out at AO2 src max*). See parameter *13.27 AO2 source min*. See parameter *13.17 AO1 source min* about the AO automatic scaling. | 30000.0 |
| | -32768.0…32767.0 | Real signal value corresponding to maximum AO2 output value. | 1 = 1 |
| *13.29* | *AO2 out at AO2 src min* | Defines the minimum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*. | 0.000 mA |
| | 0.000 … 22.000 mA | Minimum AO2 output value. | 1000 = 1 mA |
| *13.30* | *AO2 out at AO2 src max* | Defines the maximum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*. | 20.000 mA |
| | 0.000 … 22.000 mA | Maximum AO2 output value. | 1000 = 1 mA |
| *13.91* | *AO1 data storage* | Storage parameter for controlling analog output AO1, for example, through the embedded fieldbus interface. In parameter *13.12 AO1 source*, select *AO1 data storage*. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (*58.101…58.114*) to *AO1 data storage*. | 0.00 |
| | -327.68…327.67 | Storage parameter for AO1. | 100 = 1 |
| *13.92* | *AO2 data storage* | Storage parameter for controlling analog output AO2, for example, through the embedded fieldbus interface. In parameter *13.22 AO2 source*, select *AO2 data storage*. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (*58.101…58.114*) to *AO2 data storage*. | 0.00 |
| | -327.68…327.67 | Storage parameter for AO2. | 100 = 1 |
| **19 Operation mode** | | Selection of local and external control location sources and operating modes. See also section *Operating modes of the drive* (page *87*). | |
| *19.01* | *Actual operation mode* | Displays the operating mode currently used. See parameter *19.11*. This parameter is read-only. | - |
| | Zero | None. | 1 |
| | Speed | Speed control (in vector motor control mode). | 2 |
| | Reserved | | 3…9 |
| | Scalar (Hz) | Frequency control in scalar motor control mode (in scalar motor control mode). | 10 |
| | Forced magn. | Motor is in magnetizing mode. | 20 |
| *19.11* | *Ext1/Ext2 selection* | Selects the source for external control location EXT1/EXT2 selection. 0 = EXT1 1 = EXT2 | *EXT1* |
| | EXT1 | EXT1 (permanently selected). | 0 |
| | EXT2 | EXT2 (permanently selected). | 1 |
| | FBA A MCW bit 11 | Control word bit 11 received through fieldbus interface A. | 2 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 3 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 4 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 5 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 6 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 7 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 8 |
| | Reserved | | 9…18 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 21 |
| | Reserved | | 22…24 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 25 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 26 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 27 |
| | Reserved | | 28…31 |
| | EFB MCW bit 11 | Control word bit 11 received through the embedded fieldbus interface. | 32 |
| | FBA A connection loss | Detected communication loss of fieldbus interface A changes control mode to EXT2. | 33 |
| | EFB connection loss | Detected communication loss of embedded fieldbus interface changes control mode to EXT2. | 34 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| 19.18 | *HAND/OFF disable source* | Selects the source for Hand/Off disable.<br>1 = Hand and/or Off buttons are disabled on the panel and in Drive composer PC tool. Parameter *19.19 HAND/OFF disable action* specifies which buttons are disabled or enabled.<br>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* |
| | 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 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | 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]* | Source selection (see *Terms and abbreviations* on page *322*). | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *19.19* | *HAND/OFF disable action* | Selects which buttons are disabled on the panel and in the Drive composer PC tool when parameter *19.18 HAND/OFF disable source* is disabled. | *HAND* |
| | 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 |
| **20 Start/stop/direction** | | Start/stop/direction and run/start enable signal source selection; positive/negative reference enable signal source selection.<br>For information on control locations, see section *Local control vs. external control* (page *83*). | |
| *20.01* | *Ext1 commands* | Selects the source of start, stop and direction commands for external control location 1 (EXT1).<br>See parameter *20.21* for the determination of the actual direction See also parameters *20.02…20.05*. | *In1 Start* |
| | Not selected | No start or stop command sources selected. | 0 |
| | In1 Start | The source of the start and stop commands is selected by parameter *20.03 Ext1 in1 source*. The state transitions of the source bits are interpreted as follows:<br><br>| State of source 1 *(20.03)* | Command |<br>|---|---|<br>| 0 -> 1 *(20.02 = Edge)*<br>1 *(20.02 = Level)* | Start |<br>| 0 | Stop | | 1 |
| | In1 Start; In2 Dir | The source selected by *20.03 Ext1 in1 source* is the start signal; the source selected by *20.04 Ext1 in2 source* determines the direction. The state transitions of the source bits are interpreted as follows:<br><br>| State of source 1 *(20.03)* | State of source 2 *(20.04)* | Command |<br>|---|---|---|<br>| 0 | Any | Stop |<br>| 0 -> 1 *(20.02 = Edge)*<br>1 *(20.02 = Level)* | 0 | Start forward |<br>| | 1 | Start reverse | | 2 |
| | In1 Start fwd; In2 Start rev | The source selected by *20.03 Ext1 in1 source* is the forward start signal; the source selected by *20.04 Ext1 in2 source* is the reverse start signal. The state transitions of the source bits are interpreted as follows:<br><br>| State of source 1 *(20.03)* | State of source 2 *(20.04)* | Command |<br>|---|---|---|<br>| 0 | 0 | Stop |<br>| 0 -> 1 *(20.02 = Edge)*<br>1 *(20.02 = Level)* | 0 | Start forward |<br>| 0 | 0 -> 1 *(20.02 = Edge)*<br>1 *(20.02 = Level)* | Start reverse |<br>| 1 | 1 | Stop | | 3 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | In1P Start; In2 Stop | The sources of the start and stop commands are selected by parameters *20.03 Ext1 in1 source* and *20.04 Ext1 in2 source*. The state transitions of the source bits are interpreted as follows: | 4 |

| State of source 1 *(20.03)* | State of source 2 *(20.04)* | Command |
|---|---|---|
| 0 -> 1 | 1 | Start |
| Any | 0 | Stop |

**Notes:**
- Parameter *20.02 Ext1 start trigger type* **only** has an effect at startup of the drive with this setting. If the start input is ON and 20.02 = Level (1) when the drive starts up, the motor will restart. Parameter *20.02* has no effect at any other time.
- When source 2 is 0, the Start and Stop keys on the control panel are disabled.

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | In1P Start; In2 Stop; In3 Dir | The sources of the start and stop commands are selected by parameters *20.03 Ext1 in1 source* and *20.04 Ext1 in2 source*. The source selected by *20.05 Ext1 in3 source* determines the direction. The state transitions of the source bits are interpreted as follows: | 5 |

| State of source 1 *(20.03)* | State of source 2 *(20.04)* | State of source 3 *(20.05)* | Command |
|---|---|---|---|
| 0 -> 1 | 1 | 0 | Start forward |
| 0 -> 1 | 1 | 1 | Start reverse |
| Any | 0 | Any | Stop |

**Notes:**
- Parameter *20.02 Ext1 start trigger type* **only** has an effect at startup of the drive with this setting. If the start input is ON and 20.02 = Level (1) when the drive starts up, the motor will restart. Parameter *20.02* has no effect at any other time.
- When source 2 is 0, the Start and Stop keys on the control panel are disabled.

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | In1P Start fwd; In2P Start rev; In3 Stop | The sources of the start and stop commands are selected by parameters *20.03 Ext1 in1 source*, *20.04 Ext1 in2 source* and *20.05 Ext1 in3 source*. The source selected by *20.05 Ext1 in3 source* determines the stop. The state transitions of the source bits are interpreted as follows: | 6 |

| State of source 1 *(20.03)* | State of source 2 *(20.04)* | State of source 3 *(20.05)* | Command |
|---|---|---|---|
| 0 -> 1 | Any | 1 | Start forward |
| Any | 0 -> 1 | 1 | Start reverse |
| Any | Any | 0 | Stop |

**Note:** Parameter *20.02 Ext1 start trigger type* has no effect with this setting.

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Reserved | | |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | Control panel | The start and stop commands are taken from the control panel (or PC connected to the panel connector). | 11 |
| | Fieldbus A | The start and stop commands are taken from fieldbus adapter A. **Note:** Set also *20.02 Ext1 start trigger type* to *Level*. | 12 |
| | Reserved | | 13 |
| | Embedded fieldbus | The start and stop commands are taken from the embedded fieldbus interface. **Note:** Set also *20.02 Ext1 start trigger type* to *Level*. | 14 |
| *20.02* | *Ext1 start trigger type* | Defines whether the start signal for external control location EXT1 is edge-triggered or level-triggered. **Note:** If a pulse type start signal is selected, this parameter is **only** effective at drive startup. See the descriptions of the selections of parameter *20.01 Ext1 commands*. | *Level* |
| | Edge | The start signal is edge-triggered. | 0 |
| | Level | The start signal is level-triggered. | 1 |
| *20.03* | *Ext1 in1 source* | Selects source 1 for parameter *20.01 Ext1 commands*. | *DI1* |
| | Always off | 0. | 0 |
| | Always on | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Reserved | | 21…23 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 24 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 25 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 26 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *20.04* | *Ext1 in2 source* | Selects source 2 for parameter *20.01 Ext1 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*. | |
| *20.05* | *Ext1 in3 source* | Selects source 3 for parameter *20.01 Ext1 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*. | *Always off* |
| *20.06* | *Ext2 commands* | Selects the source of start, stop and direction commands for external control location 2 (EXT2). See parameter *20.21* for the determination of the actual direction. See also parameters *20.07*…. | *Not selected* |
| | Not selected | No start or stop command sources selected. | 0 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | In1 Start | The source of the start and stop commands is selected by parameter *20.08 Ext2 in1 source*. The state transitions of the source bits are interpreted as follows:<br><br>| State of source 1 *(20.08)* | Command |<br>|---|---|<br>| 0 -> 1 *(20.07 = Edge)* <br> 1 *(20.07 = Level)* | Start |<br>| 0 | Stop | | 1 |
| | In1 Start; In2 Dir | The source selected by *20.08 Ext2 in1 source* is the start signal; the source selected by *20.09 Ext2 in2 source* determines the direction. The state transitions of the source bits are interpreted as follows:<br><br>| State of source 1 *(20.08)* | State of source 2 *(20.09)* | Command |<br>|---|---|---|<br>| 0 | Any | Stop |<br>| 0 -> 1 *(20.07 = Edge)* <br> 1 *(20.07 = Level)* | 0 | Start forward |<br>| | 1 | Start reverse | | 2 |
| | In1 Start fwd; In2 Start rev | The source selected by *20.08 Ext2 in1 source* is the forward start signal; the source selected by *20.09 Ext2 in2 source* is the reverse start signal. The state transitions of the source bits are interpreted as follows:<br><br>| State of source 1 *(20.08)* | State of source 2 *(20.09)* | Command |<br>|---|---|---|<br>| 0 | 0 | Stop |<br>| 0 -> 1 *(20.07 = Edge)* <br> 1 *(20.07 = Level)* | 0 | Start forward |<br>| 0 | 0 -> 1 *(20.07 = Edge)* <br> 1 *(20.07 = Level)* | Start reverse |<br>| 1 | 1 | Stop | | 3 |
| | In1P Start; In2 Stop | The sources of the start and stop commands are selected by parameters *20.08 Ext2 in1 source* and *20.09 Ext2 in2 source*. The state transitions of the source bits are interpreted as follows:<br><br>| State of source 1 *(20.08)* | State of source 2 *(20.09)* | Command |<br>|---|---|---|<br>| 0 -> 1 | 1 | Start |<br>| Any | 0 | Stop |<br><br>**Notes:**<br>• Parameter *20.07 Ext2 start trigger type* **only** has an effect at startup of the drive with this setting. If the start input is ON and 20.02 = Level (1) when the drive starts up, the motor will restart. Parameter *20.07* has no effect at any other time.<br>• When source 2 is 0, the Start and Stop keys on the control panel are disabled. | 4 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | In1P Start; In2 Stop; 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 *20.10 Ext2 in3 source* determines the direction. The state transitions of the source bits are interpreted as follows: | 5 |

| State of source 1 *(20.08)* | State of source 2 *(20.09)* | State of source 3 *(20.10)* | Command |
|---|---|---|---|
| 0 -> 1 | 1 | 0 | Start forward |
| 0 -> 1 | 1 | 1 | Start reverse |
| Any | 0 | Any | Stop |

**Notes:**
- Parameter *20.07 Ext2 start trigger type* **only** has an effect at startup of the drive with this setting. If the start input is ON and 20.02 = Level (1) when the drive starts up, the motor will restart. Parameter *20.07* has no effect at any other time.
- When source 2 is 0, the Start and Stop keys on the control panel are disabled.

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | In1P Start fwd; In2P Start rev; In3 Stop | The sources of the start and stop commands are selected by parameters *20.08 Ext2 in1 source*, *20.09 Ext2 in2 source* and *20.10 Ext2 in3 source*. The source selected by *20.10 Ext2 in3 source* determines the direction. The state transitions of the source bits are interpreted as follows: | 6 |

| State of source 1 *(20.08)* | State of source 2 *(20.09)* | State of source 3 *(20.10)* | Command |
|---|---|---|---|
| 0 -> 1 | Any | 1 | Start forward |
| Any | 0 -> 1 | 1 | Start reverse |
| Any | Any | 0 | Stop |

**Note:** Parameter *20.07 Ext2 start trigger type* has no effect with this setting.

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | Reserved | | 7…10 |
| | Control panel | The start and stop commands are taken from the control panel (or PC connected to the panel connector). | 11 |
| | Fieldbus A | The start and stop commands are taken from fieldbus adapter A. **Note:** Set also *20.07 Ext2 start trigger type* to *Level*. | 12 |
| | Reserved | | 13 |
| | Embedded fieldbus | The start and stop commands are taken from the embedded fieldbus interface. **Note:** Set also *20.07 Ext2 start trigger type* to *Level*. | 14 |
| *20.07* | *Ext2 start trigger type* | Defines whether the start signal for external control location EXT2 is edge-triggered or level-triggered. **Note:** If a pulse type start signal is selected, this parameter is **only** effective at drive startup. See the descriptions of the selections of parameter *20.06 Ext2 commands*. | *Level* |
| | Edge | The start signal is edge-triggered. | 0 |
| | Level | The start signal is level-triggered. | 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *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*. | *Always off* |
| *20.09* | *Ext2 in2 source* | Selects source 2 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*. | *Always off* |
| *20.10* | *Ext2 in3 source* | Selects source 3 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*. | *Always off* |
| *20.21* | *Direction* | Reference direction lock. Defines the direction of the drive rather than the sign of the reference, except in some cases. In the table the actual drive rotation is shown as a function of parameter *20.21 Direction* and Direction command (from parameter *20.01 Ext1 commands* or *20.06 Ext2 commands*). | *Forward* |

|  | Direction command = Forward | Direction command = Reverse | Direction command not defined |
|---|---|---|---|
| Par. *20.21 Direction* = *Forward* | Forward | Forward | Forward |
| Par. *20.21 Direction* = *Reverse* | Reverse | Reverse | Reverse |
| Par. *20.21 Direction* = *Request* | Forward, but<br>• If reference from Constant, Floating point control (Motor potentiometer), PID, Safe speed, Last or Panel reference, reference used as is.<br>• If reference from the network, reference used as is. | Reverse, but<br>• If reference from Constant or PID, reference used as is.<br>• If reference from the network, Panel, Analog input, Floating point control (Motor potentiometer), Safe speed or Last reference, reference multiplied by -1. | Forward |

| | | | |
|---|---|---|---|
| | Request | In external control the direction is selected by a direction command (parameter *20.01 Ext1 commands* or *20.06 Ext2 commands*). If the reference comes from Constant (constant speeds/frequencies), Floating point control (Motor potentiometer), PID, Speed ref safe, Last speed reference or Panel reference, the reference is used as is. If the reference comes from a fieldbus:<br>• if the direction command is forward, the reference is used as is<br>• if the direction command is reverse, the reference is multiplied by -1. | 0 |
| | Forward | Motor rotates forward regardless of the sign of the external reference. (Negative reference values are replaced by zero. Positive reference values are used as is.) | 1 |
| | 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 |

**13**
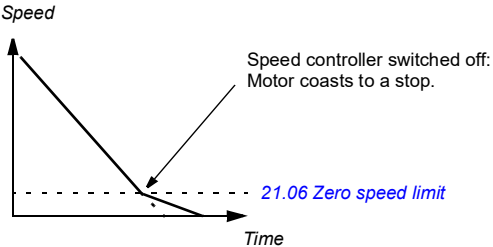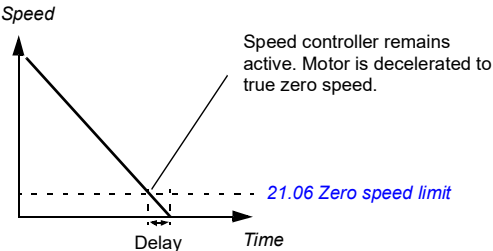
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *20.40* | *Run permissive* | Selects the source of the Run permissive signal.<br>Value 0 of the source deactivates the Run permissive and prevents running.<br>Value 1 of the source activates the Run permissive and permits running. | *Not used* |
| | Not used | 0. | 0 |
| | Not used | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | -DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 8 |
| | -DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 9 |
| | -DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 10 |
| | -DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 11 |
| | -DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 12 |
| | -DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 13 |
| | Fieldbus adapter | Control word bit 3 received through the fieldbus interface. | 14 |
| | Embedded fieldbus | ABB Drives profile: Control word bit 3 received through the embedded fieldbus interface<br>DCU profile: Inverse of control word bit 6 received through the embedded fieldbus interface. | 15 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *20.41* | *Start interlock 1* | Selects the source of the Start interlock 1 signal.<br>Value 0 of the source deactivates the Start interlock 1 signal and inhibits starting.<br>Value 1 of the source activates the Start interlock 1 signal and allows starting. | *DI4* |
| | Not used | 0. | 0 |
| | Not used | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | -DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 8 |
| | -DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 9 |
| | -DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 10 |
| | -DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 11 |
| | -DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 12 |
| | -DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 13 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Fieldbus adapter | This selection cannot be used to control Start interlock with ABB drives profile from the fieldbus adapter. Use *Other [bit]* and map to control word user bits.<br>This selection is only available for *20.41 Start interlock 1* and *20.42 Start interlock 2*. | 14 |
| | Embedded fieldbus | Start interlock 1: DCU profile: Inverse of control word bit 18 received through the embedded fieldbus interface.<br>Start interlock 2: Inverse of bit 19.<br>This selection is only available for *20.41 Start interlock 1* and *20.42 Start interlock 2* | 15 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *20.42* | *Start interlock 2* | Selects the source of the Start interlock 2 signal.<br>For the selections, see parameter *20.41 Start interlock 1*. | *Not used* |
| *20.43* | *Start interlock 3* | Selects the source of the Start interlock 3 signal.<br>Start interlock 3 is not supported over the Fieldbus adapter or Embedded fieldbus.<br>For the other selections than 14 and 15, see parameter *20.41 Start interlock 1*. | *Not used* |
| *20.44* | *Start interlock 4* | Selects the source of the Start interlock 4 signal.<br>Start interlock 4 is not supported over the Fieldbus adapter or Embedded fieldbus.<br>For the other selections than 14 and 15, see parameter *20.41 Start interlock 1*. | *Not used* |
| *20.45* | *Start interlock stop mode* | Follows motor stop mode selection, see parameter *21.03 Stop mode*. | *Not used* |
| | Not used | Not in use. | 0 |
| | Coast | The motor coasts to a stop. | 1 |
| | Ramp | Stop along the active deceleration ramp. | 2 |
| *20.46* | *Run permissive text* | Alternative alarm texts for the run permissive.<br>There is also label text (free text) for the run permissive. The panel display will display the text when the run permissive becomes unsatisfied. You edit the label text in **Menu > Primary settings > Start, stop, reference > Interlocks/Permissives > Label text**. | *Run permissive* |
| | Run permissive | | 0 |
| | Damper end switch | | 1 |
| | Valve opening | | 2 |
| | Pre-lube cycle | | 3 |
| *20.47* | *Start interlock 1 text* | Alternative alarm texts for the start interlock 1.<br>There is also label text (free text) for each start interlock. The panel display will display that specific text when the interlock becomes unsatisfied. You edit the label text in **Menu > Primary settings > Start, stop, reference > Interlocks/Permissives > Label text**. | *Start interlock 1* |
| | Start interlock 1 | | 0 |
| | Vibration switch | | 1 |
| | Firestat | | 2 |
| | Freezestat | | 3 |
| | Overpressure | | 4 |
| | Vibration trip | | 5 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Smoke alarm | | 6 |
| | Auxiliary open | | 7 |
| | Low suction | | 8 |
| | Low pressure | | 9 |
| | Access door | | 10 |
| | Pressure relief | | 11 |
| | Motor disconnect open | | 12 |
| *20.48* | *Start interlock 2 text* | Alternative alarm texts for the start interlock 2. See parameter *20.47 Start interlock 1 text*. | *Start interlock 2* |
| | Start interlock 2 | For other selections, see parameter *20.47 Start interlock 1 text*. | 0 |
| *20.49* | *Start interlock 3 text* | Alternative alarm texts for the start interlock 3. See parameter *20.47 Start interlock 1 text*. | *Start interlock 3* |
| | Start interlock 3 | For other selections, see parameter *20.47 Start interlock 1 text*. | 0 |
| *20.50* | *Start interlock 4 text* | Alternative alarm texts for the start interlock 4. See parameter *20.47 Start interlock 1 text*. | *Start interlock 4* |
| | Start interlock 4 | For other selections, see parameter *20.47 Start interlock 1 text*. | 0 |
| *20.51* | *Start interlock condition* | Selects the condition for start interlock function.<br>This parameter determines if the start command is needed before start interlock warnings are displayed. | *Start command ignored* |
| | Start command ignored | Start interlock warnings are displayed if the interlocks are missing. | 0 |
| | Start command required | Start command must be present before the start interlock warnings are displayed if the interlocks are missing. | 1 |
| **21 Start/stop mode** | | Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings. | |
| *21.01* | *Start mode* | Selects the motor start function for the vector motor control mode, ie, when *99.04 Motor control mode* is set to *Vector*.<br>**Notes**:<br>• The start function for the scalar motor control mode is selected by parameter *21.19 Scalar start mode*.<br>• Starting into a rotating motor is not possible when DC magnetizing is selected (*Fast* or *Const time*).<br>• With permanent magnet motors, *Automatic* start mode must be used.<br>• This parameter cannot be changed while the drive is running.<br>See also section *Start methods – DC magnetization* (page *123*). | *Automatic* |
| | Fast | The drive pre-magnetizes the motor before start. The pre-magnetizing time is determined automatically, being typically 200 ms to 2 s depending on motor size. This mode should be selected if a high break-away torque is required. | 0 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 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.<br>⚠ **WARNING!** The drive will start after the set magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque. | 1 |
| | Automatic | Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting into a rotating motor) and the automatic restart function. The drive motor control program identifies the flux as well as the mechanical state of the motor and starts the motor instantly under all conditions.<br>**Note:** If parameter *99.04 Motor control mode* is set to *Scalar*, no flying start or automatic restart is possible unless parameter *21.19 Scalar start mode* is set to *Automatic*. | 2 |
| *21.02* | *Magnetization time* | Defines the pre-magnetization time when<br>• parameter *21.01 Start mode* is set to *Const time* (in vector motor control mode), or<br>• parameter *21.19 Scalar start mode* is set to *Const time* (in scalar motor control mode).<br>After the start command, the drive automatically premagnetizes the motor for the set time. To ensure full magnetizing, set this parameter to the same value as, or higher than, the rotor time constant. If not known, use the rule-of-thumb value given in the table below: | 500 ms |

| 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 |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | | **Note:** This parameter cannot be changed while the drive is running. | |
| | 0…10000 ms | Constant DC magnetizing time. | 1 = 1 ms |
| *21.03* | *Stop mode* | Selects the way the motor is stopped when a stop command is received.<br>Additional braking is possible by selecting flux braking (see parameter *97.05 Flux braking*). | *Coast* |
| | Coast | Stop by switching off the output semiconductors of the drive. The motor coasts to a stop.<br>⚠ **WARNING!** If a mechanical brake is used, ensure it is safe to stop the drive by coasting. | 0 |
| | Ramp | Stop along the active deceleration ramp. See parameter group *23 Speed reference ramp* on page *397* or *28 Frequency reference chain* on page *405*. | 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Torque limit | Stop according to torque limits (parameters *30.19* and *30.20*). This mode is only possible in vector motor control mode. | 2 |
| *21.04* | *Emergency stop mode* | Selects the way the motor is stopped when an emergency stop command is received.<br>The source of the emergency stop signal is selected by parameter *21.05 Emergency stop source*. | *Ramp stop (Off1)* |
| | Ramp stop (Off1) | With the drive running:<br>• 1 = Normal operation.<br>• 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.<br>With the drive stopped:<br>• 1 = Starting allowed.<br>• 0 = Starting not allowed. | 0 |
| | Coast stop (Off2) | With the drive running:<br>• 1 = Normal operation.<br>• 0 = Stop by coasting. The drive can be restarted by restoring the start interlock signal and switching the start signal from 0 to 1.<br>With the drive stopped:<br>• 1 = Starting allowed.<br>• 0 = Starting not allowed. | 1 |
| | Eme ramp stop (Off3) | With the drive running:<br>• 1 = Normal operation<br>• 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.<br>With the drive stopped:<br>• 1 = Starting allowed<br>• 0 = Starting not allowed | 2 |
| *21.05* | *Emergency stop source* | Selects the source of the emergency stop signal. The stop mode is selected by parameter *21.04 Emergency stop mode*.<br>0 = Emergency stop active<br>1 = Normal operation<br>**Note:** This parameter cannot be changed while the drive is running. | *Inactive (true)* |
| | Active (false) | 0. | 0 |
| | Inactive (true) | 1. | 1 |
| | Reserved | | 2 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 3 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 4 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 5 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 6 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 7 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 8 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *21.06* | *Zero speed limit* | Defines the zero speed limit. The motor is stopped along a speed ramp (when ramped stop is selected or emergency stop time is used) until the defined zero speed limit is reached. After the zero speed delay, the motor coasts to a stop. | 30.00 rpm |
| | 0.00…30000.00 rpm | Zero speed limit. | See par. *46.01* |
| *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.<br><br>Without zero speed delay:<br>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.<br><br>*Speed*<br><br>Speed controller switched off: Motor coasts to a stop.<br><br>*21.06 Zero speed limit*<br><br>*Time*<br><br>With zero speed delay:<br>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.<br><br>*Speed*<br><br>Speed controller remains active. Motor is decelerated to true zero speed.<br><br>*21.06 Zero speed limit*<br><br>Delay *Time* | 0 ms |
| | 0…30000 ms | Zero speed delay. | 1 = 1 ms |

**13**
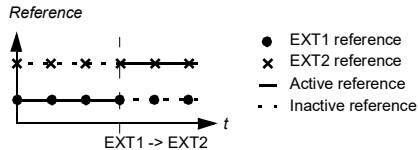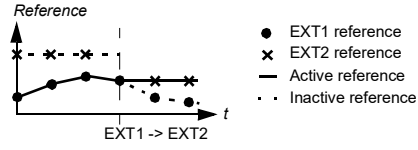
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *21.08* | *DC current control* | Activates/deactivates the DC hold and post-magnetization functions. See section *Start methods – DC magnetization* (page *123*).<br>**Note:** DC magnetization causes the motor to heat up. In applications where long DC magnetization times are required, externally ventilated motors should be used. If the DC magnetization period is long, DC magnetization cannot prevent the motor shaft from rotating if a constant load is applied to the motor. | 0000b |

| Bit | Name | Value |
|---|---|---|
| 0 | DC hold | 1 = Enable DC hold. See section *DC hold* (page *124*).<br>**Note:** The DC hold function has no effect if the start signal is switched off. |
| 1 | Post magneti zation | 1 = Enable post-magnetization. See section *Settings* (page *125*).<br>**Note:** Post-magnetization is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*). |
| 2…15 | Reserved | |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000b…0011b | DC magnetization selection. | 1 = 1 |
| *21.09* | *DC hold speed* | Defines the DC hold speed in speed control mode. See parameter *21.08 DC current control*, and section *DC hold* (page *124*). | 5.00 rpm |
| | 0.00…1000.00 rpm | DC hold speed. | See par. *46.01* |
| *21.10* | *DC current reference* | Defines the DC hold current in percent of the motor nominal current. See parameter *21.08 DC current control*, and section *Start methods – DC magnetization* (page *123*).<br>After 100 s post-magnetization time, the maximum magnetization current is limited to the magnetization current corresponding to the actual flux reference. | 30.0% |
| | 0.0…100.0% | DC hold current. | 1 = 1% |
| *21.11* | *Post magnetization time* | Defines the length of time for which post-magnetization is active after stopping the motor. The magnetization current is defined by parameter *21.10 DC current reference*.<br>See parameter *21.08 DC current control*. | 0 s |
| | 0…3000 s | Post-magnetization time. | 1 = 1 s |
| *21.14* | *Pre-heating input source* | Selects the source for controlling pre-heating for the motor. The status of the pre-heating is shown as bit 2 of *06.21 Drive status word 3*.<br>**Notes:**<br>• The heating function requires that STO is not triggered.<br>• The heating function requires that the drive is not faulted. | *Off* |
| | Off | 0. Pre-heating is always deactivated. | 0 |
| | On | 1. Pre-heating is always activated when the drive is stopped. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 8 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 9 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 10 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 11 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 12 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 13 |
| | MCW user bit 0 | Bit 12 of *06.01 Main control word* (see page *333*). | 16 |
| | MCW user bit 1 | Bit 13 of *06.01 Main control word* (see page *333*). | 17 |
| | MCW user bit 2 | Bit 14 of *06.01 Main control word* (see page *333*). | 18 |
| | MCW user bit 3 | Bit 15 of *06.01 Main control word* (see page *333*). | 19 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *21.15* | *Pre-heating time delay* | Time delay before pre-heating starts after the drive is stopped. | 60 s |
| | 10…3000 s | Pre-heating time delay. | 1 = 1 s |
| *21.16* | *Pre-heating current* | Defines the DC current used to heat the motor. The value is in percent of the nominal motor current. | 0.0% |
| | 0.0…30.0% | Pre-heating current. | 1 = 1% |
| *21.18* | *Auto restart time* | The motor can be automatically started after a short supply power failure using the automatic restart function. See section *Automatic restart* (page *136*).<br>When this parameter is set to 0.0 seconds, automatic restarting is disabled. Otherwise, the parameter defines the maximum duration of the power failure after which restarting is attempted. Note that this time also includes the DC precharging delay. See also parameter *21.34 Force auto restart*.<br>This parameter has effect only if parameter *95.04 Control board supply* is set to *External 24V*.<br>⚠ **WARNING!** Before you activate the function, make sure that no dangerous situations can occur. The function restarts the drive automatically and continues operation after a supply break. | 10.0 s |
| | 0.0 s | Automatic restarting disabled. | 0 |
| | 0.1…10.0 s | Maximum power failure duration. | 1 = 1 s |
| *21.19* | *Scalar start mode* | Selects the motor start function for the scalar motor control mode, ie, when *99.04 Motor control mode* is set to *Scalar*.<br>**Notes**:<br>• The start function for the vector motor control mode is selected by parameter *21.01 Start mode*.<br>• With permanent magnet motors, *Automatic* start mode must be used.<br>• This parameter cannot be changed while the drive is running.<br>See also section *Start methods – DC magnetization* (page *123*). | *Automatic* |
| | Normal | Immediate start from zero speed. | 0 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | 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.<br>**Note:** This mode cannot be used to start into a rotating motor.<br>⚠ **WARNING!** The drive will start after the set pre-magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque. | 1 |
| | Automatic | The drive automatically selects the correct output frequency to start a rotating motor. This is useful for flying starts: if the motor is already rotating, the drive will start smoothly at the current frequency.<br>**Note:** Cannot be used in multimotor systems. | 2 |
| | Torque boost | The drive pre-magnetizes the motor before the start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*.<br>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*.<br>This mode should selected if a high break-away torque is required.<br>**Note:** This mode cannot be used to start into a rotating motor.<br>⚠ **WARNING!** The drive will start after the set pre-magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque. | 3 |
| | Automatic+boost | Automatic start with torque boost.<br>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.<br>Compared to the Automatic start mode, Flying start detects the motor speed faster. Flying start requires more accurate information about motor model. Therefore standstill ID run is done automatically when the drive is started for the first time after selecting Flying start. Motor plate values should be accurate. Wrong plate values may decrease the starting performance | 5 |
| | Flying start+boost | Flying start with torque boost.<br>Flying start is performed first and the motor is magnetized. If the speed is found to be zero, torque boost is applied. | 6 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *21.21* | *DC hold frequency* | Defines the DC hold frequency, which is used instead of parameter *21.09 DC hold speed* when the motor is in scalar frequency mode. See parameter *21.08 DC current control*, and section *DC hold* (page *124*). | 5.00 Hz |
| | 0.00…1000.00 Hz | DC hold frequency. | 1 = 1 Hz |
| *21.22* | *Start delay* | Defines the start delay. After the conditions for start have been fulfilled, the drive waits until the delay has elapsed and then starts the motor. During the delay, warning *AFE9 Start delay* is shown.<br>Start delay can be used with all start modes. | 0.00 s |
| | 0.00…60.00 s | Start delay | 1 = 1 s |
| *21.23* | *Smooth start* | Selects the forced current vector rotation mode at low speeds. When the smooth start mode is selected, the rate of acceleration is limited by the acceleration and deceleration ramp times. If the process driven by the permanent magnet synchronous motor has high inertia, slow ramp times are recommended.<br>Can be used for permanent magnet synchronous motors only. | *Disabled* |
| | Disabled | Disabled. | 0 |
| | Enabled always | Enabled always. | 1 |
| | Start only | Enabled when starting the motor. | 2 |
| *21.24* | *Smooth start current* | Current used in the current vector rotation at low speeds. Increase the smooth start current if the application requires motor shaft swinging needs to be minimized. Note that accurate torque control is not possible in the current vector rotation mode.<br>Can be used for permanent magnet synchronous motors only. | 50.0% |
| | 10.0…100.0% | Value in percent of the nominal motor current. | 1 = 1% |
| *21.25* | *Smooth start speed* | Output frequency up to which the current vector rotation is used. See parameter *21.19 Scalar start mode*.<br>Can be used for permanent magnet synchronous motors only. | 10.0% |
| | 2.0…100.0% | Value as a percentage of the nominal motor frequency. | 1 = 1% |
| *21.26* | *Torque boost current* | Defines the maximum supplied current to motor when (*21.19 Scalar start mode* is set to *Torque boost* (see page *386*).<br>Parameter value is in percent of the motor nominal current. Nominal value of the parameter is 100.0%.<br>Torque boost is only applied at start, ending when output frequency exceeds 40% of nominal frequency or when output frequency is equal to reference.<br>Can be used in scalar mode only. | 100.0% |
| | 15.0…300.0% | Value in percent of the nominal motor current. | 1 = 1% |
| *21.30* | *Speed compensated stop mode* | Selects the method used to stop the drive.<br>Speed compensated stop is active only if<br>• the operation mode is not torque, and<br>  • parameter *21.03 Stop mode* is *Ramp*. | *Off* |
| | Off | Stop according parameter *21.03 Stop mode*, no speed compensated stop. | 0 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Speed comp FWD | If the direction of rotation is forward, speed compensation is used for constant distance braking. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp. If the direction of rotation is reverse, the drive is stopped along a ramp. | 1 |
| | Speed comp REV | If the direction of rotation is reverse, speed compensation is used for constant distance braking. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp. If the direction of rotation is forward, the drive is stopped along a ramp. | 2 |
| | Speed comp bipolar | Regardless of the direction of rotation, speed compensation is used for constant distance braking. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp. | 3 |
| *21.31* | *Speed comp stop delay* | This delay adds distance to the total distance traveled during a stop from maximum speed. It is used to adjust the distance to match requirements so that the distance traveled is not solely determined by the deceleration rate. | 0.00 s |
| | 0.00…1000.00 s | Speed delay. | 1 = 1 s |
| *21.32* | *Speed comp stop threshold* | This parameter sets a speed threshold below which the Speed compensated stop feature is disabled. In this speed region, the speed compensated stop is not attempted and the drive stops as it would, using the ramp option. | 10% |
| | 0…100% | Speed threshold as a percent of the motor nominal speed. | 1 = 1% |
| *21.34* | *Force auto restart* | Forces automatic restart. The parameter is applicable only if parameter *95.04 Control board supply* is set to *External 24V*. | *Enable* |
| | Disable | Force auto restart disabled. Parameter *21.18 Auto restart time* is in effect if its value is more than 0.0 s. | 0 |
| | Enable | Force auto restart enabled. Parameter *21.18 Auto restart time* is ignored. The drive never trips on the undervoltage fault and the start signal is on forever. When he DC voltage is restored, the normal operation continues. | 1 |
| *22 Speed reference selection* | | Speed reference selection; Floating point control (Motor potentiometer) settings. See control chain diagrams *Speed reference source selection I* (page *306*)…*Speed controller* (page *311*). | |
| *22.01* | *Speed ref unlimited* | Displays the output of the speed reference selection block. See control chain diagram *Speed reference source selection II* on page *307*. This parameter is read-only. | - |
| | -30000.00…30000.00 rpm | Value of the selected speed reference. | See par. *46.01* |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| 22.11 | *Ext1 speed ref1* | Selects EXT1 speed reference source 1.<br>Two signal sources can be defined by this parameter and *22.12 Ext1 speed ref2*. A mathematical function (*22.13 Ext1 speed function*) applied to the two signals creates an EXT1 reference (A in the figure below).<br>A digital source selected by *19.11 Ext1/Ext2 selection* can be used to switch between EXT1 reference and the corresponding EXT2 reference defined by parameter *22.18 Ext2 speed ref1*, *22.19  Ext2 speed ref2* and *22.20 Ext2 speed function* (B in the figure below). | *AI1 scaled* |
| | Zero | None. | 0 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 1 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 2 |
| | Reserved | | 3 |
| | FB A ref1 | *03.05 FB A reference 1* (see page *328*). | 4 |
| | FB A ref2 | *03.06 FB A reference 2* (see page *329*). | 5 |
| | Reserved | | 6…7 |
| | EFB ref1 | *03.09 EFB reference 1* (see page *329*). | 8 |
| | EFB ref2 | *03.10 EFB reference 2* (see page *329*). | 9 |
| | Reserved | | 10…14 |
| | Motor potentiometer | *22.80 Motor potentiometer ref act* (output of the Motor potentiometer)). | 15 |
| | PID | *40.01 Process PID output actual* (output of the process PID controller). | 16 |
| | Frequency input | *11.38 Freq in 1 actual value* (when DI5 is used as a frequency input). | 17 |
| | Control panel (ref saved) | Panel reference (*03.01 Panel reference*, see page *328*) saved by the control system for the location where the control returns is used as the reference.<br><br>*Reference*<br><br>● EXT1 reference<br>✕ EXT2 reference<br>— Active reference<br>⋯ Inactive reference<br><br>EXT1 -> EXT2 | 18 |
| | Control panel (ref copied) | Panel reference (*03.01 Panel reference*, see page *328*) 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.<br><br>*Reference*<br><br>● EXT1 reference<br>✕ EXT2 reference<br>— Active reference<br>⋯ Inactive reference<br><br>EXT1 -> EXT2 | 19 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *22.12* | *Ext1 speed ref2* | Selects EXT1 speed reference source 2.<br>For the selections, and a diagram of reference source selection, see parameter *22.11 Ext1 speed ref1*. | *Zero* |
| *22.13* | *Ext1 speed function* | Selects a mathematical function between the reference sources selected by parameters *22.11 Ext1 speed ref1* and *22.12 Ext1 speed ref2*. See diagram at *22.11 Ext1 speed ref1*. | *Ref1* |
| | Ref1 | Signal selected by *22.11 Ext1 speed ref1* is used as speed reference 1 as such (no function applied). | 0 |
| | Add (ref1 + ref2) | The sum of the reference sources is used as speed reference 1. | 1 |
| | Sub (ref1 - ref2) | The subtraction ([*22.11 Ext1 speed ref1*] - [*22.12 Ext1 speed ref2*]) of the reference sources is used as speed reference 1. | 2 |
| | Mul (ref1 × ref2) | The multiplication of the reference sources is used as speed reference 1. | 3 |
| | Min (ref1, ref2) | The smaller of the reference sources is used as speed reference 1. | 4 |
| | Max (ref1, ref2) | The greater of the reference sources is used as speed reference 1. | 5 |
| *22.18* | *Ext2 speed ref1* | Selects EXT2 speed reference source 1.<br>Two signal sources can be defined by this parameter and *22.19 Ext2 speed ref2*. A mathematical function (*22.20 Ext2 speed function*) applied to the two signals creates an EXT2 reference. See diagram at *28.11 Ext1 frequency ref1*. | *Zero* |
| | Zero | None. | 0 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 1 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 2 |
| | Reserved | | 3 |
| | FB A ref1 | *03.05 FB A reference 1* (see page *328*). | 4 |
| | FB A ref2 | *03.06 FB A reference 2* (see page *329*). | 5 |
| | Reserved | | 6…7 |
| | EFB ref1 | *03.09 EFB reference 1* (see page *329*). | 8 |
| | EFB ref2 | *03.10 EFB reference 2* (see page *329*). | 9 |
| | Reserved | | 10…14 |
| | Motor potentiometer | *22.80 Motor potentiometer ref act* (output of the Floating point control (Motor potentiometer)). | 15 |
| | PID | *40.01 Process PID output actual* (output of the process PID controller). | 16 |
| | Frequency input | *11.38 Freq in 1 actual value* (when DI5 is used as a frequency input). | 17 |
| | Control panel (ref saved) | Panel reference (*03.01 Panel reference*, see page *328*) saved by the control system for the location where the control returns is used as the reference.<br><br> | 18 |

13

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Control panel (ref copied) | Panel reference (*03.01 Panel reference*, see page *328*) 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.<br><br>*Reference*<br><br>● EXT1 reference<br>× EXT2 reference<br>— Active reference<br>· · Inactive reference<br><br>EXT1 -> EXT2 | 19 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *22.19* | *Ext2 speed ref2* | Selects EXT2 speed reference source 2.<br>For the selections, and a diagram of reference source selection, see parameter *22.18 Ext2 speed ref1*. | *Zero* |
| *22.20* | *Ext2 speed function* | Selects a mathematical function between the reference sources selected by parameters *22.18 Ext2 speed ref1* and *22.19 Ext2 speed ref2*. See diagram at *22.18 Ext2 speed ref1*. | *Ref1* |
| | Ref1 | Signal selected by *Ext2 speed ref1* is used as speed reference 1 as such (no function applied). | 0 |
| | Add (ref1 + ref2) | The sum of the reference sources is used as speed reference 1. | 1 |
| | Sub (ref1 - ref2) | The subtraction ([*22.11 Ext1 speed ref1*] - [*22.12 Ext1 speed ref2*]) of the reference sources is used as speed reference 1. | 2 |
| | Mul (ref1 × ref2) | The multiplication of the reference sources is used as speed reference 1. | 3 |
| | 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 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|-----------|
| *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. | 0000b |

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

| | 0000h…FFFFh | Constant speed configuration word. | 1 = 1 |
|--|--|--|--|
| *22.22* | *Constant speed sel1* | When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 1. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.23 Constant speed sel2* and *22.24 Constant speed sel3* select three sources whose states activate constant speeds as follows: | *DI3* |

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

| | Always off | 0. | 0 |
|--|-----------|----|---|
| | Always on | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Reserved | | 21…23 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 24 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 25 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 26 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *22.23* | *Constant speed sel2* | When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 2. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.24 Constant speed sel3* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*. | *Always off* |
| *22.24* | *Constant speed sel3* | When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 3. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.23 Constant speed sel2* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*. | *Always off* |
| *22.26* | *Constant speed 1* | Defines constant speed 1 (the speed the motor will turn when constant speed 1 is selected). | 300.00 rpm; 360.00 rpm (*95.20* b0) |
| | -30000.00… 30000.00 rpm | Constant speed 1. | See par. *46.01* |
| *22.27* | *Constant speed 2* | Defines constant speed 2. | 600.00 rpm; 720.00 rpm (*95.20* b0) |
| | -30000.00… 30000.00 rpm | Constant speed 2. | See par. *46.01* |
| *22.28* | *Constant speed 3* | Defines constant speed 3. | 900.00 rpm; 1080.00 rpm (*95.20* b0) |
| | -30000.00… 30000.00 rpm | Constant speed 3. | See par. *46.01* |
| *22.29* | *Constant speed 4* | Defines constant speed 4. | 1200.00 rpm; 1440.00 rpm (*95.20* b0) |
| | -30000.00… 30000.00 rpm | Constant speed 4. | See par. *46.01* |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *22.30* | *Constant speed 5* | Defines constant speed 5. | 1500.00 rpm; 1800.00 rpm (*95.20* b0) |
| | -30000.00… 30000.00 rpm | Constant speed 5. | See par. *46.01* |
| *22.31* | *Constant speed 6* | Defines constant speed 6. | 2400.00 rpm; 2880.00 rpm (*95.20* b0) |
| | -30000.00… 30000.00 rpm | Constant speed 6. | See par. *46.01* |
| *22.32* | *Constant speed 7* | Defines constant speed 7. | 3000.00 rpm; 3600.00 rpm (*95.20* b0) |
| | -30000.00… 30000.00 rpm | Constant speed 7. | See par. *46.01* |
| *22.41* | *Speed ref safe* | Defines a safe speed reference value that is used with supervision functions such as<br>• *12.03 AI supervision function*<br>• *49.05 Communication loss action*<br>• *50.02 FBA A comm loss func*. | 0.00 rpm |
| | -30000.00… 30000.00 rpm | Safe speed reference. | See par. *46.01* |
| *22.51* | *Critical speed function* | Enables/disables the critical speeds function. Also determines whether the specified ranges are effective in both rotating directions or not.<br>See also section *Critical speeds/frequencies* (page *117*). | 0000b |

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

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000b…0011b | Critical speeds configuration word. | 1 = 1 |
| *22.52* | *Critical speed 1 low* | Defines the low limit for critical speed range 1.<br>**Note:** This value must be less than or equal to the value of *22.53 Critical speed 1 high*. | 0.00 rpm |
| | -30000.00… 30000.00 rpm | Low limit for critical speed 1. | See par. *46.01* |
| *22.53* | *Critical speed 1 high* | Defines the high limit for critical speed range 1.<br>**Note:** This value must be greater than or equal to the value of *22.52 Critical speed 1 low*. | 0.00 rpm |
| | -30000.00… 30000.00 rpm | High limit for critical speed 1. | See par. *46.01* |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *22.54* | *Critical speed 2 low* | Defines the low limit for critical speed range 2.<br>**Note:** This value must be less than or equal to the value of *22.55 Critical speed 2 high*. | 0.00 rpm |
| | -30000.00…<br>30000.00 rpm | Low limit for critical speed 2. | See par.<br>*46.01* |
| *22.55* | *Critical speed 2 high* | Defines the high limit for critical speed range 2.<br>**Note:** This value must be greater than or equal to the value of *22.54 Critical speed 2 low*. | 0.00 rpm |
| | -30000.00…<br>30000.00 rpm | High limit for critical speed 2. | See par.<br>*46.01* |
| *22.56* | *Critical speed 3 low* | Defines the low limit for critical speed range 3.<br>**Note:** This value must be less than or equal to the value of *22.57 Critical speed 3 high*. | 0.00 rpm |
| | -30000.00…<br>30000.00 rpm | Low limit for critical speed 3. | See par.<br>*46.01* |
| *22.57* | *Critical speed 3 high* | Defines the high limit for critical speed range 3.<br>**Note:** This value must be greater than or equal to the value of *22.56 Critical speed 3 low*. | 0.00 rpm |
| | -30000.00…<br>30000.00 rpm | High limit for critical speed 3. | See par.<br>*46.01* |
| *22.71* | *Motor potentiometer function* | Activates and selects the mode of the Floating point control (Motor potentiometer). | *Disabled* |
| | Disabled | Floating point control (Motor potentiometer) is disabled and the Floating point control (Motor potentiometer) counter value set to 0. | 0 |
| | Enabled (init at stop /power-up) | When enabled, the Floating point control (Motor potentiometer) counter first adopts the value defined by parameter *22.72 Motor potentiometer initial value*. The value can then be adjusted from the up and down sources defined by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*.<br>A stop or a power cycle will reset the counter to the initial value (*22.72*). | 1 |
| | Enabled (resume always) | As *Enabled (init at stop /power-up)*, but the Floating point control (Motor potentiometer) counter is retained over a power cycle. | 2 |
| | Enabled (init to actual) | Whenever another reference source is selected, the value of the Floating point control (Motor potentiometer) counter follows that reference. After the source of reference returns to the Floating point control (Motor potentiometer) counter, its value can again be changed by the up and down sources (defined by *22.73* and *22.74*). | 3 |
| *22.72* | *Motor potentiometer initial value* | Defines an initial value (starting point) for the Floating point control (Motor potentiometer) counter. See the selections of parameter *22.71 Motor potentiometer function*. | 0.00 |
| | -32768.00…<br>32767.00 | Initial value for the counter. | 1 = 1 |

**13**
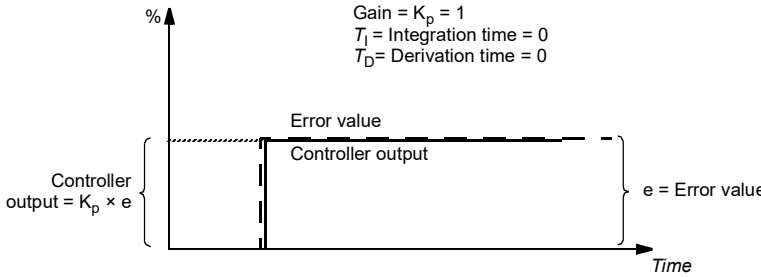
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *22.73* | *Motor potentiometer up source* | Selects the source of Floating point control (Motor potentiometer) counter up signal.<br>0 = No change<br>1 = Increase Floating point control (Motor potentiometer) counter value. (If both the up and down sources are on, the potentiometer value will not change.)<br>**Note:** Floating point control (Motor potentiometer) function up/down source control speed or frequency from zero to maximum speed or frequency. The running direction can be changed with parameter *20.04 Ext1 in2 source*. See the figure in section *Floating point control (Motor potentiometer)* on page *133*. | *Not used* |
| | Not used | 0. | 0 |
| | Not used | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Reserved | | 21…23 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 24 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 25 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 26 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *22.74* | *Motor potentiometer down source* | Selects the source of Floating point control (Motor potentiometer) counter down signal.<br>0 = No change<br>1 = Decrease Floating point control (Motor potentiometer) counter value. (If both the up and down sources are on, the counter value will not change.)<br>**Note:** Floating point control (Motor potentiometer) function up/down source control speed or frequency from zero to maximum speed or frequency. The running direction can be changed with parameter *20.04 Ext1 in2 source*. See the figure in section *Floating point control (Motor potentiometer)* on page *133*.<br>For the selections, see parameter *22.73 Motor potentiometer up source*. | *Not used* |
| *22.75* | *Motor potentiometer ramp time* | Defines the change rate of the Floating point control (Motor potentiometer) counter. This parameter specifies the time required for the Floating point control (Motor potentiometer) to change from minimum (*22.76*) to maximum (*22.77*). The same change rate applies in both directions. | 40.0 s |
| | 0.0…3600.0 s | Counter change time. | 10 = 1 s |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *22.76* | *Motor potentiometer min value* | Defines the minimum value of the Floating point control (Motor potentiometer) counter.<br>**Note:** If vector control mode is used, value of this parameter must be changed. | -50.00 |
| | -32768.00… 32767.00 | Counter minimum. | 1 = 1 |
| *22.77* | *Motor potentiometer max value* | Defines the maximum value of the Floating point control (Motor potentiometer) counter.<br>**Note:** If vector control mode is used, value of this parameter must be changed. | 50.00 |
| | -32768.00… 32767.00 | Counter maximum. | 1 = 1 |
| *22.80* | *Motor potentiometer ref act* | The output of the Floating point control (Motor potentiometer) function. (The meter is configured using parameters *22.71…22.74*.)<br>This parameter is read-only. | - |
| | -32768.00… 32767.00 | Value of the Floating point control (Motor potentiometer) counter. | 1 = 1 |
| *22.86* | *Speed reference act 6* | Displays the value of the speed reference (EXT1 or EXT2) that has been selected by *19.11 Ext1/Ext2 selection*. See diagram at *22.11 Ext1 speed ref1* or control chain diagram *Speed reference source selection I* on page *306*.<br>This parameter is read-only. | - |
| | -30000.00… 30000.00 rpm | Speed reference after additive 2. | See par. *46.01* |
| *22.87* | *Speed reference act 7* | Displays the value of speed reference before application of critical speeds. See the control chain diagram on page *307*.<br>The value is received from *22.86 Speed reference act 6* unless overridden by<br>• any constant speed<br>• *network control* reference (see page *18*)<br>• control panel reference<br>• safe speed reference.<br>This parameter is read-only. | - |
| | -30000.00… 30000.00 rpm | Speed reference before application of critical speeds. | See par. *46.01* |
| *23 Speed reference ramp* | | Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive).<br>See control chain diagram *Speed reference ramping and shaping* on page *308*. | |
| *23.01* | *Speed ref ramp input* | Displays the used speed reference (in rpm) before it enters the ramping and shaping functions. See control chain diagram *Speed reference ramping and shaping* on page *308*.<br>This parameter is read-only. | - |
| | -30000.00… 30000.00 rpm | Speed reference before ramping and shaping. | See par. *46.01* |
| *23.02* | *Speed ref ramp output* | Displays the ramped and shaped speed reference in rpm. See control chain diagram *Speed reference ramping and shaping* on page *308*.<br>This parameter is read-only. | - |
| | -30000.00… 30000.00 rpm | Speed reference after ramping and shaping. | See par. *46.01* |

**13**
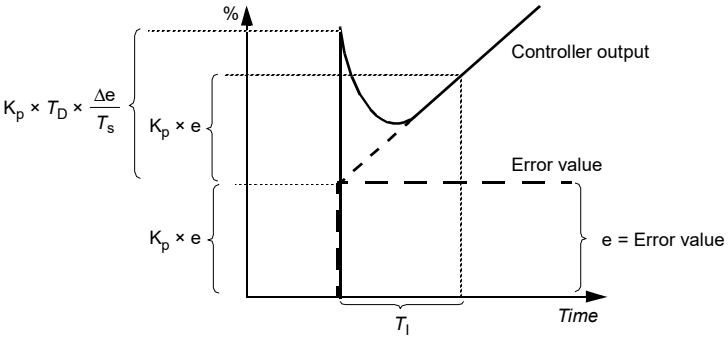
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *23.11* | *Ramp set selection* | Selects the source that switches between the two sets of acceleration/deceleration ramp times defined by parameters *23.12…23.15*.<br>0 = Acceleration time 1 and deceleration time 1 are active<br>1 = Acceleration time 2 and deceleration time 2 are active | *Acc/Dec time 1* |
| | Acc/Dec time 1 | 0. | 0 |
| | Acc/Dec time 2 | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | FBA A | For Transparent16 and Transparent32 profiles only. DCU control word bit 10 received through the fieldbus adapter. | 18 |
| | Reserved | | 19 |
| | EFB DCU CW bit 10 | Only for the DCU profile. DCU control word bit 10 received through the embedded fieldbus interface. | 20 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *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*).<br>If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate.<br>If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference.<br>If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits. | 20.000 s |
| | 0.000…1800.000 s | Acceleration time 1. | 10 = 1 s |
| *23.13* | *Deceleration time 1* | Defines deceleration time 1 as the time required for the speed to change from the speed defined by parameter *46.01 Speed scaling* (**not** from parameter *30.12 Maximum speed*) to zero.<br>If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference.<br>If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate.<br>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*).<br>**Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor. | 20.000 s |
| | 0.000…1800.000 s | Deceleration time 1. | 10 = 1 s |

**13**
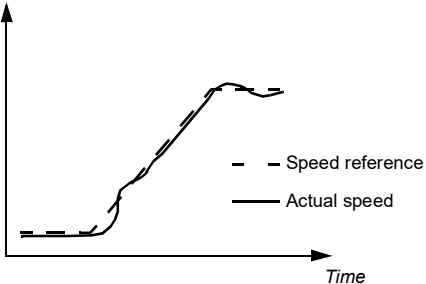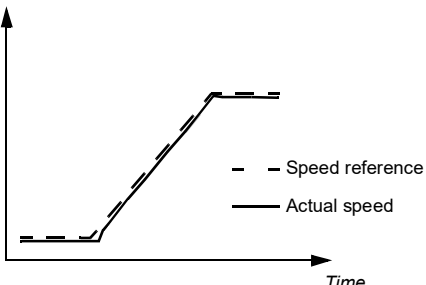
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *23.14* | *Acceleration time 2* | Defines acceleration time 2. See parameter *23.12 Acceleration time 1*. | 60.000 s |
| | 0.000…1800.000 s | Acceleration time 2. | 10 = 1 s |
| *23.15* | *Deceleration time 2* | Defines deceleration time 2. See parameter *23.13 Deceleration time 1*. | 60.000 s |
| | 0.000…1800.000 s | Deceleration time 2. | 10 = 1 s |
| *23.23* | *Emergency stop time* | Defines the time inside which the drive is stopped if an emergency stop Off3 is activated (ie. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling* to zero). Emergency stop mode and activation source are selected by parameters *21.04 Emergency stop mode* and *21.05 Emergency stop source* respectively. Emergency stop can also be activated through fieldbus.<br>**Notes:**<br>• Emergency stop Off1 uses the standard deceleration ramp as defined by parameters *23.11…23.15*.<br>• The same parameter value is also used in frequency control mode (ramp parameters *28.71…28.75*). | 3.000 s |
| | 0.000…1800.000 s | Emergency stop Off3 deceleration time. | 10 = 1 s |
| *23.28* | *Variable slope enable* | Activates the variable slope function, which controls the slope of the speed ramp during a speed reference change. This allows for a constantly variable ramp rate to be generated, instead of just the standard two ramps normally available.<br>If the update interval of the signal from an external control system and the variable slope rate (*23.29 Variable slope rate*) are equal, speed reference (*23.02 Speed ref ramp output*) is a straight line.<br><br>*Speed reference*<br><br>t = update interval of signal from an external control system<br>A = speed reference change during t<br><br>This function is only active in external control. | *Off* |
| | Off | Variable slope disabled. | 0 |
| | On | Variable slope enabled (not available in local control). | 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *23.29* | *Variable slope rate* | Defines the rate of the speed reference change when variable slope is enabled by parameter *23.28 Variable slope enable*. For the best result, enter the reference update interval into this parameter. | 50 ms |
| | 2…30000 ms | Variable slope rate. | 1 = 1 ms |
| **24 Speed reference conditioning** | | Speed error calculation; speed error window control configuration; speed error step. See control chain diagram *Speed error calculation* on page *309*. | |
| *24.01* | *Used speed reference* | Displays the ramped and corrected speed reference (before speed error calculation). See control chain diagram *Speed error calculation* on page *309*. This parameter is read-only. | - |
| | -30000.00… 30000.00 rpm | Speed reference used for speed error calculation. | See par. *46.01* |
| *24.02* | *Used speed feedback* | Displays the speed feedback used for speed error calculation. See control chain diagram *Speed error calculation* on page *309*. This parameter is read-only. | - |
| | -30000.00… 30000.00 rpm | Speed feedback used for speed error calculation. | See par. *46.01* |
| *24.03* | *Speed error filtered* | Displays the filtered speed error. See control chain diagram *Speed error calculation* on page *309*. This parameter is read-only. | - |
| | -30000.00… 30000.00 rpm | Filtered speed error. | See par. *46.01* |
| *24.04* | *Speed error inverted* | Displays the inverted (unfiltered) speed error. See control chain diagram *Speed error calculation* on page *309*. This parameter is read-only. | - |
| | -30000.0… 30000.0 rpm | Inverted speed error. | See par. *46.01* |
| *24.11* | *Speed correction* | Defines a speed reference correction, ie, a value added to the existing reference between ramping and limitation. This is useful to trim the speed if necessary, for example, to adjust draw between sections of a paper machine. See control chain diagram *Speed error calculation* on page *309*. | 0.00 rpm |
| | -10000.00… 10000.00 rpm | Speed reference correction. | See par. *46.01* |
| *24.12* | *Speed error filter time* | Defines the time constant of the speed error low-pass filter. If the used speed reference changes rapidly, the possible interferences in the speed measurement can be filtered with the speed error filter. Reducing the ripple with this filter may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control. | 0 ms |
| | 0…10000 ms | Speed error filtering time constant. 0 = filtering disabled. | 1 = 1 ms |

**13**
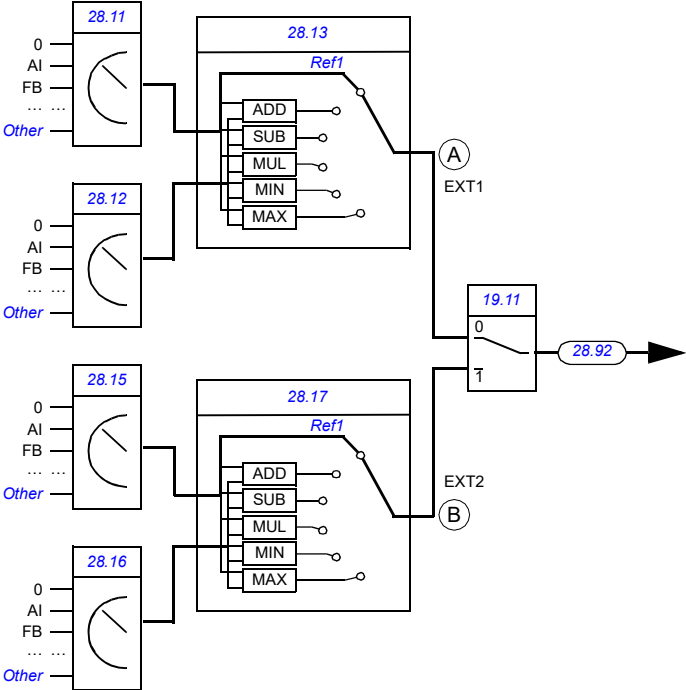
| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| **25 Speed control** | | Speed controller settings.<br>See control chain diagram *Speed error calculation* on page *309*. | |
| *25.01* | *Torque reference speed control* | Displays the speed controller output that is transferred to the torque controller. See control chain diagram *Speed error calculation* on page *309*.<br>This parameter is read-only. | - |
| | -1600.0…1600.0% | Limited speed controller output torque. | See par. *46.03* |
| *25.02* | *Speed proportional gain* | Defines the proportional gain ($K_p$) of the speed controller. Too high a gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant. | 10.00 |
| | |  | |
| | | If gain is set to 1, a 10% change in error value (reference - actual value) causes the speed controller output to change by 10%, ie, the output value is input × gain. | |
| | 0.00…250.00 | Proportional gain for speed controller. | 100 = 1 |

**13**
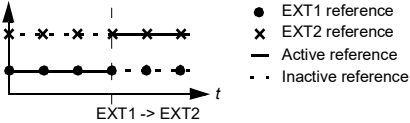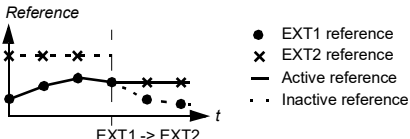
| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|-----------|
| *25.03* | *Speed integration time* | Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. This time constant must be set to the same order of magnitude as the time constant (time to respond) of the actual mechanical system being controlled, otherwise instability will result.<br>Setting the integration time to zero disables the I-part of the controller. This is useful to do when tuning the proportional gain; adjust the proportional gain first, then return the integration time.<br>Anti-windup (the integrator just integrates up to 100%) stops the integrator if the controller output is limited.<br>The figure below shows the speed controller output after an error step when the error remains constant.<br><br> | .50 s |
| | 0.00…1000.00 s | Integration time for speed controller. | 10 = 1 s |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *25.04* | *Speed derivation time* | Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. For simple applications, derivative time is not normally required and should be left at zero.<br>The speed error derivative must be filtered with a low pass filter to eliminate disturbances.<br>The figure below shows the speed controller output after an error step when the error remains constant. | 0.000 s |

$$K_p \times T_D \times \frac{\Delta e}{T_s}$$

$$K_p \times e$$

$$K_p \times e$$

Controller output

Error value

e = Error value

$T_I$

Time

Gain = $K_p$ = 1
$T_I$ = Integration time > 0
$T_D$ = Derivation time > 0
$T_s$ = Sample time period = 250 µs
$\Delta e$ = Error value change between two samples

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0.000…10.000 s | Derivation time for speed controller. | 1000 = 1 s |
| *25.05* | *Derivation filter time* | Defines the derivation filter time constant. See parameter *25.04 Speed derivation time*. | 8 ms |
| | 0…10000 ms | Derivation filter time constant. | 1 = 1 ms |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| 25.06 | *Acc comp derivation time* | Defines the derivation time for acceleration(/deceleration) compensation. In order to compensate for a high inertia load during acceleration, a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described under parameter *25.04 Speed derivation time*.<br>**Note:** As a general rule, set this parameter to the value between 50 and 100% of the sum of the mechanical time constants of the motor and the driven machine.<br>The figure below shows the speed responses when a high inertia load is accelerated along a ramp.<br>**No acceleration compensation:**<br><br>– – – Speed reference<br>——— Actual speed<br>*Time*<br><br>**Acceleration compensation:**<br><br>– – – Speed reference<br>——— Actual speed<br>*Time* | 0.00 s |
| | 0.00…1000.00 s | Acceleration compensation derivation time. | 10 = 1 s |
| 25.07 | *Acc comp filter time* | Defines the acceleration (or deceleration) compensation filter time constant. See parameters *25.04 Speed derivation time* and *25.06 Acc comp derivation time*. | 8.0 ms |
| | 0.0…1000.0 ms | Acceleration/deceleration compensation filter time. | 1 = 1 ms |
| 25.15 | *Proportional gain em stop* | Defines the proportional gain for the speed controller when an emergency stop is active. See parameter *25.02 Speed proportional gain*. | 10.00 |
| | 1.00…250.00 | Proportional gain upon an emergency stop. | 100 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *25.53* | *Torque prop reference* | Displays the output of the proportional (P) part of the speed controller. See control chain diagram *Speed error calculation* on page *309*.<br>This parameter is read-only. | - |
|  | -30000.0… 30000.0% | P-part output of speed controller. | See par. *46.03* |
| *25.54* | *Torque integral reference* | Displays the output of the integral (I) part of the speed controller. See control chain diagram *Speed error calculation* on page *309*.<br>This parameter is read-only. | - |
|  | -30000.0… 30000.0% | I-part output of speed controller. | See par. *46.03* |
| *25.55* | *Torque deriv reference* | Displays the output of the derivative (D) part of the speed controller. See control chain diagram *Speed error calculation* on page *309*.<br>This parameter is read-only. | - |
|  | -30000.0… 30000.0% | D-part output of speed controller. | See par. *46.03* |
| *25.56* | *Torque acc compensation* | Displays the output of the acceleration compensation function. See control chain diagram *Speed error calculation* on page *309*.<br>This parameter is read-only. | - |
|  | -30000.0… 30000.0% | Output of acceleration compensation function. | See par. *46.03* |

| *28 Frequency reference chain* | | Settings for the frequency reference chain.<br>See the control chain diagrams on pages *304* and *305*. | |
|---|---|---|---|
| *28.01* | *Frequency ref ramp input* | Displays the used frequency reference before ramping. See the control chain diagram *Frequency reference selection* on page *304* and *Frequency reference modification* on page *305*.<br>This parameter is read-only. | - |
|  | -500.00…500.00 Hz | Frequency reference before ramping. | See par. *46.02* |
| *28.02* | *Frequency ref ramp output* | Displays the final frequency reference (after selection, limitation and ramping). See control chain diagram on page *304*.<br>This parameter is read-only. | - |
|  | -500.00…500.00 Hz | Final frequency reference. | See par. *46.02* |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *28.11* | *Ext1 frequency ref1* | Selects EXT1 frequency reference source 1.<br>Two signal sources can be defined by this parameter and *28.12 Ext1 frequency ref2*. A mathematical function (*28.13 Ext1 frequency function*) applied to the two signals creates an EXT1 reference (A in the figure below).<br>A digital source selected by *19.11 Ext1/Ext2 selection* can be used to switch between EXT1 reference and the corresponding EXT2 reference defined by parameters *28.15 Ext2 frequency ref1*, *28.16 Ext2 frequency ref2* and *28.17 Ext2 frequency function* (B in the figure below). | *AI1 scaled* |
| | |  | |
| | Zero | None. | 0 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 1 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 2 |
| | Reserved | | 3 |
| | FB A ref1 | *03.05 FB A reference 1* (see page *328*). | 4 |
| | FB A ref2 | *03.06 FB A reference 2* (see page *329*). | 5 |
| | Reserved | | 6…7 |
| | EFB ref1 | *03.09 EFB reference 1* (see page *329*). | 8 |
| | EFB ref2 | *03.10 EFB reference 2* (see page *329*). | 9 |
| | Reserved | | 10…14 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|-----------|
| | Motor potentiometer | *22.80 Motor potentiometer ref act* (output of the Floating point control (Motor potentiometer)). | 15 |
| | PID | *40.01 Process PID output actual* (output of the process PID controller). | 16 |
| | Frequency input | *11.38 Freq in 1 actual value* (when DI5 is used as a frequency input). | 17 |
| | Control panel (ref saved) | Panel reference (*03.01 Panel reference*, see page *328*) saved by the control system for the location where the control returns is used as the reference.<br><br> | 18 |
| | Control panel (ref copied) | Panel reference (*03.01 Panel reference*, see page *328*) 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.<br><br> | 19 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| 28.12 | *Ext1 frequency ref2* | Selects EXT1 frequency reference source 2.<br>For the selections, and a diagram of reference source selection, see parameter *28.11 Ext1 frequency ref1*. | *Zero* |
| 28.13 | *Ext1 frequency function* | Selects a mathematical function between the reference sources selected by parameters *28.11 Ext1 frequency ref1* and *28.12 Ext1 frequency ref2*. See diagram at *28.11 Ext1 frequency ref1*. | *Ref1* |
| | Ref1 | Signal selected by *28.11 Ext1 frequency ref1* is used as frequency reference 1 as such (no function applied). | 0 |
| | Add (ref1 + ref2) | The sum of the reference sources is used as frequency reference 1. | 1 |
| | Sub (ref1 - ref2) | The subtraction ([*28.11 Ext1 frequency ref1*] - [*28.12 Ext1 frequency ref2*]) of the reference sources is used as frequency reference 1. | 2 |
| | Mul (ref1 × ref2) | The multiplication of the reference sources is used as frequency reference 1. | 3 |
| | Min (ref1, ref2) | The smaller of the reference sources is used as frequency reference 1. | 4 |
| | Max (ref1, ref2) | The greater of the reference sources is used as frequency reference 1. | 5 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *28.15* | *Ext2 frequency ref1* | Selects EXT2 frequency reference source 1.<br>Two signal sources can be defined by this parameter and *28.16 Ext2 frequency ref2*. A mathematical function (*28.17 Ext2 frequency function*) applied to the two signals creates an EXT2 reference. See diagram at *28.11 Ext1 frequency ref1*. | *Zero* |
| | Zero | None. | 0 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 1 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 2 |
| | Reserved | | 3 |
| | FB A ref1 | *03.05 FB A reference 1* (see page *328*). | 4 |
| | FB A ref2 | *03.06 FB A reference 2* (see page *329*). | 5 |
| | Reserved | | 6…7 |
| | EFB ref1 | *03.09 EFB reference 1* (see page *329*). | 8 |
| | EFB ref2 | *03.10 EFB reference 2* (see page *329*). | 9 |
| | Reserved | | 10…14 |
| | Motor potentiometer | *22.80 Motor potentiometer ref act* (output of the Floating point control (Motor potentiometer)). | 15 |
| | PID | *40.01 Process PID output actual* (output of the process PID controller). | 16 |
| | Frequency input | *11.38 Freq in 1 actual value* (when DI5 is used as a frequency input). | 17 |
| | Control panel (ref saved) | Panel reference (*03.01 Panel reference*, see page *328*) saved by the control system for the location where the control returns is used as the reference.<br>*Reference*<br><br>EXT1 -> EXT2<br>● EXT1 reference<br>✕ EXT2 reference<br>— Active reference<br>·· Inactive reference | 18 |
| | Control panel (ref copied) | Panel reference (*03.01 Panel reference*, see page *328*) 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.<br>*Reference*<br><br>EXT1 -> EXT2<br>● EXT1 reference<br>✕ EXT2 reference<br>— Active reference<br>·· Inactive reference | 19 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *28.16* | *Ext2 frequency ref2* | Selects EXT2 frequency reference source 2.<br>For the selections, and a diagram of reference source selection, see parameter *28.15 Ext2 frequency ref1*. | *Zero* |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *28.17* | *Ext2 frequency function* | Selects a mathematical function between the reference sources selected by parameters *28.15 Ext2 frequency ref1* and *28.16 Ext2 frequency ref2*. See diagram at *28.15 Ext2 frequency ref1*. | *Ref1* |
| | Ref1 | Signal selected by *28.15 Ext2 frequency ref1* is used as frequency reference 1 as such (no function applied). | 0 |
| | Add (ref1 + ref2) | The sum of the reference sources is used as frequency reference 1. | 1 |
| | Sub (ref1 - ref2) | The subtraction ([*28.15 Ext2 frequency ref1*] - [*28.16 Ext2 frequency ref2*]) of the reference sources is used as frequency reference 1. | 2 |
| | Mul (ref1 × ref2) | The multiplication of the reference sources is used as frequency reference 1. | 3 |
| | Min (ref1, ref2) | The smaller of the reference sources is used as frequency reference 1. | 4 |
| | Max (ref1, ref2) | The greater of the reference sources is used as frequency reference 1. | 5 |
| *28.21* | *Constant frequency function* | Determines how constant frequencies are selected, and whether the rotation direction signal is considered or not when applying a constant frequency. | 0000b |

| Bit | Name | Information |
|---|---|---|
| 0 | Const freq mode | 1 = Packed: 7 constant frequencies are selectable using the three sources defined by parameters *28.22*, *28.23* and *28.24*. |
| | | 0 = Separate: Constant frequencies 1, 2 and 3 are separately activated by the sources defined by parameters *28.22*, *28.23* and *28.24* respectively. In case of conflict, the constant frequency with the smaller number takes priority. |
| 1 | Direction enable | 1 = Start dir: To determine running direction for a constant speed, the sign of the constant speed setting (parameters *22.26*…*22.32*) is multiplied by the direction signal (forward: +1, reverse: -1). This effectively allows the drive to have 14 (7 forward, 7 reverse) constant speeds if all values in *22.26*…*22.32* are positive. |
| | | ⚠ **WARNING:** If the direction signal is reverse and the active constant speed is negative, the drive will run in the forward direction. |
| | | 0 = According to Par: The running direction for the constant speed is determined by the sign of the constant speed setting (parameters *22.26*…*22.32*). |
| 2…15 | Reserved | |

| | | | |
|---|---|---|---|
| | 0000b…0011b | Constant frequency configuration word. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| 28.22 | Constant frequency sel1 | When bit 0 of parameter 28.21 Constant frequency function is 0 (Separate), selects a source that activates constant frequency 1.<br>When bit 0 of parameter 28.21 Constant frequency function is 1 (Packed), this parameter and parameters 28.23 Constant frequency sel2 and 28.24 Constant frequency sel3 select three sources whose states activate constant frequencies as follows: | DI3 |

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

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | Always off | 0. | 0 |
| | | 1. | 1 |
| | DI1 | Digital input DI1 (10.02 DI delayed status, bit 0). | 2 |
| | DI2 | Digital input DI2 (10.02 DI delayed status, bit 1). | 3 |
| | DI3 | Digital input DI3 (10.02 DI delayed status, bit 2). | 4 |
| | DI4 | Digital input DI4 (10.02 DI delayed status, bit 3). | 5 |
| | DI5 | Digital input DI5 (10.02 DI delayed status, bit 4). | 6 |
| | DI6 | Digital input DI6 (10.02 DI delayed status, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of 34.01 Timed functions status (see page 439). | 18 |
| | Timed function 2 | Bit 1 of 34.01 Timed functions status (see page 439). | 19 |
| | Timed function 3 | Bit 2 of 34.01 Timed functions status (see page 439). | 20 |
| | Reserved | | 21…23 |
| | Supervision 1 | Bit 0 of 32.01 Supervision status (see page 432). | 24 |
| | Supervision 2 | Bit 1 of 32.01 Supervision status (see page 432). | 25 |
| | Supervision 3 | Bit 2 of 32.01 Supervision status (see page 432). | 26 |
| | Other [bit] | Source selection (see Terms and abbreviations on page 322). | - |
| 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.<br>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.<br>For the selections, see parameter 28.22 Constant frequency sel1. | Always off |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *28.24* | *Constant frequency sel3* | When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 3.<br>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*.<br>For the selections, see parameter *28.22 Constant frequency sel1*. | *Always off* |
| *28.26* | *Constant frequency 1* | Defines constant frequency 1 (the frequency the motor will turn when constant frequency 1 is selected). | 5.00 Hz; 6.00 Hz (*95.20* b0) |
| | -500.00…500.00 Hz | Constant frequency 1. | See par. *46.02* |
| *28.27* | *Constant frequency 2* | Defines constant frequency 2. | 10.00 Hz; 12.00 Hz (*95.20* b0) |
| | -500.00…500.00 Hz | Constant frequency 2. | See par. *46.02* |
| *28.28* | *Constant frequency 3* | Defines constant frequency 3. | 15.00 Hz; 18.00 Hz (*95.20* b0) |
| | -500.00…500.00 Hz | Constant frequency 3. | See par. *46.02* |
| *28.29* | *Constant frequency 4* | Defines constant frequency 4. | 20.00 Hz; 24.00 Hz (*95.20* b0) |
| | -500.00…500.00 Hz | Constant frequency 4. | See par. *46.02* |
| *28.30* | *Constant frequency 5* | Defines constant frequency 5. | 25.00 Hz; 30.00 Hz (*95.20* b0) |
| | -500.00…500.00 Hz | Constant frequency 5. | See par. *46.02* |
| *28.31* | *Constant frequency 6* | Defines constant frequency 6. | 40.00 Hz; 48.00 Hz (*95.20* b0) |
| | -500.00…500.00 Hz | Constant frequency 6. | See par. *46.02* |
| *28.32* | *Constant frequency 7* | Defines constant frequency 7. | 50.00 Hz; 60.00 Hz (*95.20* b0) |
| | -500.00…500.00 Hz | Constant frequency 7. | See par. *46.02* |
| *28.41* | *Frequency ref safe* | Defines a safe frequency reference value that is used with supervision functions such as<br>• *12.03 AI supervision function*<br>• *49.05 Communication loss action*<br>• *50.02 FBA A comm loss func.* | 0.00 Hz |
| | -500.00…500.00 Hz | Safe frequency reference. | See par. *46.02* |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *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.<br>See also section *Critical speeds/frequencies* (page *117*). | 0000b |

| Bit | Name | Information |
|-----|------|-------------|
| 0 | Crit freq | 1 = Enable: Critical frequencies enabled. |
|   |   | 0 = Disable: Critical frequencies disabled. |
| 1 | Sign mode | 1 = According to par: The signs of parameters *28.52…28.57* are taken into account. |
|   |   | 0 = Absolute: Parameters *28.52…28.57* are handled as absolute values. Each range is effective in both directions of rotation. |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
|   | 0000b…0011b | Critical frequencies configuration word. | 1 = 1 |
| *28.52* | *Critical frequency 1 low* | Defines the low limit for critical frequency 1.<br>**Note:** This value must be less than or equal to the value of *28.53 Critical frequency 1 high*. | 0.00 Hz |
|   | -500.00…500.00 Hz | Low limit for critical frequency 1. | See par. *46.02* |
| *28.53* | *Critical frequency 1 high* | Defines the high limit for critical frequency 1.<br>**Note:** This value must be greater than or equal to the value of *28.52 Critical frequency 1 low*. | 0.00 Hz |
|   | -500.00…500.00 Hz | High limit for critical frequency 1. | See par. *46.02* |
| *28.54* | *Critical frequency 2 low* | Defines the low limit for critical frequency 2.<br>**Note:** This value must be less than or equal to the value of *28.55 Critical frequency 2 high*. | 0.00 Hz |
|   | -500.00…500.00 Hz | Low limit for critical frequency 2. | See par. *46.02* |
| *28.55* | *Critical frequency 2 high* | Defines the high limit for critical frequency 2.<br>**Note:** This value must be greater than or equal to the value of *28.54 Critical frequency 2 low*. | 0.00 Hz |
|   | -500.00…500.00 Hz | High limit for critical frequency 2. | See par. *46.02* |
| *28.56* | *Critical frequency 3 low* | Defines the low limit for critical frequency 3.<br>**Note:** This value must be less than or equal to the value of *28.57 Critical frequency 3 high*. | 0.00 Hz |
|   | -500.00…500.00 Hz | Low limit for critical frequency 3. | See par. *46.02* |
| *28.57* | *Critical frequency 3 high* | Defines the high limit for critical frequency 3.<br>**Note:** This value must be greater than or equal to the value of *28.56 Critical frequency 3 low*. | 0.00 Hz |
|   | -500.00…500.00 Hz | High limit for critical frequency 3. | See par. *46.02* |
| *28.71* | *Freq ramp set selection* | Selects a source that switches between the two sets of acceleration/deceleration times defined by parameters *28.72…28.75*.<br>0 = Acceleration time 1 and deceleration time 1 are in force<br>1 = Acceleration time 2 and deceleration time 2 are in force | *Acc/Dec time 1* |
|   | Acc/Dec time 1 | 0. | 0 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Acc/Dec time 2 | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | FBA A | For Transparent16 and Transparent32 profiles only. DCU control word bit 10 received through the fieldbus adapter. | 18 |
| | Reserved | | 19 |
| | EFB DCU CW bit 0 | Only for the DCU profile. DCU control word bit 10 received through the embedded fieldbus interface. | 20 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *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*.<br>If the reference increases faster than the set acceleration rate, the motor will follow the acceleration rate.<br>If the reference increases slower than the set acceleration rate, the motor frequency will follow the reference.<br>If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits. | 30.000 s |
| | 0.000…1800.000 s | Acceleration time 1. | 10 = 1 s |
| *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.<br>If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control (*30.30 Overvoltage control*) is on.<br>**Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor. | 30.000 s |
| | 0.000…1800.000 s | Deceleration time 1. | 10 = 1 s |
| *28.74* | *Freq acceleration time 2* | Defines acceleration time 2. See parameter *28.72 Freq acceleration time 1*. | 60.000 s |
| | 0.000…1800.000 s | Acceleration time 2. | 10 = 1 s |
| *28.75* | *Freq deceleration time 2* | Defines deceleration time 2. See parameter *28.73 Freq deceleration time 1*. | 60.000 s |
| | 0.000…1800.000 s | Deceleration time 2. | 10 = 1 s |
| *28.76* | *Freq ramp in zero source* | Selects a source that forces the frequency reference to zero.<br>0 = Force frequency reference to zero<br>1 = Normal operation | *Inactive* |
| | Active | 0. | 0 |
| | Inactive | 1. | 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *28.92* | *Frequency ref act 3* | Displays the frequency reference after the function applied by parameter *28.13 Ext1 frequency function* (if any), and after selection (*19.11 Ext1/Ext2 selection*). See control chain diagram *Frequency reference selection* on page *304*.<br>This parameter is read-only. | - |
| | -500.00…500.00 Hz | Frequency reference after selection. | See par. *46.02* |
| *28.96* | *Frequency ref act 7* | Displays the frequency reference after application of constant frequencies, control panel reference, etc. See control chain diagram *Frequency reference selection* on page *304*.<br>This parameter is read-only. | - |
| | -500.00…500.00 Hz | Frequency reference 7. | See par. *46.02* |
| *28.97* | *Frequency ref unlimited* | Displays the frequency reference after application of critical frequencies, but before ramping and limiting. See control chain diagram *Frequency reference modification* on page *305*.<br>This parameter is read-only. | - |
| | -500.00…500.00 Hz | Frequency reference before ramping and limiting. | See par. *46.02* |

**13**
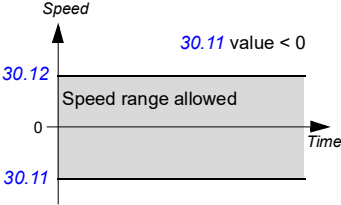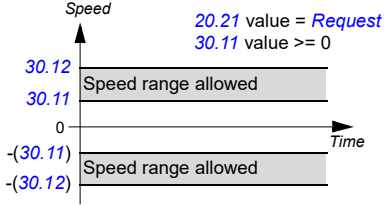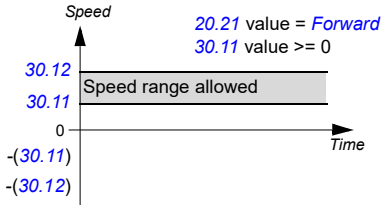
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| **30 Limits** | | Drive operation limits. | |
| *30.01* | *Limit word 1* | Displays limit word 1.<br>This parameter is read-only. | - |

| Bit | Name | Description |
|---|---|---|
| 0 | Torq lim | 1 = Drive torque is being limited by the motor control (undervoltage control, current control, load angle control or pull-out control), or by the torque limits defined by parameters. |
| 1…2 | Reserved | |
| 3 | Torq ref max | 1 = Torque reference is being limited by *30.20 Maximum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*. |
| 4 | Torq ref min | 1 = Torque reference is being limited by *30.19 Minimum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*. |
| 5 | Tlim max speed | 1 = Torque reference is being limited by the rush control because of maximum speed limit (*30.12 Maximum speed*) |
| 6 | Tlim min speed | 1 = Torque reference is being limited by the rush control because of minimum speed limit (*30.11 Minimum speed*) |
| 7 | Max speed ref lim | 1 = Speed reference is being limited by *30.12 Maximum speed* |
| 8 | Min speed ref lim | 1 = Speed reference is being limited by *30.11 Minimum speed* |
| 9 | Max freq ref lim | 1 = Frequency reference is being limited by *30.14 Maximum frequency* |
| 10 | Min freq ref lim | 1 = Frequency reference is being limited by *30.13 Minimum frequency* |
| 11…15 | Reserved | |

| | | |
|---|---|---|
| 0000h…FFFFh | Limit word 1. | 1 = 1 |

**13**
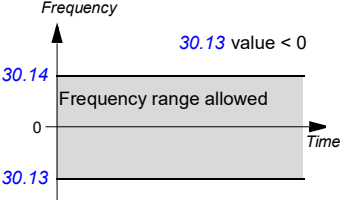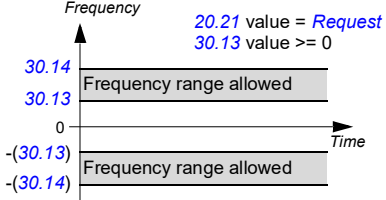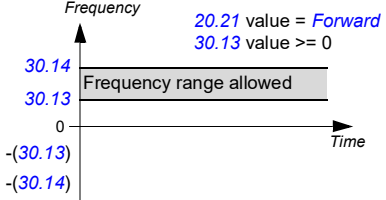
| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *30.02* | *Torque limit status* | Displays the torque controller limitation status word.<br>This parameter is read-only. | - |

| Bit | Name | Description |
|-----|------|-------------|
| 0 | Undervoltage | *1 = Intermediate DC circuit undervoltage |
| 1 | Overvoltage | *1 = Intermediate DC circuit overvoltage |
| 2 | Minimum torque | *1 = Torque is being limited by *30.19 Minimum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit* |
| 3 | Maximum torque | *1 = Torque is being limited by *30.20 Maximum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit* |
| 4 | Internal current | 1 = An inverter current limit (identified by bits 8…11) is active |
| 5 | Load angle | (With permanent magnet motors and reluctance motors only)<br>1 = Load angle limit is active, ie, the motor cannot produce any more torque |
| 6 | Motor pullout | (With asynchronous motors only)<br>Motor pull-out limit is active, ie, the motor cannot produce any more torque |
| 7 | Reserved | |
| 8 | Thermal | 1 = Input current is being limited by the main circuit thermal limit |
| 9 | Max current | *1 = Maximum output current ($I_{MAX}$) is being limited |
| 10 | User current | *1 = Output current is being limited by *30.17 Maximum current* |
| 11 | Thermal IGBT | *1 = Output current is being limited by a calculated thermal current value |
| 12…15 | Reserved | |
| \*Only one out of bits 0…3, and one out of bits 9…11 can be on simultaneously. The bit typically indicates the limit that is exceeded first. | | |

| | | | |
|-----|-----------|-------------|------------|
| | 0000h…FFFFh | Torque limitation status word. | 1 = 1 |

**13**
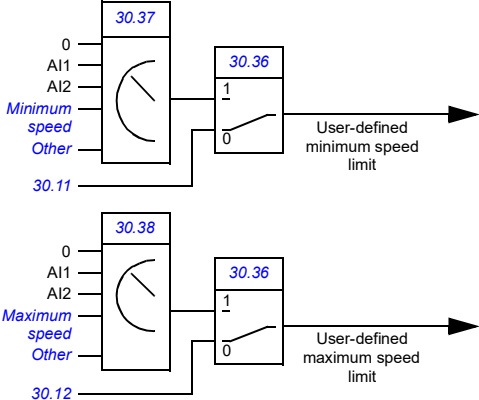
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *30.11* | *Minimum speed* | Defines together with *30.12 Maximum speed* the allowed speed range. See the figure below.<br>A positive or zero minimum speed value defines two ranges, one positive and one negative.<br>⚠ **WARNING!** The absolute value of *30.11 Minimum speed* must not be higher than the absolute value of *30.12 Maximum speed*.<br>⚠ **WARNING!** In speed control mode only. In frequency control mode, use frequency limits (*30.13* and *30.14*). | 0.00 rpm |

Speed

*30.11* value < 0

*30.12*

Speed range allowed

0

Time

*30.11*

Speed

*20.21* value = *Request*
*30.11* value >= 0

*30.12*
*30.11*

Speed range allowed

0

Time

-(*30.11*)
-(*30.12*)

Speed range allowed

Speed

*20.21* value = *Forward*
*30.11* value >= 0

*30.12*
*30.11*

Speed range allowed

0

Time

-(*30.11*)
-(*30.12*)

| | -30000.00…<br>30000.00 rpm | Minimum allowed speed. | See par. *46.01* |
| *30.12* | *Maximum speed* | Defines together with *30.11 Minimum speed* the allowed speed range. See parameter *30.11 Minimum speed*.<br>**Note:** This parameter does not affect the speed acceleration and deceleration ramp times. See parameter *46.01 Speed scaling*. | 1500.00 rpm;<br>1800.00 rpm<br>(*95.20* b0) |
| | -30000.00…<br>30000.00 rpm | Maximum speed. | See par. *46.01* |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *30.13* | *Minimum frequency* | Defines together with *30.14 Maximum frequency* the allowed frequency range. See the figure.<br>A positive or zero minimum frequency value defines two ranges, one positive and one negative.<br>⚠ **WARNING!** The absolute value of *30.13 Minimum frequency* must not be higher than the absolute value of *30.14 Maximum frequency*.<br>⚠ **WARNING!** in frequency control mode only. | 0.00 Hz |
| | |  | |
| | -500.00…500.00 Hz | Minimum frequency. | See par. *46.02* |
| *30.14* | *Maximum frequency* | Defines together with *30.13 Minimum frequency* the allowed frequency range. See parameter *30.13 Minimum frequency*.<br>**Note:** This parameter does not affect the frequency acceleration and deceleration ramp times. See parameter *46.02 Frequency scaling*. | 50.00 Hz; 60.00 Hz (*95.20* b0) |
| | -500.00…500.00 Hz | Maximum frequency. | See par. *46.02* |
| *30.17* | *Maximum current* | Defines the maximum allowed motor current. This depends on the drive type; it is automatically determined on the basis of the rating.<br>The system sets the default value to 90% of the rated current so you can increase the parameter value by 10% if needed. | 0.00 A |
| | 0.00…30000.00 A | Maximum motor current. | 1 = 1 A |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *30.18* | *Torq lim sel* | Selects a source that switches between two different predefined minimum torque limit sets.<br>0 = minimum torque limit defined by *30.19* and maximum torque limit defined by *30.20* are active<br>1 = minimum torque limit selected by *30.21* and maximum torque limit defined by *30.22* are active<br>The user can define two sets of torque limits, and switch between the sets using a binary source such as a digital input.<br>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).<br><br><br><br>**Note:** In addition to the user-defined limits, torque may be limited for other reasons (such as power limitation). See block diagram *Torque limitation* on page *312*. | *Torque limit set 1* |
| | Torque limit set 1 | 0 (minimum torque limit defined by *30.19* and maximum torque limit defined by *30.20* are active). | 0 |
| | Torque limit set 2 | 1 (minimum torque limit selected by *30.21* and maximum torque limit defined by *30.22* are active). | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…10 |
| | EFB | Only for the DCU profile. DCU control word bit 15 received through the embedded fieldbus interface. | 11 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| 30.19 | Minimum torque 1 | Defines a minimum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter 30.18 Torq lim sel.<br>The limit is effective when<br>• the source selected by 30.18 Torq lim sel is 0, or<br>• 30.18 is set to Torque limit set 1.<br>**Note:** If your application, like a pump or a fan, requires that the motor must rotate/one direction only, use speed/frequency limit (30.11 Minimum speed/30.13 Minimum frequency), or direction limit (20.21 Direction) to achieve this. Do not set parameter 30.19 Minimum torque 1 or 30.27 Power generating limit to 0%, as the drive is then not able to stop correctly. | -300.0% |
| | -1600.0…0.0% | Minimum torque limit 1. | See par. 46.03 |
| 30.20 | Maximum torque 1 | Defines a maximum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter 30.18 Torq lim sel.<br>The limit is effective when<br>• the source selected by 30.18 Torq lim sel is 0, or<br>• 30.18 is set to Torque limit set 1 | 300.0% |
| | 0.0…1600.0% | Maximum torque 1. | See par. 46.03 |
| 30.21 | Min torque 2 source | Defines the source of the minimum torque limit for the drive (in percent of nominal motor torque) when<br>• the source selected by parameter 30.18 Torq lim sel is 1, or<br>• 30.18 is set to Torque limit set 2.<br>See diagram at 30.18 Torq lim sel.<br>**Note:** Any positive values received from the selected source are inverted. | Minimum torque 2 |
| | Zero | None. | 0 |
| | AI1 scaled | 12.12 AI1 scaled value (see page 361). | 1 |
| | AI2 scaled | 12.22 AI2 scaled value (see page 363). | 2 |
| | Reserved | | 3…14 |
| | PID | 40.01 Process PID output actual (output of the process PID controller). | 15 |
| | Minimum torque 2 | 30.23 Minimum torque 2. | 16 |
| | Other | Source selection (see Terms and abbreviations on page 322). | - |
| 30.22 | Max torque 2 source | Defines the source of the maximum torque limit for the drive (in percent of nominal motor torque) when<br>• the source selected by parameter 30.18 Torq lim sel is 1, or<br>• 30.18 is set to Torque limit set 2.<br>See diagram at 30.18 Torq lim sel.<br>**Note:** Any negative values received from the selected source are inverted | Maximum torque 2 |
| | Zero | None. | 0 |
| | AI1 scaled | 12.12 AI1 scaled value (see page 361). | 1 |
| | AI2 scaled | 12.22 AI2 scaled value (see page 363). | 2 |
| | Reserved | | 3…14 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | PID | *40.01 Process PID output actual* (output of the process PID controller). | 15 |
| | Maximum torque 2 | *30.24 Maximum torque 2*. | 16 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *30.23* | *Minimum torque 2* | Defines the minimum torque limit for the drive (in percent of nominal motor torque) when<br>• the source selected by *30.18 Torq lim sel* is 1, or<br>• *30.18* is set to *Torque limit set 2*<br>and<br>• *30.21 Min torque 2 source* is set to *Minimum torque 2*.<br>See diagram at *30.18 Torq lim sel*. | -300.0% |
| | -1600.0…0.0% | Minimum torque limit 2. | See par. *46.03* |
| *30.24* | *Maximum torque 2* | Defines the maximum torque limit for the drive (in percent of nominal motor torque) when<br>The limit is effective when<br>• the source selected by *30.18 Torq lim sel* is 1, or<br>• *30.18* is set to *Torque limit set 2*<br>and<br>• *30.22 Max torque 2 source* is set to *Maximum torque 2*.<br>See diagram at *30.18 Torq lim sel*. | 300.0% |
| | 0.0…1600.0% | Maximum torque limit 2. | See par. *46.03* |
| *30.26* | *Power motoring limit* | Defines the maximum allowed power fed by the inverter to the motor in percent of nominal motor power. | 300.00% |
| | 0.00…600.00% | Maximum motoring power. | 1 = 1% |
| *30.27* | *Power generating limit* | Defines the maximum allowed power fed by the motor to the inverter in percent of nominal motor power.<br>**Note:** If your application, like a pump or a fan, requires that the motor must rotate/one direction only, use speed/frequency limit (*30.11 Minimum speed*/*30.13 Minimum frequency*), or direction limit (*20.21 Direction*) to achieve this. Do not set parameter *30.19 Minimum torque 1* or *30.27 Power generating limit* to 0%, as the drive is then not able to stop correctly. | -300.00% |
| | -600.00…0.00% | Maximum generating power. | 1 = 1% |
| *30.30* | *Overvoltage control* | Enables the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque.<br>**Note:** If the drive is equipped with a brake chopper and resistor, or a regenerative supply unit, the controller must be disabled. | *Enable* |
| | Disable | Overvoltage control disabled. | 0 |
| | Enable | Overvoltage control enabled. | 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *30.31* | *Undervoltage control* | Enables the undervoltage control of the intermediate DC link. If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor torque in order to keep the voltage above the lower limit. By decreasing the motor torque, the inertia of the load will cause regeneration back to the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to a stop. This will act as a power-loss ride-through functionality in systems with high inertia, such as a centrifuge or a fan. | *Enable* |
| | Disable | Undervoltage control disabled. | 0 |
| | Enable | Undervoltage control enabled. | 1 |
| *30.35* | *Thermal current limitation* | Enables/disables temperature-based output current limitation. The limitation should only be disabled if required by the application. | *Enable* |
| | Disable | Thermal current limitation disabled. | 0 |
| | Enable | Thermal current limitation enabled. | 1 |
| *30.36* | *Speed limit selection* | Selects a source that switches between two different predefined adjustable speed limit sets. 0 = minimum speed limit defined by *30.11* and maximum speed limit defined by *30.12* are active 1 = minimum speed limit selected by *30.37* and maximum speed limit defined by *30.38* are active. The user can define two sets of speed limits, and switch between the sets using a binary source such as a digital input. The first set of limits is defined by parameters *30.11 Minimum speed* and *30.12 Maximum speed*. The second set has selector parameters for both the minimum (*30.37*) and maximum (*30.38*) limits that allows the use of a selectable analog source (such as an analog input).<br><br>*30.37*<br>0<br>AI1<br>AI2<br>*Minimum speed*<br>*Other*<br>*30.11*<br>*30.36*<br>1<br>0<br>User-defined minimum speed limit<br><br>*30.38*<br>0<br>AI1<br>AI2<br>*Maximum speed*<br>*Other*<br>*30.12*<br>*30.36*<br>1<br>0<br>User-defined maximum speed limit | *Not selected* |
| | Not selected | Adjustable speed limits are disabled. (Minimum speed limit defined by *30.11 Minimum speed* and maximum speed limit defined by *30.12 Maximum speed* are active). | 0 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Selected | Adjustable speed limits are enabled.<br>(Minimum speed limit defined by *30.37 Minimum speed source* and maximum speed limit defined by *30.38 Maximum speed source* are active). | 1 |
| | Ext1 active | Adjustable speed limits are enabled if EXT1 is active. | 2 |
| | Ext2 active | Adjustable speed limits are enabled if EXT2 is active. | 3 |
| | Reserved | | 4 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 5 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 6 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 7 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 8 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 9 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 10 |
| | Reserved | | 11 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *30.37* | *Minimum speed source* | Defines the source of a minimum speed limit for the drive when the source is selected by *30.36 Speed limit selection*.<br>**Note:** In vector motor control mode only. In scalar motor control mode, use frequency limits *30.13* and *30.14*. | *Minimum speed* |
| | Zero | None. | 0 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 1 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 2 |
| | Reserved | | 3…10 |
| | Minimum speed | *30.11 Minimum speed*. | 11 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *30.38* | *Maximum speed source* | Defines the source of a maximum speed limit for the drive when the source is selected by *30.36 Speed limit selection*.<br>**Note:** In vector motor control mode only. In scalar motor control mode, use frequency limits *30.13* and *30.14*. | *Maximum speed* |
| | Zero | None. | 0 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 1 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 2 |
| | Reserved | | 3…11 |
| | Maximum speed | *30.12 Maximum speed*. | 12 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |

| **31 Fault functions** | Configuration of external events; selection of behavior of the drive upon fault situations. | |
|---|---|---|
| *31.01* *External event 1 source* | Defines the source of external event 1.<br>See also parameter *31.02 External event 1 type*.<br>0 = Trigger event<br>1 = Normal operation | *Inactive (true)* |
| Active (false) | 0. | 0 |
| Inactive (true) | 1. | 1 |
| Reserved | | 2 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 3 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 4 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 5 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 6 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 7 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 8 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *31.02* | *External event 1 type* | Selects the type of external event 1. | *Fault* |
| | Fault | The external event generates a fault. | 0 |
| | Warning | The external event generates a warning. | 1 |
| *31.03* | *External event 2 source* | Defines the source of external event 2. See also parameter *31.04 External event 2 type*. For the selections, see parameter *31.01 External event 1 source*. | *Inactive (true)* |
| *31.04* | *External event 2 type* | Selects the type of external event 2. | *Fault* |
| | Fault | The external event generates a fault. | 0 |
| | Warning | The external event generates a warning. | 1 |
| *31.05* | *External event 3 source* | Defines the source of external event 3. See also parameter *31.06 External event 3 type*. For the selections, see parameter *31.01 External event 1 source*. | *Inactive (true)* |
| *31.06* | *External event 3 type* | Selects the type of external event 3. | *Fault* |
| | Fault | The external event generates a fault. | 0 |
| | Warning | The external event generates a warning. | 1 |
| *31.07* | *External event 4 source* | Defines the source of external event 4. See also parameter *31.08 External event 4 type*. For the selections, see parameter *31.01 External event 1 source*. | *Inactive (true)* |
| *31.08* | *External event 4 type* | Selects the type of external event 4. | *Fault* |
| | Fault | The external event generates a fault. | 0 |
| | Warning | The external event generates a warning. | 1 |
| *31.09* | *External event 5 source* | Defines the source of external event 5. See also parameter *31.10 External event 5 type*. For the selections, see parameter *31.01 External event 1 source*. | *Inactive (true)* |
| *31.10* | *External event 5 type* | Selects the type of external event 5. | *Fault* |
| | Fault | The external event generates a fault. | 0 |
| | Warning | The external event generates a warning. | 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *31.11* | *Fault reset selection* | Selects the source of an external fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists.<br>0 -> 1 = Reset<br>**Note:** A fault reset from the fieldbus interface is always observed regardless of this parameter. | *Not used* |
| | Not used | 0. | 0 |
| | Not used | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Reserved | | 21…23 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 24 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 25 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 26 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *31.12* | *Autoreset selection* | Selects faults that are automatically reset. The parameter is a 16-bit word with each bit corresponding to a fault type. Whenever a bit is set to 1, the corresponding fault is automatically reset.<br>**Note:** Infinite reset trials are executed if parameter *70.02 Override enable* is set to value *On, critical*.<br>⚠ **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.<br>The bits of this binary number correspond to the following faults: | 000Ch (00…1100b) |

| Bit | Fault |
|---|---|
| 0 | Overcurrent |
| 1 | Overvoltage |
| 2 | Undervoltage |
| 3 | AI supervision fault |
| 4…9 | Reserved |
| 10 | Selectable fault (see parameter *31.13 Selectable fault*) |
| 11 | External fault 1 (from source selected by parameter *31.01 External event 1 source*) |
| 12 | External fault 2 (from source selected by parameter *31.03 External event 2 source*) |
| 13 | External fault 3 (from source selected by parameter *31.05 External event 3 source*) |
| 14 | External fault 4 (from source selected by parameter *31.07 External event 4 source*) |
| 15 | External fault 5 (from source selected by parameter *31.09 External event 5 source*) |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h…FFFFh | Automatic reset configuration word. | 1 = 1 |
| *31.13* | *Selectable fault* | Defines the fault that can be automatically reset using parameter *31.12 Autoreset selection*, bit 10.<br>Faults are listed in chapter *Fault tracing* (page *198*). | 0000h |
| | 0000h…FFFFh | Fault code. | 10 = 1 |
| *31.14* | *Number of trials* | Defines the number of automatic fault resets the drive performs within the time defined by parameter *31.15 Total trials time*. | 0 |
| | 0…5 | Number of automatic resets. | 10 = 1 |
| *31.15* | *Total trials time* | Defines a time window for automatic fault resets. The maximum number of attempts made during any period of this length is defined by *31.14 Number of trials*.<br>**Note:** If the fault condition remains and cannot be reset, each reset attempt will generate an event and start a new time window. In practice, if the specified number of resets (*31.14*) at specified intervals (*31.16*) take longer than the value of *31.15*, the drive will continue to attempt resetting the fault until the cause is eventually removed. | 30.0 s |
| | 1.0…600.0 s | Time for automatic resets. | 10 = 1 s |
| *31.16* | *Delay time* | Defines the time that the drive will wait after a fault before attempting an automatic reset. See parameter *31.12 Autoreset selection*. | 0.0 s |
| | 0.0…120.0 s | Autoreset delay. | 10 = 1 s |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *31.19* | *Motor phase loss* | Selects how the drive reacts when a motor phase loss is detected.<br>In scalar motor control mode:<br>• 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.<br>• If the motor nominal current is below 1/6 of the drive nominal current or there is no motor connected, ABB recommends to disable the motor output phase loss function. | *Fault* |
| | No action | No action taken. | 0 |
| | Fault | Drive trips on fault *3381 Output phase loss*. | 1 |
| *31.20* | *Earth fault* | Selects how the drive reacts when an earth (ground) fault or current unbalance is detected in the motor or the motor cable. | *Fault* |
| | No action | No action taken. | 0 |
| | Warning | Drive generates warning *A2B3 Earth leakage*. | 1 |
| | Fault | Drive trips on fault *2330 Earth leakage*. | 2 |
| *31.21* | *Supply phase loss* | Selects how the drive reacts when a supply phase loss is detected. | *Fault* |
| | No action | No action taken. | 0 |
| | Fault | Drive trips on fault *3130 Input phase loss*. | 1 |
| *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.<br>The tables at each selection below show the indications generated with that particular setting.<br>**Notes:**<br>• 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.<br>• The loss of only one STO signal always generates a fault as it is interpreted as a malfunction.<br>For more information on the STO, see chapter *The Safe torque off function* in the *Hardware manual* of the drive. | *Fault/Fault* |
| | Fault/Fault | <table><tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr><tr><th>IN1</th><th>IN2</th></tr><tr><td>0</td><td>0</td><td>Fault *5091 Safe torque off*</td></tr><tr><td>0</td><td>1</td><td>Faults *5091 Safe torque off*<br>and<br>*FA81 Safe torque off 1*</td></tr><tr><td>1</td><td>0</td><td>Faults *5091 Safe torque off*<br>and<br>*FA82 Safe torque off 2*</td></tr><tr><td>1</td><td>1</td><td>(Normal operation)</td></tr></table> | 0 |

**13**

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

**Fault/Warning** — Def/FbEq16: 1

| Inputs | | Indication | |
|---|---|---|---|
| IN1 | IN2 | Running | Stopped |
| 0 | 0 | Fault *5091 Safe torque off* | Warning *A5A0 Safe torque off* |
| 0 | 1 | Faults *5091 Safe torque off* and *FA81 Safe torque off 1* | Warning *A5A0 Safe torque off* and fault *FA81 Safe torque off 1* |
| 1 | 0 | Faults *5091 Safe torque off* and *FA82 Safe torque off 2* | Warning *A5A0 Safe torque off* and fault *FA82 Safe torque off 2* |
| 1 | 1 | (Normal operation) | |

**Fault/Event** — Def/FbEq16: 2

| Inputs | | Indication | |
|---|---|---|---|
| IN1 | IN2 | Running | Stopped |
| 0 | 0 | Fault *5091 Safe torque off* | Event *B5A0 STO event* |
| 0 | 1 | Faults *5091 Safe torque off* and *FA81 Safe torque off 1* | Event *B5A0 STO event* and fault *FA81 Safe torque off 1* |
| 1 | 0 | Faults *5091 Safe torque off* and *FA82 Safe torque off 2* | Event *B5A0 STO event* and fault *FA82 Safe torque off 2* |
| 1 | 1 | (Normal operation) | |

**Warning/Warning** — Def/FbEq16: 3

| Inputs | | Indication (running or stopped) |
|---|---|---|
| IN1 | IN2 | |
| 0 | 0 | Warning *A5A0 Safe torque off* |
| 0 | 1 | Warning *A5A0 Safe torque off* and fault *FA81 Safe torque off 1* |
| 1 | 0 | Warning *A5A0 Safe torque off* and fault *FA82 Safe torque off 2* |
| 1 | 1 | (Normal operation) |

**Event/Event** — Def/FbEq16: 4

| Inputs | | Indication (running or stopped) |
|---|---|---|
| IN1 | IN2 | |
| 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) |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | No indication/No indication | | 5 |

| Inputs | | Indication (running or stopped) |
|---|---|---|
| IN1 | IN2 | |
| 0 | 0 | None |
| 0 | 1 | Fault *FA81 Safe torque off 1* |
| 1 | 0 | Fault *FA82 Safe torque off 2* |
| 1 | 1 | (Normal operation) |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *31.23* | *Wiring or earth fault* | Selects how the drive reacts to incorrect input power and motor cable connection (ie. input power cable is connected to drive motor connection). | *Fault* |
| | No action | No action taken. | 0 |
| | Fault | Drive trips on fault *3181 Wiring or earth fault*. | 1 |
| *31.24* | *Stall function* | Selects how the drive reacts to a motor stall condition.<br>A stall condition is defined as follows:<br>• The drive exceeds the stall current limit (*31.25 Stall current limit*), and<br>• the output frequency is below the level set by parameter *31.27 Stall frequency limit* or the motor speed is below the level set by parameter *31.26 Stall speed limit*, and<br>• the conditions above have been true longer than the time set by parameter *31.28 Stall time*. | *No action* |
| | No action | None (stall supervision disabled). | 0 |
| | Warning | Drive generates warning *A780 Motor stall*. | 1 |
| | Fault | Drive trips on fault *7121 Motor stall*. | 2 |
| *31.25* | *Stall current limit* | Stall current limit in percent of the nominal current of the motor. See parameter *31.24 Stall function*. | 200.0% |
| | 0.0…1600.0% | Stall current limit. | 10 = 1% |
| *31.26* | *Stall speed limit* | Stall speed limit in rpm. See parameter *31.24 Stall function*. | 150.00 rpm; 180.00 rpm (*95.20* b0) |
| | 0.00…10000.00 rpm | Stall speed limit. | See par. *46.01* |
| *31.27* | *Stall frequency limit* | Stall frequency limit. See parameter *31.24 Stall function*.<br>**Note:** Setting the limit below 10 Hz is not recommended. | 15.00 Hz; 18.00 Hz (*95.20* b0) |
| | 0.00…1000.00 Hz | Stall frequency limit. | See par. *46.02* |
| *31.28* | *Stall time* | Stall time. See parameter *31.24 Stall function*. | 20 s |
| | 0…3600 s | Stall time. | 1 = 1 s |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *31.30* | *Overspeed trip margin* | Defines, together with *30.11 Minimum speed* and *30.12 Maximum speed*, the maximum allowed speed of the motor (overspeed protection). If the speed (*24.02 Used speed feedback*) exceeds the speed limit defined by parameter *30.11* or *30.12* by more than the value of this parameter, the drive trips on the *7310 Overspeed* fault. | 500.00 rpm; 500.00 rpm (*95.20* b0) |
| | | ⚠ **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. | |
| | |  | |
| | 0.00…10000.00 rpm | Overspeed trip margin. | See par. *46.01* |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| 31.31 | Frequency trip margin | Defines, together with 30.13 Minimum frequency and 30.14 Maximum frequency, the maximum allowed frequency of the motor (overfrequency protection). The absolute value of this overfrequency trip level is calculated by adding the value of this parameter to the higher of the absolute values of 30.13 Minimum frequency and 30.14 Maximum frequency. If the output frequency (01.06 Output frequency) exceeds the overfrequency trip level (ie. the absolute value of the output frequency exceeds the absolute value of the overfrequency trip level), the drive trips on fault 73F0 Overfrequency. ⚠ WARNING! This function only supervises the frequency in scalar motor control mode. <br><br>*Frequency* <br> Overfrequency trip level <br> 31.31 <br> 30.14 <br> ABS(30.14) <br> 0 ⸻ *Time* <br> ABS(30.14) <br> 30.13 <br> 31.31 <br> Overfrequency trip level | 15.00 Hz |
| | 0.00…10000.00 Hz | Overfrequency trip margin. | 1 = 1 Hz |
| 31.32 | Emergency ramp supervision | Parameters 31.32 Emergency ramp supervision and 31.33 Emergency ramp supervision delay, together with the derivative of 24.02 Used speed feedback, provide a supervision function for emergency stop modes Off1 and Off3. <br> The supervision is based on either <br> • observing the time within which the motor stops, or <br> • comparing the actual and expected deceleration rates. <br> If this parameter is set to 0%, the maximum stop time is directly set in parameter 31.33. Otherwise, 31.32 defines the maximum allowed deviation from the expected deceleration rate, which is calculated from parameters 23.11…23.15 (Off1) or 23.23 Emergency stop time (Off3). If the actual deceleration rate (24.02) deviates too much from the expected rate, the drive trips on fault 73B0 Emergency ramp failed, sets bit 8 of 06.17 Drive status word 2, and coasts to a stop. <br> If 31.32 is set to 0% and 31.33 is set to 0 s, the emergency stop ramp supervision is disabled. <br> See also parameter 21.04 Emergency stop mode. | 0% |
| | 0…300% | Maximum deviation from expected deceleration rate. | 1 = 1% |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| *31.33* | *Emergency ramp supervision delay* | If parameter *31.32 Emergency ramp supervision* is set to 0%, this parameter defines the maximum time an emergency stop (mode Off1 or Off3) is allowed to take. If the motor has not stopped when the time elapses, the drive trips on fault *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop.<br>If *31.32* is set to a value other than 0%, this parameter defines a delay between the receipt of the emergency stop command and the activation of the supervision. It is recommended to specify a short delay to allow the speed change rate to stabilize. | 0 s |
| | 0…100 s | Maximum ramp-down time, or supervision activation delay. | 1 = 1 s |
| **32 Supervision** | | Configuration of signal supervision functions 1…6.<br>Six values can be chosen to be monitored; a warning or fault is generated whenever predefined limits are exceeded.<br>See also section *Diagnostics menu* (page *179*). | |
| *32.01* | *Supervision status* | Signal supervision status word.<br>Indicates whether the values monitored by the signal supervision functions are within or outside their respective limits.<br>**Note:** This word is independent of the drive actions defined by parameters *32.06*, *32.16*, *32.26*, *32.36*, *32.46* and *32.56*. | 0000b |

| Bit | Name | Description |
|-----|------|-------------|
| 0 | Supervision 1 active | 1 = Signal selected by *32.07* is outside its limits. |
| 1 | Supervision 2 active | 1 = Signal selected by *32.17* is outside its limits. |
| 2 | Supervision 3 active | 1 = Signal selected by *32.27* is outside its limits. |
| 3 | Supervision 4 active | 1 = Signal selected by *32.37* is outside its limits. |
| 4 | Supervision 5 active | 1 = Signal selected by *32.47* is outside its limits. |
| 5 | Supervision 6 active | 1 = Signal selected by *32.27* is outside its limits. |
| 6…15 | Reserved | |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| | 0000h…FFFFh | Signal supervision status word. | 1 = 1 |
| *32.05* | *Supervision 1 function* | Selects the mode of signal supervision function 1. Determines how the monitored signal (see parameter *32.07*) is compared to its lower and upper limits (*32.09* and *32.10* respectively). The action to be taken when the condition is fulfilled is selected by *32.06*. | *Disabled* |
| | Disabled | Signal supervision 1 not in use. | 0 |
| | Low | Action is taken whenever the signal falls below its lower limit. | 1 |
| | High | Action is taken whenever the signal rises above its upper limit. | 2 |
| | Abs low | Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit. | 3 |
| | Abs high | Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit. | 4 |
| | Both | Action is taken whenever the signal falls below its low limit or rises above its high limit. | 5 |
| | Abs both | Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit. | 6 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | Hysteresis | See parameter *32.11 Supervision 1 hysteresis*. | 7 |
| *32.06* | *Supervision 1 action* | Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 1 exceeds its limits.<br>**Note:** This parameter does not affect the status indicated by *32.01 Supervision status*. | *No action* |
| | No action | No warning or fault generated. | 0 |
| | Warning | Drive generates warning *A8B0 ABB Signal supervision 1*. | 1 |
| | Fault | Drive trips on fault *80B0 Signal supervision 1*. | 2 |
| | Fault if running | If running, the drive trips on fault *80B0 Signal supervision 1*. | 3 |
| *32.07* | *Supervision 1 signal* | Selects the signal to be monitored by signal supervision function 1. | *Frequency* |
| | Zero | None. | 0 |
| | Speed | *01.01 Motor speed used* (page *325*). | 1 |
| | Reserved | | 2 |
| | Frequency | *01.06 Output frequency* (page *325*). | 3 |
| | Current | *01.07 Motor current* (page *325*). | 4 |
| | Reserved | | 5 |
| | Torque | *01.10 Motor torque* (page *325*). | 6 |
| | DC voltage | *01.11 DC voltage* (page *325*). | 7 |
| | Output power | *01.14 Output power* (page *326*). | 8 |
| | AI1 | *12.11 AI1 actual value* (page *361*). | 9 |
| | AI2 | *12.21 AI2 actual value* (page *363*). | 10 |
| | Reserved | | 11…17 |
| | Speed ref ramp in | *23.01 Speed ref ramp input* (page *397*). | 18 |
| | Speed ref ramp out | *23.02 Speed ref ramp output* (page *397*). | 19 |
| | Speed ref used | *24.01 Used speed reference* (page *400*). | 20 |
| | Reserved | | |
| | Freq ref used | *28.02 Frequency ref ramp output* (page *405*). | 22 |
| | Inverter temperature | *05.11 Inverter temperature* (page *331*). | 23 |
| | Process PID output | *40.01 Process PID output actual* (page *463*). | 24 |
| | Process PID feedback | *40.02 Process PID feedback actual* (page *463*). | 25 |
| | Process PID setpoint | *40.03 Process PID setpoint actual* (page *464*). | 26 |
| | Process PID deviation | *40.04 Process PID deviation actual* (page *464*). | 27 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *32.08* | *Supervision 1 filter time* | Defines a filter time constant for the signal monitored by signal supervision 1. | 0.000 s |
| | 0.000 … 30.000 s | Signal filter time. | 1000 = 1 s |
| *32.09* | *Supervision 1 low* | Defines the lower limit for signal supervision 1. | 0.00 |
| | -21474836.00… 21474836.00 | Low limit. | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *32.10* | *Supervision 1 high* | Defines the upper limit for signal supervision 1. | 0.00 |
| | -21474836.00… 21474836.00 | Upper limit. | - |
| *32.11* | *Supervision 1 hysteresis* | Defines the hysteresis for the signal monitored by signal supervision 1. Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis. | 0.00 |
| | 0.00…100000.00 | Hysteresis. | - |
| *32.15* | *Supervision 2 function* | Selects the mode of signal supervision function 2. Determines how the monitored signal (see parameter *32.17*) is compared to its lower and upper limits (*32.19* and *32.20* respectively). The action to be taken when the condition is fulfilled is selected by *32.16*. | *Disabled* |
| | Disabled | Signal supervision 2 not in use. | 0 |
| | Low | Action is taken whenever the signal falls below its lower limit. | 1 |
| | High | Action is taken whenever the signal rises above its upper limit. | 2 |
| | Abs low | Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit. | 3 |
| | Abs high | Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit. | 4 |
| | Both | Action is taken whenever the signal falls below its low limit or rises above its high limit. | 5 |
| | Abs both | Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit. | 6 |
| | Hysteresis | See parameter *32.21 Supervision 2 hysteresis*. | 7 |
| *32.16* | *Supervision 2 action* | Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 2 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*. | *No action* |
| | No action | No warning or fault generated. | 0 |
| | Warning | Drive generates warning *A8B1 ABB Signal supervision 2*. | 1 |
| | Fault | Drive trips on fault *80B1 Signal supervision 2*. | 2 |
| | Fault if running | If running, the drive trips on fault *80B1 Signal supervision 2*. | 3 |
| *32.17* | *Supervision 2 signal* | Selects the signal to be monitored by signal supervision function 2. For the available selections, see parameter *32.07 Supervision 1 signal*. | *Current* |
| *32.18* | *Supervision 2 filter time* | Defines a filter time constant for the signal monitored by signal supervision 2. | 0.000 s |
| | 0.000 … 30.000 s | Signal filter time. | 1000 = 1 s |
| *32.19* | *Supervision 2 low* | Defines the lower limit for signal supervision 2. | 0.00 |
| | -21474836.00… 21474836.00 | Low limit. | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *32.20* | *Supervision 2 high* | Defines the upper limit for signal supervision 2. | 0.00 |
| | -21474836.00… 21474836.00 | Upper limit. | - |
| *32.21* | *Supervision 2 hysteresis* | Defines the hysteresis for the signal monitored by signal supervision 2. Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis. | 0.00 |
| | 0.00…100000.00 | Hysteresis. | - |
| *32.25* | *Supervision 3 function* | Selects the mode of signal supervision function 3. Determines how the monitored signal (see parameter *32.27*) is compared to its lower and upper limits (*32.29* and *32.30* respectively). The action to be taken when the condition is fulfilled is selected by *32.26*. | *Disabled* |
| | Disabled | Signal supervision 3 not in use. | 0 |
| | Low | Action is taken whenever the signal falls below its lower limit. | 1 |
| | High | Action is taken whenever the signal rises above its upper limit. | 2 |
| | Abs low | Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit. | 3 |
| | Abs high | Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit. | 4 |
| | Both | Action is taken whenever the signal falls below its low limit or rises above its high limit. | 5 |
| | 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 | See parameter *32.31 Supervision 3 hysteresis*. | 7 |
| *32.26* | *Supervision 3 action* | Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 3 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*. | *No action* |
| | No action | No warning or fault generated. | 0 |
| | Warning | Drive generates warning *A8B2 ABB Signal supervision 3*. | 1 |
| | Fault | Drive trips on fault *80B2 Signal supervision 3*. | 2 |
| | Fault if running | If running, the drive trips on fault *80B2 Signal supervision 3*. | 3 |
| *32.27* | *Supervision 3 signal* | Selects the signal to be monitored by signal supervision function 3. For the available selections, see parameter *32.07 Supervision 1 signal*. | *Torque* |
| *32.28* | *Supervision 3 filter time* | Defines a filter time constant for the signal monitored by signal supervision 3. | 0.000 s |
| | 0.000 … 30.000 s | Signal filter time. | 1000 = 1 s |
| *32.29* | *Supervision 3 low* | Defines the lower limit for signal supervision 3. | 0.00 |
| | -21474836.00… 21474836.00 | Low limit. | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *32.30* | *Supervision 3 high* | Defines the upper limit for signal supervision 3. | 0.00 |
| | -21474836.00… 21474836.00 | Upper limit. | - |
| *32.31* | *Supervision 3 hysteresis* | Defines the hysteresis for the signal monitored by signal supervision 3.<br>Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis. | 0.00 |
| | 0.00…100000.00 | Hysteresis. | - |
| *32.35* | *Supervision 4 function* | Selects the mode of signal supervision function 4. Determines how the monitored signal (see parameter *32.37*) is compared to its lower and upper limits (*32.39* and *32.30* respectively). The action to be taken when the condition is fulfilled is selected by *32.36*. | *Disabled* |
| | Disabled | Signal supervision 4 not in use. | 0 |
| | Low | Action is taken whenever the signal falls below its lower limit. | 1 |
| | High | Action is taken whenever the signal rises above its upper limit. | 2 |
| | Abs low | Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit. | 3 |
| | Abs high | Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit. | 4 |
| | Both | Action is taken whenever the signal falls below its low limit or rises above its high limit. | 5 |
| | Abs both | Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit. | 6 |
| | Hysteresis | See parameter *32.41 Supervision 4 hysteresis*. | 7 |
| *32.36* | *Supervision 4 action* | Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 4 exceeds its limits.<br>**Note:** This parameter does not affect the status indicated by *32.01 Supervision status*. | *No action* |
| | No action | No warning or fault generated. | 0 |
| | Warning | Drive generates warning *A8B3 ABB Signal supervision 4*. | 1 |
| | Fault | Drive trips on fault *80B3 Signal supervision 4*. | 2 |
| | Fault if running | 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.<br>For the available selections, see parameter *32.07 Supervision 1 signal*. | *Zero* |
| *32.38* | *Supervision 4 filter time* | Defines a filter time constant for the signal monitored by signal supervision 4. | 0.000 s |
| | 0.000 … 30.000 s | Signal filter time. | 1000 = 1 s |
| *32.39* | *Supervision 4 low* | Defines the lower limit for signal supervision 4. | 0.00 |
| | -21474836.00… 21474836.00 | Low limit. | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *32.40* | *Supervision 4 high* | Defines the upper limit for signal supervision 4. | 0.00 |
| | -21474836.00… 21474836.00 | Upper limit. | - |
| *32.41* | *Supervision 4 hysteresis* | Defines the hysteresis for the signal monitored by signal supervision 4. Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis. | 0.00 |
| | 0.00…100000.00 | Hysteresis. | - |
| *32.45* | *Supervision 5 function* | Selects the mode of signal supervision function 5. Determines how the monitored signal (see parameter *32.47*) is compared to its lower and upper limits (*32.49* and *32.40* respectively). The action to be taken when the condition is fulfilled is selected by *32.46*. | *Disabled* |
| | Disabled | Signal supervision 5 not in use. | 0 |
| | Low | Action is taken whenever the signal falls below its lower limit. | 1 |
| | High | Action is taken whenever the signal rises above its upper limit. | 2 |
| | Abs low | Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit. | 3 |
| | Abs high | Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit. | 4 |
| | Both | Action is taken whenever the signal falls below its low limit or rises above its high limit. | 5 |
| | Abs both | Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit. | 6 |
| | Hysteresis | See parameter *32.51 Supervision 5 hysteresis*. | 7 |
| *32.46* | *Supervision 5 action* | Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 5 exceeds its limits.<br>**Note:** This parameter does not affect the status indicated by *32.01 Supervision status*. | *No action* |
| | No action | No warning or fault generated. | 0 |
| | Warning | Drive generates warning *A8B4 ABB Signal supervision 5*. | 1 |
| | Fault | Drive trips on fault *80B4 Signal supervision 5*. | 2 |
| | Fault if running | Drive trips on fault *80B4 Signal supervision 5* if the motor is running. | 3 |
| *32.47* | *Supervision 5 signal* | Selects the signal to be monitored by signal supervision function 5. For the available selections, see parameter *32.07 Supervision 1 signal*. | *Zero* |
| *32.48* | *Supervision 5 filter time* | Defines a filter time constant for the signal monitored by signal supervision 5. | 0.000 s |
| | 0.000 … 30.000 s | Signal filter time. | 1000 = 1 s |
| *32.49* | *Supervision 5 low* | Defines the lower limit for signal supervision 5. | 0.00 |
| | -21474836.00… 21474836.00 | Low limit. | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *32.50* | *Supervision 5 high* | Defines the upper limit for signal supervision 5. | 0.00 |
| | -21474836.00… 21474836.00 | Upper limit. | - |
| *32.51* | *Supervision 5 hysteresis* | Defines the hysteresis for the signal monitored by signal supervision 5. Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis. | 0.00 |
| | 0.00…100000.00 | Hysteresis. | - |
| *32.55* | *Supervision 6 function* | Selects the mode of signal supervision function 6. Determines how the monitored signal (see parameter *32.57*) is compared to its lower and upper limits (*32.59* and *32.50* respectively). The action to be taken when the condition is fulfilled is selected by *32.56*. | *Disabled* |
| | Disabled | Signal supervision 6 not in use. | 0 |
| | Low | Action is taken whenever the signal falls below its lower limit. | 1 |
| | High | Action is taken whenever the signal rises above its upper limit. | 2 |
| | Abs low | Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit. | 3 |
| | Abs high | Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit. | 4 |
| | Both | Action is taken whenever the signal falls below its low limit or rises above its high limit. | 5 |
| | Abs both | Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit. | 6 |
| | Hysteresis | See parameter *32.61 Supervision 6 hysteresis*. | 7 |
| *32.56* | *Supervision 6 action* | Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 6 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*. | *No action* |
| | No action | No warning or fault generated. | 0 |
| | Warning | Drive generates warning *A8B5 ABB Signal supervision 6*. | 1 |
| | Fault | Drive trips on fault *80B5 Signal supervision 6* is generated. | 2 |
| | Fault if running | Drive trips on fault *80B5 Signal supervision 6* is generated if the motor is running. | 3 |
| *32.57* | *Supervision 6 signal* | Selects the signal to be monitored by signal supervision function 6. For the available selections, see parameter *32.07 Supervision 1 signal*. | *Zero* |
| *32.58* | *Supervision 6 filter time* | Defines a filter time constant for the signal monitored by signal supervision 6. | 0.000 s |
| | 0.000 … 30.000 s | Signal filter time. | 1000 = 1 s |
| *32.59* | *Supervision 6 low* | Defines the lower limit for signal supervision 6. | 0.00 |
| | -21474836.00… 21474836.00 | Low limit. | - |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *32.60* | *Supervision 6 high* | Defines the upper limit for signal supervision 6. | 0.00 |
| | -21474836.00… 21474836.00 | Upper limit. | - |
| *32.61* | *Supervision 6 hysteresis* | Defines the hysteresis for the signal monitored by signal supervision 6. Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis. | 0.00 |
| | 0.00…100000.00 | Hysteresis. | - |
| **34 Timed functions** | | Configuration of the timed functions. See section *Timed functions* on page *118*. | |
| *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. | - |

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

| | 0000h…0FFFFh | Status of combined timers 1…3. | 1 = 1 |
|---|---|---|---|
| *34.02* | *Timer status* | Status of timers 1…12. This parameter is read-only. | - |

| Bit | Name | Description |
|---|---|---|
| 0 | Timer 1 | 1 = Active. |
| 1 | Timer 2 | 1 = Active. |
| 2 | Timer 3 | 1 = Active. |
| 3 | Timer 4 | 1 = Active. |
| 4 | Timer 5 | 1 = Active. |
| 5 | Timer 6 | 1 = Active. |
| 6 | Timer 7 | 1 = Active. |
| 7 | Timer 8 | 1 = Active. |
| 8 | Timer 9 | 1 = Active. |
| 9 | Timer 10 | 1 = Active. |
| 10 | Timer 11 | 1 = Active. |
| 11 | Timer 12 | 1 = Active. |
| 12…15 | Reserved | |

| | 0000h…FFFFh | Timer status. | 1 = 1 |
|---|---|---|---|

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *34.04* | *Season/exception day status* | Status of seasons 1…4, exception weekday and exception holiday. Only one season can be active at a time. A day can be a workday and a holiday at the same time.<br>This parameter is read-only. | - |

| Bit | Name | Description |
|---|---|---|
| 0 | Season 1 | 1 = Active. |
| 1 | Season 2 | 1 = Active. |
| 2 | Season 3 | 1 = Active. |
| 3 | Season 4 | 1 = Active. |
| 4…9 | Reserved | |
| 10 | Exception workday | 1 = Active. |
| 11 | Exception holiday | 1 = Active. |
| 12…15 | Reserved | |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h…FFFFh | Status of the seasons and exception weekday and holiday. | 1 = 1 |
| *34.10* | *Timed functions enable* | Selects the source for the timed functions enable signal.<br>0 = Disabled.<br>1 = Enabled. | *Disabled* |
| | Disabled | 0. | 0 |
| | Enabled | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |

**13**

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

| Bit | Name | Description |
|-----|------|-------------|
| 0 | Monday | 1 = Monday is an active start day. |
| 1 | Tuesday | 1 = Tuesday is an active start day. |
| 2 | Wednesday | 1 = Wednesday is an active start day. |
| 3 | Thursday | 1 = Thursday is an active start day. |
| 4 | Friday | 1 = Friday is an active start day. |
| 5 | Saturday | 1 = Saturday is an active start day. |
| 6 | Sunday | 1 = Sunday is an active start day. |
| 7 | Season 1 | 1 = Timer is active in season 1. |
| 8 | Season 2 | 1 = Timer is active in season 2. |
| 9 | Season 3 | 1 = Timer is active in season 3. |
| 10 | Season 4 | 1 = Timer is active in season 4. |
| 11 | Exceptions | 0 = Exceptions days are disabled. The timer follows only weekday and season settings (bits 0…10 in the timer configuration) and the start time and duration of the timer (see *34.12* and *34.13*). Exception day settings, parameters *34.70*…*34.90*, do not have any effect on this timer. 1 = Exception days are enabled. The timer is active during the weekdays and seasons defined with bits 0…10 and the times defined by *34.12* and *34.13*. In addition, the timer is active during the exception days defined with bit 12, bit 13 and parameters *34.70*…*34.90*. If bit 12 and bit 13 are both zero, the timer is inactive during the exception days. |
| 12 | Holidays | This bit has no effect unless bit 11 = 1 (Exceptions days are enabled). When bits 11 and 12 are both 1, the timer is active during the weekdays and seasons defined with bits 0…10 and times defined by parameters *34.12* and *34.13*. In addition, the timer is active when the ongoing day is defined as Exception day Holiday by parameters *34.70*…*34.90* and the current time matches with the time range defined by *34.12* and *34.13*. During Exception days, weekday and season bits are ignored. |
| 13 | Workdays | This bit has no effect unless bit 11 = 1 (Exceptions enabled). When bits 11 and 13 are both 1, the Timer is active during the weekdays and seasons defined with bits 0…10 and the times defined by parameters *34.12* and *34.13*. In addition, the timer is active when the ongoing day is defined as Exception day Workday by parameters *34.70*…*34.90* and the current time matches with the time range defined by *34.12* and *34.13*. During Exception days, weekday and season bits are ignored. |
| 14…15 | Reserved | |

**13**

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

| Bits of parameter *34.11 Timer 1 configuration* | | | | | | | | | | | | | | Description |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday | Season1 | Season2 | Season3 | Season4 | Exceptions | Holidays | Workdays | |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | **Example 1:** Timer is active during the times of the day defined by other parameters <u>every Weekday</u> and <u>every Season</u>.<br>Exception day settings (*34.70…34.90*) do not have any effect on the Timer. |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | **Example 2:** Timer is active during the times of the day defined by other parameters from <u>Mon to Fri</u>, every Season.<br>Exception day settings (*34.70…34.90*) do not have any effect on the Timer. |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | **Example 3:** Timer is active during the times of the day defined by other parameters from Mon to Fri, <u>only during Season 3</u> (can be configured as, eg, summer).<br>Exception day settings (*34.70…34.90*) do not have any effect on the Timer. |
| 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | **1** | **1** | 0 | **Example 4:** Timer is active during the times of the day defined by other parameters from Mon to Fri, every Season.<br>In addition, the Timer is active <u>every Exception day Holidays, regardless what is the day or season</u>. |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | **1** | 0 | **1** | **Example 5:** Timer is active during the times of the day defined by other parameters on Mon, Wed, Fri and Sun, during Season1 and Season 2.<br>In addition, the Timer is active every <u>Exception day Workdays, regardless what is the day or season</u>. |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | **1** | 0 | 0 | **Example 6:** Timer is active during the times of the day defined by other parameters every Weekday and every Season.<br>The Timer is <u>inactive during all Exception days</u>. |

| | 0000h…FFFFh | Configuration of timer 1. | 1 = 1 |
|---|---|---|---|
| *34.12* | *Timer 1 start time* | Defines the daily start time of timer 1. The time can be changed in second steps.<br>The timer can be started at an other time than the start time. For example, if the timer's duration is more than one day and the active session starts during the time, the timer is started at 00:00 and stopped when there is no duration left. | 00:00:00 |
| | 00:00:00…23:59:59 | Daily start time of the timer. | 1 = 1 |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *34.13* | *Timer 1 duration* | Defines the duration of timer 1. The duration can be changed in minute steps.<br>The duration can extend over the change of the day but if an exception day becomes active, the period is interrupted at midnight. In the same way the period started on an exception day stays active only until the end of the day, even if the duration is longer. The timer will continue after a break if there is duration left. | 00 00:00 |
| | 00 00:00…07 00:00 | Timer duration. | 1 = 1 |
| *34.14* | *Timer 2 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |
| *34.15* | *Timer 2 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.16* | *Timer 2 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.17* | *Timer 3 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |
| *34.18* | *Timer 3 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.19* | *Timer 3 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.20* | *Timer 4 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |
| *34.21* | *Timer 4 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.22* | *Timer 4 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.23* | *Timer 5 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |
| *34.24* | *Timer 5 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.25* | *Timer 5 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.26* | *Timer 6 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |
| *34.27* | *Timer 6 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.28* | *Timer 6 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.29* | *Timer 7 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |
| *34.30* | *Timer 7 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.31* | *Timer 7 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.32* | *Timer 8 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |
| *34.33* | *Timer 8 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.34* | *Timer 8 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.35* | *Timer 9 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |
| *34.36* | *Timer 9 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.37* | *Timer 9 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.38* | *Timer 10 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |
| *34.39* | *Timer 10 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.40* | *Timer 10 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.41* | *Timer 11 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| *34.42* | *Timer 11 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.43* | *Timer 11 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.44* | *Timer 12 configuration* | See *34.11 Timer 1 configuration*. | 0000 0111 1000 0000b |
| *34.45* | *Timer 12 start time* | See *34.12 Timer 1 start time*. | 00:00:00 |
| *34.46* | *Timer 12 duration* | See *34.13 Timer 1 duration*. | 00 00:00 |
| *34.60* | *Season 1 start date* | Defines the start date of season 1 in format dd.mm, where dd is the number of the day and mm is the number of the month. The season changes at midnight. One season can be active at a time. Timers are started on exception days even if they are not inside the active season. The season start dates (1…4) must be given in increasing order to use all seasons. The default value is interpreted that the season is not configured. If the season start dates are not in increasing order and the value is something else than the default value, a season configuration warning is given. | 01.01. |
| | 01.01…31.12 | Season start date. | |
| *34.61* | *Season 2 start date* | Defines the start date of season 2. See *34.60 Season 1 start date*. | 01.01. |
| *34.62* | *Season 3 start date* | Defines the start date of season 3. See *34.60 Season 1 start date*. | 01.01. |
| *34.63* | *Season 4 start date* | Defines the start date of season 4. See *34.60 Season 1 start date*. | 01.01. |
| *34.70* | *Number of active exceptions* | Defines how many of the exceptions are active by specifying the last active one. All preceding exceptions are active. Exceptions 1…3 are periods (duration can be defined) and exceptions 4…16 are days (duration is always 24 hours). **Example:** If the value is 4, exceptions 1…4 are active, and exceptions 5…16 are not active. | 3 |
| | 0…16 | Number of active exception periods or days. | - |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *34.71* | *Exception types* | Defines the types of exceptions 1…16 as workday or holiday. Exceptions 1…3 are periods (duration can be defined) and exceptions 4…16 are days (duration is always 24 hours). | 0000 0000 0000 0000b |

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

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h…FFFFh | Types of exception period or days. | 1 = 1 |
| *34.72* | *Exception 1 start* | Defines the start date of the exception period in format dd.mm, where dd is the number of the day and mm is the number of the month. The timer started on an exception day is always stopped at 23:59:59 even if it has duration left. The same date can be configured to be holiday and workday. The date is active if any of exception days are active. | 01.01. |
| | 01.01.…31.12. | Start date of exception period 1. | |
| *34.73* | *Exception 1 length* | Defines the length of the exception period in days. Exception period is handled the same as a number of consecutive exception days. | 0 d |
| | 0…60 d | Length of exception period 1. | 1 = 1 |
| *34.74* | *Exception 2 start* | See *34.72 Exception 1 start*. | 01.01. |
| *34.75* | *Exception 2 length* | See *34.73 Exception 1 length*. | 0 d |
| *34.76* | *Exception 3 start* | See *34.72 Exception 1 start*. | 01.01. |
| *34.77* | *Exception 3 length* | See *34.73 Exception 1 length*. | 0 d |
| *34.78* | *Exception day 4* | Defines the date of exception day 4. | 01.01. |
| | 01.01.…31.12. | Start date of exception day 4. The timer started on an exception day is always stopped at 23:59:59 even if it has duration left. | |
| *34.79* | *Exception day 5* | See *34.79 Exception day 4*. | 01.01 |
| *34.80* | *Exception day 6* | See *34.79 Exception day 4*. | 01.01 |
| *34.81* | *Exception day 7* | See *34.79 Exception day 4*. | 01.01 |
| *34.82* | *Exception day 8* | See *34.79 Exception day 4*. | 01.01 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *34.83* | *Exception day 9* | See *34.79 Exception day 4*. | 01.01 |
| *34.84* | *Exception day 10* | See *34.79 Exception day 4*. | 01.01 |
| *34.85* | *Exception day 11* | See *34.79 Exception day 4*. | 01.01 |
| *34.86* | *Exception day 12* | See *34.79 Exception day 4*. | 01.01 |
| *34.87* | *Exception day 13* | See *34.79 Exception day 4*. | 01.01 |
| *34.88* | *Exception day 14* | See *34.79 Exception day 4*. | 01.01 |
| *34.89* | *Exception day 15* | See *34.79 Exception day 4*. | 01.01 |
| *34.90* | *Exception day 16* | See *34.79 Exception day 4*. | 01.01 |
| *34.100* | *Timed function 1* | Defines which timers are connected to combined timer 1.<br>0 = Not connected.<br>1 = Connected.<br>See *34.01 Timed functions status*. | 0000 0000 0000 0000b |

| Bit | Name | Description |
|---|---|---|
| 0 | Timer 1 | 0 = Inactive. 1 = Active. |
| 1 | Timer 2 | 0 = Inactive. 1 = Active. |
| 2 | Timer 3 | 0 = Inactive. 1 = Active. |
| 3 | Timer 4 | 0 = Inactive. 1 = Active. |
| 4 | Timer 5 | 0 = Inactive. 1 = Active. |
| 5 | Timer 6 | 0 = Inactive. 1 = Active. |
| 6 | Timer 7 | 0 = Inactive. 1 = Active. |
| 7 | Timer 8 | 0 = Inactive. 1 = Active. |
| 8 | Timer 9 | 0 = Inactive. 1 = Active. |
| 9 | Timer 10 | 0 = Inactive. 1 = Active. |
| 10 | Timer 11 | 0 = Inactive. 1 = Active. |
| 11 | Timer 12 | 0 = Inactive. 1 = Active. |
| 12…15 | Reserved | |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h…FFFFh | Timers connected to combined timer 1. | 1 = 1 |
| *34.101* | *Timed function 2* | Defines which timers are connected to combined timer 2.<br>See *34.01 Timed functions status*. | 0000 0000 0000 0000b |
| *34.102* | *Timed function 3* | Defines which timers are connected to combined timer 3.<br>See *34.01 Timed functions status*. | 0000 0000 0000 0000b |
| *34.110* | *Boost time function* | Defines which combined timers (that is, timers that are connected to the combined timers) are activated with the extra time function. | 0000 0000 0000 0000b |

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

| | | | |
|---|---|---|---|
| 0000h…FFFFh | Combined timers including the extra timer. | | 1 = 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *34.111* | *Boost time activation source* | Selects the source of extra time activation signal.<br>0 = Disabled.<br>1 = Enabled. | *Off* |
| | Off | 0. | 0 |
| | On | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *34.112* | *Boost time duration* | Defines the time inside which the extra time is deactivated after extra time activation signal is switched off.<br>**Example:** If parameter *34.111 Boost time activation source* is set to *DI1* and *34.112 Boost time duration* is set to 00 01:30, the extra time is active for 1 hour and 30 minutes after digital input DI is deactivated. | 00 00:00 |
| | 00 00:00…07 00:00 | Extra time duration. | 1 = 1 |
| *35 Motor thermal protection* | | Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration; motor overload protection.<br>See also section *Programmable protection functions* (page *176*). | |
| *35.01* | *Motor estimated temperature* | Displays the motor temperature as estimated by the internal motor thermal protection model (see parameters *35.50*…*35.55*). The unit is selected by parameter *96.16 Unit selection*.<br>This parameter is read-only. | - |
| | -60…1000 °C or -76…1832 °F | Estimated motor temperature. | 1 = 1° |
| *35.02* | *Measured temperature 1* | Displays the temperature received through the source defined by parameter *35.11 Temperature 1 source*. The unit is selected by parameter *96.16 Unit selection*.<br>**Note:** With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown.<br>This parameter is read-only. | - |
| | -60…5000 °C or -76…9032 °F, 0 ohm or [*35.12*] ohm | Measured temperature 1. | 1 = 1 unit |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *35.03* | *Measured temperature 2* | Displays the temperature received through the source defined by parameter *35.21 Temperature 2 source*. The unit is selected by parameter *96.16 Unit selection*.<br>**Note:** With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown.<br>This parameter is read-only. | - |
| | -60…5000 °C or -76…9032 °F, 0 ohm or [*35.22*] ohm | Measured temperature 2. | 1 = 1 unit |
| *35.05* | *Motor overload level* | Motor overload level as a percent of the motor overload fault limit. See section *Motor overload protection* (page *131*).<br>This parameter is read-only. | 0.0% |
| | 0.0…100.0% | Motor overload level.<br>0.0%   No motor overloading<br>88.0%   Motor overloaded to warning level<br>100.0% Motor overloaded to fault level. | 10 = 1% |
| *35.11* | *Temperature 1 source* | Selects the source from which measured temperature 1 is read.<br>Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list. | *Estimated temperature* |
| | Disabled | None. Temperature monitoring function 1 is disabled. | 0 |
| | Estimated temperature | Estimated motor temperature (see parameter *35.01 Motor estimated temperature*).<br>The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*. | 1 |
| | KTY84 analog I/O | KTY84 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output.<br>The following settings are required:<br>• Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot.<br>• Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt).<br>• In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*.<br>The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees. | 2 |
| | Reserved | | 3…4 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 1 × Pt100 analog I/O | Pt100 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output.<br>The following settings are required:<br>• Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot.<br>• Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt).<br>• In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*.<br>The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees. | 5 |
| | 2 × Pt100 analog I/O | As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly. | 6 |
| | 3 × Pt100 analog I/O | As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly. | 7 |
| | PTC DI6 | PTC sensor is connected to DI6 through a thermistor relay.<br>**Note:** With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown. | 8 |
| | Reserved | | 9…10 |
| | Direct temperature | The temperature is taken from the source selected by parameter *35.14 Temperature 1 AI source*. The value of the source is assumed to be degrees Celsius. | 11 |
| | KTY83 analog I/O | KTY83 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output.<br>The following settings are required:<br>• Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot.<br>• Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt).<br>• In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*.<br>The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees. | 12 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 1 × Pt1000 analog I/O | Pt1000 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output.<br>The following settings are required:<br>• Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot.<br>• Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt).<br>• In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*.<br>The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees. | 13 |
| | 2 × Pt1000 analog I/O | As selection *1 × Pt1000 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly. | 14 |
| | 3 × Pt1000 analog I/O | As selection *1 × Pt1000 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly. | 15 |
| | Ni1000 | Ni1000 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output.<br>The following settings are required:<br>• Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot.<br>• Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt).<br>• In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*.<br>The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees. | 16 |
| | Reserved | | 17…20 |
| | Therm(0) | Normally closed thermistor relay connected to digital input DI6. The motor is overheated when the digital input is 0. | 21 |
| | Therm(1) | Normally open thermistor relay connected to digital input DI6. The motor is overheated when the digital input is 1. | 22 |
| *35.12* | *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*.<br>The unit is selected by parameter *96.16 Unit selection*. | 130 °C or 266 °F |
| | -60…5000 °C or -76…9032 °F | Fault limit for temperature monitoring function 1. | 1 = 1 ° |

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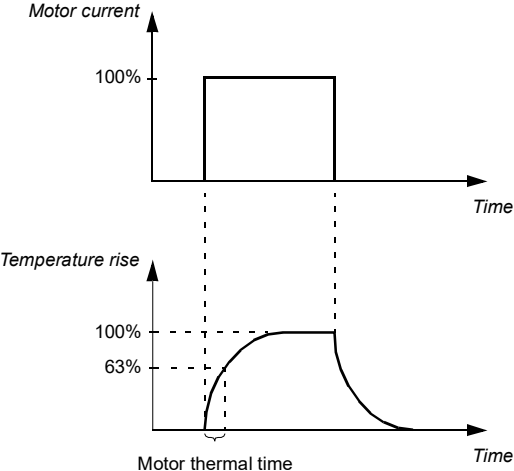
| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *35.13* | *Temperature 1 warning limit* | Defines the warning limit for temperature supervision function 1. When measured temperature 1 exceeds the limit, warning *A491 External temperature 1* is generated.<br>The unit is selected by parameter *96.16 Unit selection*. | 110 °C or 230 °F |
| | -60…5000 °C or -76…9032 °F | Warning limit for temperature monitoring function 1. | 1 = 1 ° |
| *35.14* | *Temperature 1 AI source* | Specifies the analog input when the setting of *35.11 Temperature 1 source* requires measurement through an analog input.<br>**Note:** If parameter *35.11 Temperature 1 source* is set to *Direct temperature*, use selection *Other* here, and point to *12.12 AI1 scaled value*. | *Not selected* |
| | Not selected | None. | 0 |
| | AI1 actual value | Analog input AI1 on the control unit. | 1 |
| | AI2 actual value | Analog input AI2 on the control unit. | 2 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *35.21* | *Temperature 2 source* | Selects the source from which measured temperature 2 is read.<br>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* |
| | Disabled | None. Temperature monitoring function 2 is disabled. | 0 |
| | Estimated temperature | Estimated motor temperature (see parameter *35.01 Motor estimated temperature*).<br>The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*. | 1 |
| | KTY84 analog I/O | KTY84 sensor connected to the analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output.<br>The following settings are required:<br>• Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot.<br>• Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt).<br>• In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*.<br>The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees. | 2 |
| | Reserved | | 3…4 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | 1 × Pt100 analog I/O | Pt100 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output.<br>The following settings are required:<br>• Set the hardware jumper or switch related to the analog input to *U* (voltage). Any change must be validated by a control unit reboot.<br>• Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt).<br>• In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*.<br>The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees. | 5 |
| | 2 × Pt100 analog I/O | As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly. | 6 |
| | 3 × Pt100 analog I/O | As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly. | 7 |
| | PTC DI6 | PTC sensor is connected to DI6 through a thermistor relay.<br>**Note:** With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown. | 8 |
| | Reserved | | 9…10 |
| | Direct temperature | The temperature is taken from the source selected by parameter *35.24 Temperature 2 AI source*. The value of the source is assumed to be degrees Celsius. | 11 |
| | KTY83 analog I/O | KTY83 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output.<br>The following settings are required:<br>• Set the hardware jumper or switch related to the analog input to *U* (voltage). Any change must be validated by a control unit reboot.<br>• Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt).<br>• In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*.<br>The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees. | 12 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 1 × Pt1000 analog I/O | Pt1000 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output.<br>The following settings are required:<br>• Set the hardware jumper or switch related to the analog input to *U* (voltage). Any change must be validated by a control unit reboot.<br>• Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt).<br>• In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*.<br>The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees. | 13 |
| | 2 × Pt1000 analog I/O | As selection *1 × Pt1000 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly. | 14 |
| | 3 × Pt1000 analog I/O | As selection *1 × Pt1000 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly. | 15 |
| | Ni1000 | Ni1000 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output.<br>The following settings are required:<br>• Set the hardware jumper or switch related to the analog input to *U* (voltage). Any change must be validated by a control unit reboot.<br>• Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt).<br>• In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*.<br>The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees. | 16 |
| | Reserved | | 17…20 |
| | Therm(0) | Normally closed thermistor relay connected to digital input DI6. The motor is overheated when the digital input is 0. | 21 |
| | Therm(1) | Normally open thermistor relay connected to digital input DI6. The motor is overheated when the digital input is 1. | 22 |
| *35.22* | *Temperature 2 fault limit* | Defines the fault limit for temperature supervision function 2. When measured temperature 1 exceeds the limit, the drive trips on fault *4982 External temperature 2*. | 130 °C or 266 °F |
| | -60…5000 °C or -76…9032 °F | Fault limit for temperature monitoring function 2. | 1 = 1 ° |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| 35.23 | Temperature 2 warning limit | Defines the warning limit for temperature supervision function 2. When measured temperature 1 exceeds the limit, warning A492 External temperature 2 is generated. The unit is selected by parameter 96.16 Unit selection. | 110 °C or 230 °F |
| | -60…5000 °C or -76…9032 °F | Warning limit for temperature monitoring function 2. | 1 = 1 ° |
| 35.24 | Temperature 2 AI source | Specifies the analog input when the setting of 35.11 Temperature 1 source requires measurement through an analog input. | Not selected |
| | Not selected | None. | 0 |
| | AI1 actual value | Analog input AI1 on the control unit. | 1 |
| | AI2 actual value | Analog input AI2 on the control unit. | 2 |
| | Other | Source selection (see Terms and abbreviations on page 322). | - |
| 35.50 | Motor ambient temperature | Defines the ambient temperature of the motor for the motor thermal protection model. The unit is selected by parameter 96.16 Unit selection. The motor thermal protection model estimates the motor temperature on the basis of parameters 35.50…35.55. The motor temperature increases if it operates in the region above the load curve, and decreases if it operates in the region below the load curve. ⚠ **WARNING!** The model cannot protect the motor if the motor does not cool properly because of dust, dirt, etc. | 20 °C or 68 °F |
| | -60…100 °C or -76 … 212 °F | Ambient temperature. | 1 = 1° |
| 35.51 | Motor load curve | Defines the motor load curve together with parameters 35.52 Zero speed load and 35.53 Break point. The load curve is used by the motor thermal protection model to estimate the motor temperature. When the parameter is set to 100%, the maximum load is taken as the value of parameter 99.06 Motor nominal current (higher loads heat up the motor). The load curve level should be adjusted if the ambient temperature differs from the nominal value set in 35.50 Motor ambient temperature. | 110% |
| |  | | |
| | 50…150% | Maximum load for the motor load curve. | 1 = 1% |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *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.<br>See parameter *35.51 Motor load curve*. | 70% |
| | 25…150% | Zero speed load for the motor load curve. | 1 = 1% |
| *35.53* | *Break point* | Defines the motor load curve together with parameters *35.51 Motor load curve* and *35.52 Zero speed load*. Defines the break point frequency of the load curve, ie, the point at which the motor load curve begins to decrease from the value of parameter *35.51 Motor load curve* towards the value of parameter *35.52 Zero speed load*.<br>See parameter *35.51 Motor load curve*. | 45.00 Hz |
| | 1.00…500.00 Hz | Break point for the motor load curve. | See par. *46.02* |
| *35.54* | *Motor nominal temperature rise* | Defines the temperature rise of the motor above ambient when the motor is loaded with nominal current. See the motor manufacturer's recommendations.<br>The unit is selected by parameter *96.16 Unit selection*. | 80 °C or 176 °F |
| | |  | |
| | 0…300 °C or 32…572 °F | Temperature rise. | 1 = 1° |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *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.<br>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.<br>The thermal time for Class 10 trip curve is 350 s, for Class 20 trip curve 700 s and for Class 30 trip curve 1050 s.<br><br> | 256 s |
| | 100…10000 s | Motor thermal time constant. | 1 = 1 s |
| *35.56* | *Motor overload action* | Selects the action taken when motor overload is detected. See section *Motor overload protection* (page *131*). | *Warning and fault* |
| | No action | No action taken. | 0 |
| | Warning only | Drive generates warning *A783 Motor overload* when the motor is overloaded to the warning level, that is, parameter *35.05 Motor overload level* reaches value 88.0%. | 1 |
| | Warning and fault | Drive generates warning *A783 Motor overload* when the motor is overloaded to the warning level, that is, parameter *35.05 Motor overload level* reaches value 88.0%.<br>Drive trips on fault *7122 Motor overload* when the motor is overloaded to the fault level, that is, parameter *35.05 Motor overload level* reaches value 100.0%. | 2 |
| *35.57* | *Motor overload class* | Defines the motor overload class to be used. The class of protection is specified by the user as the time for tripping at 7.2 times (IEC 60947-4-1) or 6 times (NEMA ICS) the tripping level current.<br>See section *Motor overload protection* (page *131*). | *Class 20* |
| | Class 5 | Motor overload class 5. | 0 |
| | Class 10 | Motor overload class 10. | 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Class 20 | Motor overload class 20. | 2 |
| | Class 30 | Motor overload class 30. | 3 |
| | Class 40 | Motor overload class 40. | 4 |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *36 Load analyzer* | | Peak value and amplitude logger settings.<br>See also section *Load analyzer* (page *173*). | |
| *36.01* | *PVL signal source* | Selects the signal to be monitored by the peak value logger. The signal is filtered using the filtering time specified by parameter *36.02 PVL filter time*.<br>The peak value is stored, along with other pre-selected signals at the time, into parameters *36.10*…*36.15*.<br>The peak value logger can be reset using parameter *36.09 Reset loggers*. The logger is also reset whenever the signal source is changed. The date and time of the last reset are stored into parameters *36.16* and *36.17* respectively. | *Motor current* |
| | Not selected | None (peak value logger disabled). | 0 |
| | Motor speed used | *01.01 Motor speed used* (page *325*). | 1 |
| | Reserved | | 2 |
| | Output frequency | *01.06 Output frequency* (page *325*). | 3 |
| | Motor current | *01.07 Motor current* (page *325*). | 4 |
| | Reserved | | 5 |
| | Motor torque | *01.10 Motor torque* (page *325*). | 6 |
| | DC voltage | *01.11 DC voltage* (page *325*). | 7 |
| | Output power | *01.14 Output power* (page *326*). | 8 |
| | Reserved | | 9 |
| | Speed ref ramp in | *23.01 Speed ref ramp input* (page *397*). | 10 |
| | Speed ref ramp out | *23.02 Speed ref ramp output* (page *397*). | 11 |
| | Speed ref used | *24.01 Used speed reference* (page *400*). | 12 |
| | Reserved | | 13 |
| | Freq ref used | *28.02 Frequency ref ramp output* (page *405*). | 14 |
| | Reserved | | 15 |
| | Process PID out | *40.01 Process PID output actual* (page *463*). | 16 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *36.02* | *PVL filter time* | Peak value logger filtering time. See parameter *36.01 PVL signal source*. | 2.00 s |
| | 0.00…120.00 s | Peak value logger filtering time. | 100 = 1 s |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| 36.06 | AL2 signal source | Selects the signal to be monitored by amplitude logger 2. The signal is sampled at 200 ms intervals.<br>The results are displayed by parameters 36.40…36.49. Each parameter represents an amplitude range, and shows what portion of the samples fall within that range.<br>The signal value corresponding to 100% is defined by parameter 36.07 AL2 signal scaling.<br>Amplitude logger 2 can be reset using parameter 36.09 Reset loggers. The logger is also reset whenever the signal source or scaling is changed. The date and time of the last reset are stored into parameters 36.50 and 36.51 respectively.<br>For the selections, see parameter 36.01 PVL signal source. | Output power |
| 36.07 | AL2 signal scaling | Defines the signal value that corresponds to 100% amplitude. | 100.00 |
| | 0.00…32767.00 | Signal value corresponding to 100%. | 1 = 1 |
| 36.09 | Reset loggers | Resets the peak value logger and/or amplitude logger 2. (Amplitude logger 1 cannot be reset.) | Done |
| | Done | Reset completed or not requested (normal operation). | 0 |
| | All | Reset both the peak value logger and amplitude logger 2. | 1 |
| | PVL | Reset the peak value logger. | 2 |
| | AL2 | Reset amplitude logger 2. | 3 |
| 36.10 | PVL peak value | Peak value recorded by the peak value logger. | 0.00 |
| | -32768.00…32767.00 | Peak value. | 1 = 1 |
| 36.11 | PVL peak date | The date on which the peak value was recorded. | 01.01.1980 |
| | - | Peak occurrence date. | - |
| 36.12 | PVL peak time | The time at which the peak value was recorded. | 00:00:05 |
| | - | Peak occurrence time. | - |
| 36.13 | PVL current at peak | Motor current at the moment the peak value was recorded. | 0.00 A |
| | -32768.00…32767.00 A | Motor current at peak. | 1 = 1 A |
| 36.14 | PVL DC voltage at peak | Voltage in the intermediate DC circuit of the drive at the moment the peak value was recorded. | 0.00 V |
| | 0.00…2000.00 V | DC voltage at peak. | 10 = 1 V |
| 36.15 | PVL speed at peak | Motor speed at the moment the peak value was recorded. | 0.00 rpm |
| | -30000.00…30000.00 rpm | Motor speed at peak. | See par. 46.01 |
| 36.16 | PVL reset date | The date on which the peak value logger was last reset. | 01.01.1980 |
| | - | Last reset date of the peak value logger. | - |
| 36.17 | PVL reset time | The time at which the peak value logger was last reset. | 00:00:05 |
| | - | Last reset time of the peak value logger. | - |
| 36.20 | AL1 0 to 10% | Percentage of samples recorded by amplitude logger 1 that fall between 0 and 10%. 100% corresponds to the $I_{max}$ value given in the ratings table in chapter Technical data in the Hardware manual of the drive. | 0.00% |
| | 0.00…100.00% | Amplitude logger 1 samples between 0 and 10%. | 1 = 1% |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *36.21* | *AL1 10 to 20%* | Percentage of samples recorded by amplitude logger 1 that fall between 10 and 20%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 1 samples between 10 and 20%. | 1 = 1% |
| *36.22* | *AL1 20 to 30%* | Percentage of samples recorded by amplitude logger 1 that fall between 20 and 30%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 1 samples between 20 and 30%. | 1 = 1% |
| *36.23* | *AL1 30 to 40%* | Percentage of samples recorded by amplitude logger 1 that fall between 30 and 40%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 1 samples between 30 and 40%. | 1 = 1% |
| *36.24* | *AL1 40 to 50%* | Percentage of samples recorded by amplitude logger 1 that fall between 40 and 50%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 1 samples between 40 and 50%. | 1 = 1% |
| *36.25* | *AL1 50 to 60%* | Percentage of samples recorded by amplitude logger 1 that fall between 50 and 60%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 1 samples between 50 and 60%. | 1 = 1% |
| *36.26* | *AL1 60 to 70%* | Percentage of samples recorded by amplitude logger 1 that fall between 60 and 70%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 1 samples between 60 and 70%. | 1 = 1% |
| *36.27* | *AL1 70 to 80%* | Percentage of samples recorded by amplitude logger 1 that fall between 70 and 80%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 1 samples between 70 and 80%. | 1 = 1% |
| *36.28* | *AL1 80 to 90%* | Percentage of samples recorded by amplitude logger 1 that fall between 80 and 90%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 1 samples between 80 and 90%. | 1 = 1% |
| *36.29* | *AL1 over 90%* | Percentage of samples recorded by amplitude logger 1 that exceed 90%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 1 samples over 90%. | 1 = 1% |
| *36.40* | *AL2 0 to 10%* | Percentage of samples recorded by amplitude logger 2 that fall between 0 and 10%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 2 samples between 0 and 10%. | 1 = 1% |
| *36.41* | *AL2 10 to 20%* | Percentage of samples recorded by amplitude logger 2 that fall between 10 and 20%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 2 samples between 10 and 20%. | 1 = 1% |
| *36.42* | *AL2 20 to 30%* | Percentage of samples recorded by amplitude logger 2 that fall between 20 and 30%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 2 samples between 20 and 30%. | 1 = 1% |
| *36.43* | *AL2 30 to 40%* | Percentage of samples recorded by amplitude logger 2 that fall between 30 and 40%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 2 samples between 30 and 40%. | 1 = 1% |
| *36.44* | *AL2 40 to 50%* | Percentage of samples recorded by amplitude logger 2 that fall between 40 and 50%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 2 samples between 40 and 50%. | 1 = 1% |
| *36.45* | *AL2 50 to 60%* | Percentage of samples recorded by amplitude logger 2 that fall between 50 and 60%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 2 samples between 50 and 60%. | 1 = 1% |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *36.46* | *AL2 60 to 70%* | Percentage of samples recorded by amplitude logger 2 that fall between 60 and 70%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 2 samples between 60 and 70%. | 1 = 1% |
| *36.47* | *AL2 70 to 80%* | Percentage of samples recorded by amplitude logger 2 that fall between 70 and 80%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 2 samples between 70 and 80%. | 1 = 1% |
| *36.48* | *AL2 80 to 90%* | Percentage of samples recorded by amplitude logger 2 that fall between 80 and 90%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 2 samples between 80 and 90%. | 1 = 1% |
| *36.49* | *AL2 over 90%* | Percentage of samples recorded by amplitude logger 2 that exceed 90%. | 0.00% |
| | 0.00…100.00% | Amplitude logger 2 samples over 90%. | 1 = 1% |
| *36.50* | *AL2 reset date* | The date on which amplitude logger 2 was last reset. | 01.01.1980 |
| | - | Last reset date of amplitude logger 2. | - |
| *36.51* | *AL2 reset time* | The time at which amplitude logger 2 was last reset. | 00:00:05 |
| | - | Last reset time of amplitude logger 2. | - |
| **37 User load curve** | | Settings for user load curve. See also section *User load curve* (page *179*). | |
| *37.01* | *ULC output status word* | Displays the status of the monitored signal. The status is shown only while the drive is running. (The status word is independent of the actions and delays selected by parameters *37.03*, *37.04*, *37.41* and *37.42*.) This parameter is read-only. | 0000h |

| Bit | Name | Description |
|---|---|---|
| 0 | Under load limit | 1 = Signal lower than the underload curve. |
| 1 | Within load range | 1 = Signal between the underload and overload curve. |
| 2 | Overload limit | 1 = Signal higher than the overload curve. |
| 3 | Outside load limit | 1 = Signal lower than the underload curve or higher than the overload curve. |
| …15 | Reserved | |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h…FFFFh | Status of the monitored signal. | 1 = 1 |
| *37.02* | *ULC supervision signal* | Selects the signal to be monitored. The function compares the absolute value of the signal against the load curve. | *Motor torque %* |
| | Not selected | No signal selected (monitoring disabled). | 0 |
| | Motor speed % | *01.03 Motor speed %* (page *325*). | 1 |
| | Motor current % | *01.08 Motor current % of motor nom* (page *325*). | 2 |
| | Motor torque % | *01.10 Motor torque* (page *325*). | 3 |
| | Output power % of motor nominal | *01.15 Output power % of motor nom* (page *326*). | 4 |
| | Output power % of drive nominal | *01.16 Output power % of drive nom* (page *326*). | 5 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *37.03* | *ULC overload actions* | Selects how the drive reacts if the absolute value of the monitored signal stays continuously above the overload curve for longer than the value of *37.41 ULC overload timer*. | *Disabled* |
| | Disabled | No action taken. | 0 |
| | Warning | Drive generates warning *A8BE ULC overload warning* | 1 |
| | Fault | Drive trips on fault *8002 ULC overload fault*. | 2 |
| | Warning/Fault | Drive generates warning *A8BE ULC overload warning* if the signal stays continuously above the overload curve for half of the time defined by parameter *37.41 ULC overload timer*. Drive trips on fault *8002 ULC overload fault* if the signal stays continuously above the overload curve for a time defined by parameter *37.41 ULC overload timer*. | 3 |
| *37.04* | *ULC underload actions* | Selects how the drive reacts if the absolute value of the monitored signal stays continuously above the overload curve for longer than the value of *37.42 ULC underload timer*. | *Disabled* |
| | Disabled | No action taken. | 0 |
| | Warning | Drive generates warning *A8BF ULC underload warning* | 1 |
| | Fault | Drive trips on fault *8001 ULC underload fault*. | 2 |
| | Warning/Fault | Drive generates warning *A8BF ULC underload warning* if the signal stays continuously below the underload curve for half of the time defined by parameter *37.41 ULC overload timer*. Drive trips on fault *8001 ULC underload fault* if the signal stays continuously above the underload curve for a time defined by parameter *37.42 ULC underload timer*. | 3 |
| *37.11* | *ULC speed table point 1* | Defines the first of the five speed points on the X-axis of the user load curve. Speed points are used if parameter *99.04 Motor control mode* is set to *Vector* or if *99.04 Motor control mode* is set to *Scalar* and the reference unit is rpm. The five points must be in order from lowest to highest. The points are defined as positive values, but the range is symmetrically effective also in the negative direction. The monitoring is not active outside these two areas. | 150.0 rpm |
| | -30000.0…30000.0 rpm | Speed. | 1 = 1 rpm |
| *37.12* | *ULC speed table point 2* | Defines the second speed point. See parameter *37.11 ULC speed table point 1*. | 750.0 rpm |
| | -30000.0…30000.0 rpm | Speed. | 1 = 1 rpm |
| *37.13* | *ULC speed table point 3* | Defines the third speed point. See parameter *37.11 ULC speed table point 1*. | 1290.0 rpm |
| | -30000.0…30000.0 rpm | Speed. | 1 = 1 rpm |
| *37.14* | *ULC speed table point 4* | Defines the fourth speed point. See parameter *37.11 ULC speed table point 1*. | 1500.0 rpm |
| | -30000.0…30000.0 rpm | Speed. | 1 = 1 rpm |
| *37.15* | *ULC speed table point 5* | Defines the fifth speed point. See parameter *37.11 ULC speed table point 1*. | 1800.0 rpm |
| | -30000.0…30000.0 rpm | Speed. | 1 = 1 rpm |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *37.16* | *ULC frequency table point 1* | Defines the first of the five frequency points on the X-axis of the user load curve.<br>Frequency points are used if parameter *99.04 Motor control mode* is set to *Scalar* and the reference unit is Hz.<br>The five points must be in order from lowest to highest. The points are defined as positive values, but the range is symmetrically effective also in the negative direction. The monitoring is not active outside these two areas. | 5.0 Hz |
| | -500.0…500.0 Hz | Frequency. | 1 = 1 Hz |
| *37.17* | *ULC frequency table point 2* | Defines the second frequency point.<br>See parameter *37.16 ULC frequency table point 1*. | 25.0 Hz |
| | -500.0…500.0 Hz | Frequency. | 1 = 1 Hz |
| *37.18* | *ULC frequency table point 3* | Defines the third frequency point.<br>See parameter *37.16 ULC frequency table point 1*. | 43.0 Hz |
| | -500.0…500.0 Hz | Frequency. | 1 = 1 Hz |
| *37.19* | *ULC frequency table point 4* | Defines the fourth frequency point.<br>See parameter *37.16 ULC frequency table point 1*. | 50.0 Hz |
| | -500.0…500.0 Hz | Frequency. | 1 = 1 Hz |
| *37.20* | *ULC frequency table point 5* | Defines the fifth frequency point.<br>See parameter *37.16 ULC frequency table point 1*. | 60.0 Hz |
| | -500.0…500.0 Hz | Frequency. | 1 = 1 Hz |
| *37.21* | *ULC underload point 1* | Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (*37.11 ULC speed table point 1*…*37.15 ULC speed table point 5* or *37.15 ULC speed table point 5*…*37.20 ULC frequency table point 5*) define the underload (lower) curve.<br>Each point of the underload curve must have a lower value than the corresponding overload point. | 10.0% |
| | -1600.0…1600.0% | Underload point. | 1 = 1% |
| *37.22* | *ULC underload point 2* | Defines the second underload point.<br>See parameter *37.21 ULC underload point 1*. | 15.0% |
| | -1600.0…1600.0% | Underload point. | 1 = 1% |
| *37.23* | *ULC underload point 3* | Defines the third underload point.<br>See parameter *37.21 ULC underload point 1* | 25.0% |
| | -1600.0…1600.0% | Underload point. | 1 = 1% |
| *37.24* | *ULC underload point 4* | Defines the fourth underload point.<br>See parameter *37.21 ULC underload point 1* | 30.0% |
| | -1600.0…1600.0% | Underload point. | 1 = 1% |
| *37.25* | *ULC underload point 5* | Defines the fifth underload point.<br>See parameter *37.21 ULC underload point 1* | 30.0% |
| | -1600.0…1600.0% | Underload point. | 1 = 1% |
| *37.31* | *ULC overload point 1* | Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (*37.11 ULC speed table point 1*…*37.15 ULC speed table point 5* or *37.15 ULC speed table point 5*…*37.20 ULC frequency table point 5*) define the overload (higher) curve.<br>Each point of the overload curve must have a higher value than the corresponding underload point. | 300.0% |
| | -1600.0…1600.0% | Overload point. | 1 = 1% |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *37.32* | *ULC overload point 2* | Defines the second overload point.<br>See parameter *37.31 ULC overload point 1*. | 300.0% |
| | -1600.0…1600.0% | Overload point. | 1 = 1% |
| *37.33* | *ULC overload point 3* | Defines the third overload point.<br>See parameter *37.31 ULC overload point 1*. | 300.0% |
| | -1600.0…1600.0% | Overload point. | 1 = 1% |
| *37.34* | *ULC overload point 4* | Defines the fourth overload point.<br>See parameter *37.31 ULC overload point 1*. | 300.0% |
| | -1600.0…1600.0% | Overload point. | 1 = 1% |
| *37.35* | *ULC overload point 5* | Defines the fifth overload point.<br>See parameter *37.31 ULC overload point 1*. | 300.0% |
| | -1600.0…1600.0% | Overload point. | 1 = 1% |
| *37.41* | *ULC overload timer* | Defines the time for which the monitored signal must continuously stay above the overload curve before the drive takes the action selected by *37.03 ULC overload actions*. | 20.0 s |
| | 0.0…10000.0 s | Overload timer. | 1 = 1 s |
| *37.42* | *ULC underload timer* | Defines the time for which the monitored signal must continuously stay below the underload curve before the drive takes the action selected by *37.04 ULC underload actions*. | 20.0 s |
| | 0.0…10000.0 s | Underload timer | 1 = 1 s |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *40 Process PID set 1* | | Parameter values for process PID control.<br>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.<br>Two different parameter sets can be defined for the process PID. One parameter set is in use at a time. The first set is made up of parameters *40.07…40.50*, the second set is defined by the parameters in group *41 Process PID set 2*. The binary source that defines which set is used is selected by parameter *40.57 PID set1/set2 selection*.<br>See also control chain diagrams *PID setpoint compensation* on page *314* and *Direction lock* on page *319*.<br>To set the PID customer unit, select **Menu > Primary settings > PID > Unit** on the panel. | |
| *40.01* | *Process PID output actual* | Displays the output of the process PID controller. See control chain diagram *Direction lock* on page *319*.<br>This parameter is read-only. | - |
| | -200000.00… 200000.00 | Process PID controller output. | 1 = 1 |
| *40.02* | *Process PID feedback actual* | Displays the value of process feedback after source selection, mathematical function (parameter *40.10 Set 1 feedback function*), and filtering. See control chain diagram *PID setpoint compensation* on page *314*.<br>This parameter is read-only. | - |
| | -200000.00… 200000.00 PID unit 1 | Process feedback. | 1 = 1 PID unit 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *40.03* | *Process PID setpoint actual* | Displays the value of process PID setpoint after source selection, mathematical function (*40.18 Set 1 setpoint function*), limitation and ramping. See control chain diagram *PID setpoint compensation* on page *314*.<br>This parameter is read-only. | - |
| | -200000…200000 PID unit 1 | Setpoint for process PID controller. | 1 = 1 PID unit 1 |
| *40.04* | *Process PID deviation actual* | Displays the process PID deviation. By default, this value equals setpoint - feedback, but deviation can be inverted by parameter *40.31 Set 1 deviation inversion*. See control chain diagram *Process PID controller* on page *316*.<br>This parameter is read-only. | - |
| | -200000.00… 200000.00 PID unit 1 | PID deviation. | 1 = 1 PID unit 1 |
| *40.06* | *Process PID status word* | Displays status information on process PID control.<br>This parameter is read-only. | - |

| Bit | Name | Value |
|---|---|---|
| 0 | PID active | 1 = Process PID control active. |
| 1 | Setpoint frozen | 1 = Process PID setpoint frozen. |
| 2 | Output frozen | 1 = Process PID controller output frozen. |
| 3 | PID sleep mode | 1 = Sleep mode active. |
| 4 | Sleep boost | 1 = Sleep boost active. |
| 5 | Reserved | |
| 6 | Tracking mode | 1 = Tracking function active. |
| 7 | Output limit high | 1 = PID output is being limited by par. *40.37*. |
| 8 | Output limit low | 1 = PID output is being limited by par. *40.36*. |
| 9 | Deadband active | 1 = Feedback value is in the deadband range (*40.39*). |
| 10 | PID set | 0 = Parameter set 1 in use. 1 = Parameter set 2 in use. |
| 11 | Reserved | |
| 12 | Internal setpoint active | 1 = Internal setpoint active (see par. *40.16*…*40.23*) |
| 13…15 | Reserved | |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h…FFFFh | Process PID control status word. | 1 = 1 |
| *40.07* | *Process PID operation mode* | Activates/deactivates process PID control.<br>**Note:** Process PID control is only available in external control; see section *Local control vs. external control* (page *83*). | *Off* |
| | Off | Process PID control inactive. | 0 |
| | On | Process PID control active. | 1 |
| | On when drive running | Process PID control is active when the drive is running. | 2 |
| *40.08* | *Set 1 feedback 1 source* | Selects the primary source of process feedback. See control chain diagram *PID setpoint compensation* on page *314*. | *AI2 scaled* |
| | Not selected | None. | 0 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 1 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 2 |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | Freq in scaled | *11.39 Freq in 1 scaled value* (see page *356*). | 3 |
| | Reserved | | 4…7 |
| | AI1 percent | *12.101 AI1 percent value* (see page *364*). | 8 |
| | AI2 percent | *12.102 AI2 percent value* (see page *364*). | 9 |
| | Feedback data storage | *40.91 Feedback data storage* (see page *479*). (Selection not available for parameter *71.08 Feedback 1 source.*) | 10 |
| | Actual flow | Parameter *80.01 Actual flow*. | 11 |
| | Actual flow % | Parameter *80.02 Actual flow*. | 12 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.09* | *Set 1 feedback 2 source* | Selects the second source of process feedback. The second source is used only if the setpoint function requires two inputs.<br>For the selections, see parameter *40.08 Set 1 feedback 1 source*. | *Not selected* |
| *40.10* | *Set 1 feedback function* | Defines how process feedback is calculated from the two feedback sources selected by parameters *40.08 Set 1 feedback 1 source* and *40.09 Set 1 feedback 2 source*.<br>The result of the function (for any selection) is multiplied by parameter *40.90 Set 1 feedback multiplier*. (That is why in selections 12 and 13, the multiplier k is constant 1.) | *In1* |
| | In1 | Source 1. | 0 |
| | In1+In2 | Sum of sources 1 and 2. | 1 |
| | In1-In2 | Source 2 subtracted from source 1. | 2 |
| | In1*In2 | Source 1 multiplied by source 2. | 3 |
| | In1/In2 | Source 1 divided by source 2. | 4 |
| | MIN(In1,In2) | Smaller of the two sources. | 5 |
| | MAX(In1,In2) | Greater of the two sources. | 6 |
| | AVE(In1,In2) | Average of the two sources. | 7 |
| | sqrt(In1) | Square root of source 1. | 8 |
| | sqrt(In1-In2) | Square root of (source 1 - source 2). | 9 |
| | sqrt(In1+In2) | Square root of (source 1 + source 2). | 10 |
| | sqrt(In1)+sqrt(In2) | Square root of source 1 + square root of source 2. | 11 |
| | k*sqrt(In1) | Square root of source 1. (k = 1) | 12 |
| | k*sqrt(In1-In2) | Square root of (source 1 - source 2). (k = 1) | 13 |
| *40.11* | *Set 1 feedback filter time* | Defines the filter time constant for process feedback. | 0.000 s |
| | 0.000…30.000 s | Feedback filter time. | 1 = 1 s |

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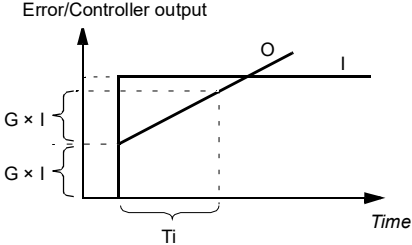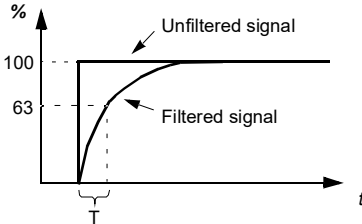
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *40.14* | *Set 1 setpoint scaling* | Defines, together with parameter *40.15 Set 1 output scaling*, a general scaling factor for the process PID control chain.<br>If the parameter is set to zero, automatic setpoint scaling is activated, where suitable setpoint scale is calculated according to selected setpoint source. Actual setpoint scale is shown in parameter *40.61 Setpoint scaling actual*.<br>The scaling can be utilized when, for example, the process setpoint is input in Hz, and the output of the PID controller is used as an rpm value in speed control. In this case, this parameter might be set to 50, and parameter *40.15* to the nominal motor speed at 50 Hz.<br>In effect, the output of the PID controller = [*40.15*] when deviation (setpoint - feedback) = [*40.14*] and [*40.32*] = 1.<br>**Note:** The scaling is based on the ratio between *40.14* and *40.15*. For example, the values 50 and 1500 would produce the same scaling as 1 and 30. | 0.00 |
|  | -200000.00… 200000.00 | Scaling. | 1 = 1 |
| *40.15* | *Set 1 output scaling* | See parameter *40.14 Set 1 setpoint scaling*.<br>If the parameter is set to zero, scaling is automatic: | 0.00 |

| Operation mode (see par. *19.01*) | Scaling |
|---|---|
| Speed control | *46.01 Speed scaling* |
| Frequency control | *46.02 Frequency scaling* |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
|  | -200000.00… 200000.00 | Process PID controller output base. | 1 = 1 |
| *40.16* | *Set 1 setpoint 1 source* | Selects the primary source of process PID setpoint. See the control chain diagram on page *314*. | *AI1 percent* |
|  | Not selected | None. | 0 |
|  | Reserved |  | 1 |
|  | Internal setpoint | Internal setpoint. See parameter *40.19 Set 1 internal setpoint sel1*. | 2 |
|  | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 3 |
|  | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 4 |
|  | Reserved |  | 5…7 |
|  | Motor potentiometer | *22.80 Motor potentiometer ref act* (output of the Floating point control (Motor potentiometer)). | 8 |
|  | Reserved |  | 9 |
|  | Freq in scaled | *11.39 Freq in 1 scaled value* (see page *356*). | 10 |
|  | AI1 percent | *12.101 AI1 percent value* (see page *364*) | 11 |
|  | AI2 percent | *12.102 AI2 percent value* (see page *364*) | 12 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Control panel (ref saved) | Panel reference (*03.01 Panel reference*, see page *328*) saved by the control system for the location where the control returns is used as the reference.<br>(Selection not available for parameter *71.16 Setpoint 1 source*.)<br><br>*Reference*<br><br>● EXT1 reference<br>✕ EXT2 reference<br>— Active reference<br>··· Inactive reference<br>EXT1 -> EXT2 | 13 |
| | Control panel (ref copied) | Panel reference (*03.01 Panel reference*, see page *328*) 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.<br><br>*Reference*<br><br>● EXT1 reference<br>✕ EXT2 reference<br>— Active reference<br>··· Inactive reference<br>EXT1 -> EXT2 | 14 |
| | FB A ref1 | *03.05 FB A reference 1* (see page *328*). | 15 |
| | FB A ref2 | *03.06 FB A reference 2* (see page *329*). | 16 |
| | Reserved | | 17…18 |
| | EFB ref1 | *03.09 EFB reference 1* (see page *329*). | 19 |
| | EFB ref2 | *03.10 EFB reference 2* (see page *329*). | 20 |
| | Reserved | | 21…23 |
| | Setpoint data storage | *40.92 Setpoint data storage* (see page *479*).<br>(Selection not available for parameter *71.16 Setpoint 1 source*.) | 24 |
| | Compensated setpoint | *40.70 Compensated setpoint* (see page *477*). | 25 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| 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.<br>For the selections, see parameter *40.16 Set 1 setpoint 1 source*. | *Not selected* |
| 40.18 | *Set 1 setpoint function* | Selects a function between the setpoint sources selected by parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source*.<br>The result of the function (for any selection) is multiplied by parameter *40.89 Set 1 setpoint multiplier*. (That is why in selections 12 and 13, the multiplier k is constant 1.) | *In1* |
| | In1 | Source 1. | 0 |
| | In1+In2 | Sum of sources 1 and 2. | 1 |
| | In1-In2 | Source 2 subtracted from source 1. | 2 |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | In1*In2 | Source 1 multiplied by source 2. | 3 |
| | In1/In2 | Source 1 divided by source 2. | 4 |
| | MIN(In1,In2) | Smaller of the two sources. | 5 |
| | MAX(In1,In2) | Greater of the two sources. | 6 |
| | AVE(In1,In2) | Average of the two sources. | 7 |
| | sqrt(In1) | Square root of source 1. | 8 |
| | sqrt(In1-In2) | Square root of (source 1 - source 2). | 9 |
| | sqrt(In1+In2) | Square root of (source 1 + source 2). | 10 |
| | sqrt(In1)+sqrt(In2) | Square root of source 1 + square root of source 2. | 11 |
| | k*sqrt(In1) | Square root of source 1. (k = 1) | 12 |
| | k*sqrt(In1-In2) | Square root of (source 1 - source 2). (k = 1) | 13 |
| 40.19 | Set 1 internal setpoint sel1 | Selects together with *40.20 Set 1 internal setpoint sel2* the internal setpoint out of the presets defined by parameters *40.21…40.24*.<br>**Note:** Parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source* must be set to *Internal setpoint*. | *Not selected* |
| | Not selected | 0. | 0 |
| | Selected | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 21 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 22 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 23 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| 40.20 | Set 1 internal setpoint sel2 | Selects together with *40.19 Set 1 internal setpoint sel1* the internal setpoint used out of the three internal setpoints defined by parameters *40.21…40.23*. See table at *40.19 Set 1 internal setpoint sel1*. | *Not selected* |
| | Not selected | 0. | 0 |

The table within parameter 40.19 description:

| Source defined by par. *40.19* | Source defined by par. *40.20* | Setpoint preset active |
|---|---|---|
| 0 | 0 | 0 (par. *40.24*) |
| 1 | 0 | 1 (par. *40.21*) |
| 0 | 1 | 2 (par. *40.22*) |
| 1 | 1 | 3 (par. *40.23*) |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Selected | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 21 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 22 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 23 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.21* | *Set 1 internal setpoint 1* | Internal process setpoint 1. See parameter *40.19 Set 1 internal setpoint sel1*. | 0.00 PID unit 1 |
| | -200000.00… 200000.00 PID unit 1 | Internal process setpoint 1. | 1 = 1 PID unit 1 |
| *40.22* | *Set 1 internal setpoint 2* | Internal process setpoint 2. See parameter *40.19 Set 1 internal setpoint sel1*. | 0.00 PID unit 1 |
| | -200000.00… 200000.00 PID unit 1 | Internal process setpoint 2. | 1 = 1 PID unit 1 |
| *40.23* | *Set 1 internal setpoint 3* | Internal process setpoint 3. See parameter *40.19 Set 1 internal setpoint sel1*. | 0.00 PID unit 1 |
| | -200000.00… 200000.00 PID unit 1 | Internal process setpoint 3. | 1 = 1 PID unit 1 |
| *40.24* | *Set 1 internal setpoint 0* | Internal process setpoint 0. See parameter *40.19 Set 1 internal setpoint sel1*. | 0.00 PID unit 1 |
| | -200000.00… 200000.00 PID unit 1 | Internal process setpoint 0. | 1 = 1 PID unit 1 |
| *40.26* | *Set 1 setpoint min* | Defines a minimum limit for the process PID controller setpoint. | 0.00 PID unit 1 |
| | -200000.00… 200000.00 PID unit 1 | Minimum limit for process PID controller setpoint. | 1 = 1 PID unit 1 |
| *40.27* | *Set 1 setpoint max* | Defines a maximum limit for the process PID controller setpoint. | 200000.00 PID unit 1 |
| | -200000.00… 200000.00 PID unit 1 | Maximum limit for process PID controller setpoint. | 1 = 1 PID unit 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|------|------------|-------------|------------|
| *40.28* | *Set 1 setpoint increase time* | Defines the minimum time it takes for the setpoint to increase from 0% to 100%. | 0.0 s |
| | 0.0…1800.0 s | Setpoint increase time. | 1 = 1 |
| *40.29* | *Set 1 setpoint decrease time* | Defines the minimum time it takes for the setpoint to decrease from 100% to 0%. | 0.0 s |
| | 0.0…1800.0 s | Setpoint decrease time. | 1 = 1 |
| *40.30* | *Set 1 setpoint freeze enable* | Freezes, or defines a source that can be used to freeze, the setpoint of the process PID controller. This feature is useful when the reference is based on a process feedback connected to an analog input, and the sensor must be serviced without stopping the process.<br>1 = Process PID controller setpoint frozen<br>See also parameter *40.38 Set 1 output freeze enable*. | *Not selected* |
| | Not selected | Process PID controller setpoint not frozen. | 0 |
| | Selected | Process PID controller setpoint frozen. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 21 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 22 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 23 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.31* | *Set 1 deviation inversion* | Inverts the input of the process PID controller.<br>0 = Deviation not inverted (Deviation = Setpoint - Feedback)<br>1 = Deviation inverted (Deviation = Feedback - Setpoint)<br>See also section *Sleep and boost functions for process PID control* (page *142*). | *Not inverted (Ref - Fbk)* |
| | Not inverted (Ref - Fbk) | 0. | 0 |
| | Inverted (Fbk - Ref) | 1. | 1 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.32* | *Set 1 gain* | Defines the gain for the process PID controller. See parameter *40.33 Set 1 integration time*. | 1.00 |
| | 0.01…100.00 | Gain for PID controller. | 100 = 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *40.33* | *Set 1 integration time* | Defines the integration time for the process PID controller. This time needs to be set to the same order of magnitude as the reaction time of the process being controlled, otherwise instability will result.<br><br><br><br>I = controller input (error)<br>O = controller output<br>G = gain<br>Ti = integration time<br><br>**Note:** Setting this value to 0 disables the "I" part, turning the PID controller into a PD controller. | 10.0 s |
| | 0.0…9999.0 s | Integration time. | 1 = 1 s |
| *40.34* | *Set 1 derivation time* | Defines the derivation time of the process PID controller. The derivative component at the controller output is calculated on basis of two consecutive error values ($E_{K-1}$ and $E_K$) according to the following formula:<br>PID DERIV TIME × ($E_K$ - $E_{K-1}$)/$T_S$, in which<br>$T_S$ = 2 ms sample time<br>E = Error = Process reference - process feedback. | 0.000 s |
| | 0.000…10.000 s | Derivation time. | 1000 = 1 s |
| *40.35* | *Set 1 derivation filter time* | Defines the time constant of the 1-pole filter used to smooth the derivative component of the process PID controller.<br><br><br><br>$$O = I \times (1 - e^{-t/T})$$<br><br>I = filter input (step)<br>O = filter output<br>$t$ = time<br>T = filter time constant | 0.0 s |
| | 0.0…10.0 s | Filter time constant. | 10 = 1 s |

**13**
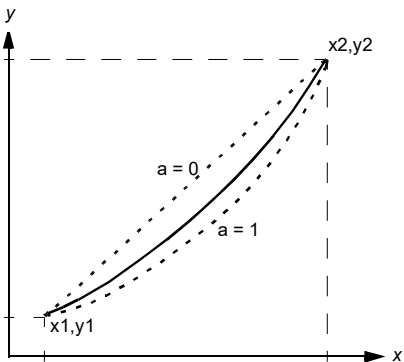
| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| *40.36* | *Set 1 output min* | Defines the minimum limit for the process PID controller output. Using the minimum and maximum limits, it is possible to restrict the operation range. | 0.00 |
| | -200000.00… 200000.00 | Minimum limit for process PID controller output. | 1 = 1 |
| *40.37* | *Set 1 output max* | Defines the maximum limit for the process PID controller output. See parameter *40.36 Set 1 output min*. | 100.00 |
| | -200000.00… 200000.00 | Maximum limit for process PID controller output. | 1 = 1 |
| *40.38* | *Set 1 output freeze enable* | Freezes (or defines a source that can be used to freeze) the output of the process PID controller, keeping the output at the value it was before freeze was enabled. This feature can be used when, for example, a sensor providing process feedback must to be serviced without stopping the process. 1 = Process PID controller output frozen See also parameter *40.30 Set 1 setpoint freeze enable*. | *Not selected* |
| | Not selected | Process PID controller output not frozen. | 0 |
| | Selected | Process PID controller output frozen. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 21 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 22 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 23 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |

**13**

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



*40.39 Set 1 deadband range*

Setpoint

Feedback

PID controller output

PID controller output frozen

*40.40 Set 1 deadband delay*

*Time*

| | | | |
|---|---|---|---|
| | 00……200000.0 | Deadband range. | 1 = 1 |
| *40.40* | *Set 1 deadband delay* | Delay for the deadband. See parameter *40.39 Set 1 deadband range*. | 0.0 s |
| | 0.0 … 3600.0 s | Delay for deadband area. | 1 = 1 s |
| *40.43* | *Set 1 sleep level* | Defines the start limit for the sleep function. If the value is 0.0, set 1 sleep mode is disabled.<br>The sleep function compares PID output (parameter *40.01 Process PID output actual*) to the value of this parameter. If PID output remains below this value longer than the sleep delay defined by *40.44 Set 1 sleep delay*, the drive enters the sleep mode and stops the motor. | 0.0 |
| | 0.0…200000.0 | Sleep start level. | 1 = 1 |
| *40.44* | *Set 1 sleep delay* | Defines a delay before the sleep function actually becomes enabled, to prevent nuisance sleeping.<br>The delay timer starts when the sleep mode is enabled by parameter *40.43 Set 1 sleep level*, and resets when the sleep mode is disabled. | 60.0 s |
| | 0.0…3600.0 s | Sleep start delay. | 1 = 1 s |
| *40.45* | *Set 1 sleep boost time* | Defines a boost time for the sleep boost step. See parameter *40.46 Set 1 sleep boost step*. | 0.0 s |
| | 0.0…3600.0 s | Sleep boost time. | 1 = 1 s |
| *40.46* | *Set 1 sleep boost step* | When the drive is entering sleep mode, the process setpoint is increased by this value for the time defined by parameter *40.45 Set 1 sleep boost time*.<br>If active, sleep boost is aborted when the drive wakes up. | 0.0 PID unit 1 |
| | 0.0…200000.0 PID unit 1 | Sleep boost step. | 1 = 1 PID unit 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *40.47* | *Set 1 wake-up deviation* | Defines the wake-up level as deviation between process setpoint and feedback.<br>When the deviation exceeds the value of this parameter, and remains there for the duration of the wake-up delay (*40.48 Set 1 wake-up delay*), the drive wakes up.<br>See also parameter *40.31 Set 1 deviation inversion*. | 0.00 PID unit 1 |
| | -200000.00… 200000.00 PID unit 1 | Wake-up level (as deviation between process setpoint and feedback). | 1 = 1 PID unit 1 |
| *40.48* | *Set 1 wake-up delay* | Defines a wake-up delay for the sleep function to prevent nuisance wake-ups. See parameter *40.47 Set 1 wake-up deviation*.<br>The delay timer starts when the deviation exceeds the wake-up level (*40.47 Set 1 wake-up deviation*), and resets if the deviation falls below the wake-up level. | 0.50 s |
| | 0.00…60.00 s | Wake-up delay. | 1 = 1 s |
| *40.49* | *Set 1 tracking mode* | Activates (or selects a source that activates) tracking mode. In tracking mode, the value selected by parameter *40.50 Set 1 tracking ref selection* is substituted for the PID controller output. See also section *Tracking* (page *143*).<br>1 = Tracking mode enabled | *Not selected* |
| | Not selected | 0. | 0 |
| | Selected | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 21 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 22 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 23 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.50* | *Set 1 tracking ref selection* | Selects the value source for tracking mode. See parameter *40.49 Set 1 tracking mode*. | *Not selected* |
| | Not selected | None. | 0 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 1 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 2 |
| | FB A ref1 | *03.05 FB A reference 1* (see page *328*). | 3 |
| | FB A ref2 | *03.06 FB A reference 2* (see page *329*). | 4 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *40.57* | *PID set1/set2 selection* | Selects the source that determines whether process PID parameter set 1 (parameters *40.07…40.50*) or set 2 (group *41 Process PID set 2*) is used. | *PID set 1* |
| | PID set 1 | 0. Process PID parameter set 1 in use. | 0 |
| | PID set 2 | 1. Process PID parameter set 2 in use. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 21 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 22 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 23 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.58* | *Set 1 increase prevention* | Prevention of PID integration term increase for PID set 1. | *No* |
| | No | Increase prevention not in use. | 0 |
| | Limiting | The PID integration term is not increased if the maximum value for the PID output is reached. This parameter is valid for the PID set 1. | 1 |
| | Ext PID min lim | The process PID integration term is not increased when the output of the external PID has reached its minimum limit. In this setup, the external PID is used as a source for the process PID. This parameter is valid for the PID set 1. | 2 |
| | Ext PID max lim | The process PID integration term is not increased when the output of the external PID has reached its maximum limit. In this setup, the external PID is used as a source for the process PID. This parameter is valid for the PID set 1. | 3 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.59* | *Set 1 decrease prevention* | Prevention of PID integration term decrease for PID set 1. | *No* |
| | No | Decrease prevention not in use. | 0 |
| | Limiting | The PID integration term is not decreased if the minimum value for the PID output is reached. This parameter is valid for the PID set 1. | 1 |
| | Ext PID min lim | The process PID integration term is not decreased when the output of the external PID has reached its minimum limit. In this setup, the external PID is used as a source for the process PID. This parameter is valid for the PID set 1. | 2 |
| | Ext PID max lim | The process PID integration term is not decreased when the output of the external PID has reached its maximum limit. In this setup, the external PID is used as a source for the process PID. This parameter is valid for the PID set 1. | 3 |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|-----------|
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.60* | *Set 1 PID activation source* | Selects a source that enables/disables process PID control. See also parameter *40.07 Process PID operation mode*. 0 = Process PID control disabled. 1 = Process PID control enabled. | *On* |
| | Off | 0. | 0 |
| | On | 1. | 1 |
| | Follow Ext1/Ext2 selection | Process PID control is disabled when external control location EXT1 is active, and enabled when external control location EXT2 is active. See also parameter *19.11 Ext1/Ext2 selection*. | 2 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 3 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 4 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 5 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 6 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 7 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 8 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.61* | *Setpoint scaling actual* | Actual setpoint scaling. See parameter *40.14 Set 1 setpoint scaling*. | 100.00 |
| | -200000.00… 200000.00 | Scaling. | 1 = 1 |
| *40.62* | *PID internal setpoint actual* | Displays the value of the internal setpoint. See control chain diagram *PID setpoint compensation* on page *314*. This parameter is read-only. | - |
| | -200000.00… 200000.00 PID unit 1 | Process PID internal setpoint. | 1 = 1 PID unit 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *40.70* | *Compensated setpoint* | Compensated setpoint determined for the input specified by parameter *40.71 Set 1 compensation input source*.<br>The determination of the compensated setpoint is based on the curve specified by points (x1, y1), (x2, y2) and the non-linearity of the curve specified with parameters *40.71…40.76*. The compensated setpoint curve will be a mixture of a straight line between the points and a squared line between the points:<br><br>x = value from *40.71 Set 1 compensation input source*<br>y = *40.70 Compensated setpoint*<br>a = *40.76 Set 1 compensation non-linearity*<br>Compensated setpoint curve = a ∗ squared function + (1 - a) ∗ linear function | - |
| | -200000.00… 200000.00 PID unit 1 | Compensated setpoint value. | 1 = 1 PID unit 1 |
| *40.71* | *Set 1 compensation input source* | Selects the source for set 1 compensation input. | *AI1 percent* |
| | Not selected | None. | 0 |
| | Reserved | | 1 |
| | Internal setpoint | Internal setpoint. See parameter *40.19 Set 1 internal setpoint sel1*. | 2 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 3 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 4 |
| | Reserved | | 5…7 |
| | Motor potentiometer | *22.80 Motor potentiometer ref act* (output of the Floating point control (Motor potentiometer)). | 8 |
| | Reserved | | 9 |
| | Freq in scaled | *11.39 Freq in 1 scaled value* (see page *356*). | 10 |
| | AI1 percent | *12.101 AI1 percent value* (see page *364*) | 11 |
| | AI2 percent | *12.102 AI2 percent value* (see page *364*) | 12 |
| | Reserved | | 13…14 |
| | FB A ref1 | *03.05 FB A reference 1* (see page *328*). | 15 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | FB A ref2 | *03.06 FB A reference 2* (see page *329*). | 16 |
| | Reserved | | 17…18 |
| | EFB ref1 | *03.09 EFB reference 1* (see page *329*). | 19 |
| | EFB ref2 | *03.10 EFB reference 2* (see page *329*). | 20 |
| | Reserved | | 21…23 |
| | Setpoint data storage | *40.92 Setpoint data storage* (see page *479*) | 24 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.72* | *Set 1 compensation input 1* | Point x1 on the setpoint compensation curve, see parameter *40.71 Compensated setpoint*. | 0.00 |
| | -200000.00… 200000.00 | Setpoint value. | 1 = 1 |
| *40.73* | *Set 1 compensated output 1* | Point y1 (= the compensated output of parameter *40.72 Set 1 compensation input 1*) on the setpoint compensation curve, see parameter *40.70 Compensated setpoint*. | 0.00 PID unit 1 |
| | -200000.00… 200000.00 PID unit 1 | Compensated setpoint value. | 1 = 1 PID unit 1 |
| *40.74* | *Set 1 compensation input 2* | Point x2 on the setpoint compensation curve, see parameter *40.71 Compensated setpoint*. | 0.00 |
| | -200000.00… 200000.00 | Setpoint value. | 1 = 1 |
| *40.75* | *Set 1 compensated output 2* | Point y2 (= the compensated output of parameter *40.74 Set 1 compensation input 2*) on the setpoint compensation curve, see parameter *40.70 Compensated setpoint*. | 0.00 PID unit 1 |
| | -200000.00… 200000.00 PID unit 1 | Compensated setpoint value. | 1 = 1 PID unit 1 |
| *40.76* | *Set 1 compensation non-linearity* | Describes the non-linearity of the setpoint compensation curve, see parameter *40.70 Compensated setpoint*. | 0% |
| | 0…100% | Percentage. | 1 = 1 |
| *40.79* | *Set 1 units* | Unit used for PID set 1. | *User text* |
| | User text | User editable text. User text default is "PID unit 1". | 0 |
| | % | | 4 |
| | bar | | 74 |
| | kPa | | 75 |
| | Pa | | 77 |
| | psi | | 76 |
| | CFM | | 26 |
| | inH$_2$O | | 58 |
| | °C | | 150 |
| | °F | | 151 |
| | mbar | | 44 |
| | m$^3$/h | | 78 |
| | dm$^3$/h | | 21 |
| | l/s | | 79 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | l/min | | 37 |
| | l/h | | 38 |
| | m$^3$/s | | 88 |
| | m$^3$/min | | 40 |
| | km$^3$/h | | 131 |
| | gal/s | | 47 |
| | ft$^3$/s | | 50 |
| | ft$^3$/min | | 51 |
| | ft$^3$/h | | 52 |
| | ppm | | 34 |
| | inHg | | 29 |
| | kCFM | | 126 |
| | inWC | | 65 |
| | gpm | | 80 |
| | gal/min | | 48 |
| | in wg | | 59 |
| | MPa | | 94 |
| | ftWC | | 125 |
| *40.80* | *Set 1 PID output min source* | Selects the source for set 1 PID output minimum. | *Set1 output min* |
| | None | Not selected. | 0 |
| | Set1 output min | *40.36 Set 1 output min*. | 1 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.81* | *Set 1 PID output max source* | Selects the source for set 1 PID output maximum. | *Set1 output max* |
| | None | Not selected. | 0 |
| | Set1 output max | *40.37 Set 1 output max* | 1 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *40.89* | *Set 1 setpoint multiplier* | Defines the multiplier with which the result of the function specified by parameter *40.18 Set 1 setpoint function* is multiplied. | 1.00 |
| | -200000.00… 200000.00 | Multiplier. | 1 = 1 |
| *40.90* | *Set 1 feedback multiplier* | Defines the multiplier with which the result of the function specified by parameter *40.10 Set 1 feedback function* is multiplied. | 1.00 |
| | -200000.00… 200000.00 | Multiplier. | 1 = 1 |
| *40.91* | *Feedback data storage* | Storage parameter for receiving a process feedback value, for example, through the embedded fieldbus interface. The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (*58.101*…*58.114*) to *Feedback data storage*. In *40.08 Set 1 feedback 1 source* (or *40.09 Set 1 feedback 2 source*), select *Feedback data storage*. | 0.00 |
| | -327.68…327.67 | Storage parameter for process feedback. | 100 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *40.92* | *Setpoint data storage* | Storage parameter for receiving a process setpoint value, for example, through the embedded fieldbus interface. The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (*58.101*…*58.114*)) to *Setpoint data storage*. In *40.16 Set 1 setpoint 1 source* (or *40.17 Set 1 setpoint 2 source*), select *Setpoint data storage*. | 0.00 |
| | -327.68…327.67 | Storage parameter for process setpoint. | 100 = 1 |
| *40.96* | *Process PID output %* | Percentage scaled signal of parameter *40.01 Process PID feedback actual*. | 0.00% |
| | -100.00…100.00% | Percentage. | 100 = 1% |
| *40.97* | *Process PID feedback %* | Percentage scaled signal of parameter *40.02 Process PID feedback actual*. | 0.00% |
| | -100.00…100.00% | Percentage. | 100 = 1% |
| *40.98* | *Process PID setpoint %* | Percentage scaled signal of parameter *40.03 Process PID setpoint actual*. | 0.00% |
| | -100.00…100.00% | Percentage. | 100 = 1% |
| *40.99* | *Process PID deviation %* | Percentage scaled signal of parameter *40.04 Process PID deviation actual*. | 0.00% |
| | -100.00…100.00% | Percentage. | 100 = 1% |
| *41 Process PID set 2* | | A second set of parameter values for process PID control. The selection between this set and first set (parameter group *40 Process PID set 1*) is made by parameter *40.57 PID set1/set2 selection*. See also parameters *40.01*…*40.06*, and control chain diagrams *PID setpoint compensation* and *Direction lock* on pages *314* and *319*, respectively. | |
| *41.08* | *Set 2 feedback 1 source* | See parameter *40.08 Set 1 feedback 1 source*. | *AI2 percent* |
| *41.09* | *Set 2 feedback 2 source* | See parameter *40.09 Set 1 feedback 2 source*. | *Not selected* |
| *41.10* | *Set 2 feedback function* | See parameter *40.10 Set 1 feedback function*. | *In1* |
| *41.11* | *Set 2 feedback filter time* | See parameter *40.11 Set 1 feedback filter time*. | 0.000 s |
| *41.14* | *Set 2 setpoint scaling* | See parameter *40.14 Set 1 setpoint scaling*. | 0.00 |
| *41.15* | *Set 2 output scaling* | See parameter *40.15 Set 1 output scaling*. | 0.00 |
| *41.16* | *Set 2 setpoint 1 source* | See parameter *40.16 Set 1 setpoint 1 source*. | *AI1 percent* |
| *41.17* | *Set 2 setpoint 2 source* | See parameter *40.17 Set 1 setpoint 2 source*. | *Not selected* |
| *41.18* | *Set 2 setpoint function* | See parameter *40.18 Set 1 setpoint function*. | *In1* |
| *41.19* | *Set 2 internal setpoint sel1* | See parameter *40.19 Set 1 internal setpoint sel1*. | *Not selected* |
| *41.20* | *Set 2 internal setpoint sel2* | See parameter *40.20 Set 1 internal setpoint sel2*. | *Not selected* |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *41.21* | *Set 2 internal setpoint 1* | See parameter *40.21 Set 1 internal setpoint 1*. | 0.00 PID unit 1 |
| *41.22* | *Set 2 internal setpoint 2* | See parameter *40.22 Set 1 internal setpoint 2*. | 0.00 PID unit 1 |
| *41.23* | *Set 2 internal setpoint 3* | See parameter *40.23 Set 1 internal setpoint 3*. | 0.00 PID unit 1 |
| *41.24* | *Set 2 internal setpoint 0* | See parameter *40.24 Set 1 internal setpoint 0*. | 0.00 PID unit 1 |
| *41.26* | *Set 2 setpoint min* | See parameter *40.26 Set 1 setpoint min*. | 0.00 PID unit 1 |
| *41.27* | *Set 2 setpoint max* | See parameter *40.27 Set 1 setpoint max*. | 200000.00 PID unit 1 |
| *41.28* | *Set 2 setpoint increase time* | See parameter *40.28 Set 1 setpoint increase time*. | 0.0 s |
| *41.29* | *Set 2 setpoint decrease time* | See parameter *40.29 Set 1 setpoint decrease time*. | 0.0 s |
| *41.30* | *Set 2 setpoint freeze enable* | See parameter *40.30 Set 1 setpoint freeze enable*. | *Not selected* |
| *41.31* | *Set 2 deviation inversion* | See parameter *40.31 Set 1 deviation inversion*. | *Not inverted (Ref - Fbk)* |
| *41.32* | *Set 2 gain* | See parameter *40.32 Set 1 gain*. | 1.00 |
| *41.33* | *Set 2 integration time* | See parameter *40.33 Set 1 integration time*. | 60.0 s |
| *41.34* | *Set 2 derivation time* | See parameter *40.34 Set 1 derivation time*. | 0.000 s |
| *41.35* | *Set 2 derivation filter time* | See parameter *40.35 Set 1 derivation filter time*. | 0.0 s |
| *41.36* | *Set 2 output min* | See parameter *40.36 Set 1 output min*. | 0.00 |
| *41.37* | *Set 2 output max* | See parameter *40.37 Set 1 output max*. | 100.00 |
| *41.38* | *Set 2 output freeze enable* | See parameter *40.38 Set 1 output freeze enable*. | *Not selected* |
| *41.39* | *Set 2 deadband range* | See parameter *40.39 Set 1 deadband range*. | 0.0 bar |
| *41.40* | *Set 2 deadband delay* | See parameter *40.40 Set 1 deadband delay*. | 0.0 s |
| *41.43* | *Set 2 sleep level* | See parameter *40.43 Set 1 sleep level*. | 0.0 |
| *41.44* | *Set 2 sleep delay* | See parameter *40.44 Set 1 sleep delay*. | 60.0 s |
| *41.45* | *Set 2 sleep boost time* | See parameter *40.45 Set 1 sleep boost time*. | 0.0 s |
| *41.46* | *Set 2 sleep boost step* | See parameter *40.46 Set 1 sleep boost step*. | 0.0 PID unit 1 |
| *41.47* | *Set 2 wake-up deviation* | See parameter *40.47 Set 1 wake-up deviation*. | 0.00 PID unit 1 |
| *41.48* | *Set 2 wake-up delay* | See parameter *40.48 Set 1 wake-up delay*. | 0.50 s |
| *41.49* | *Set 2 tracking mode* | See parameter *40.49 Set 1 tracking mode*. | *Not selected* |
| *41.50* | *Set 2 tracking ref selection* | See parameter *40.50 Set 1 tracking ref selection*. | *Not selected* |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *41.58* | *Set 2 increase prevention* | See parameter *40.58 Set 1 increase prevention*. | *No* |
| *41.59* | *Set 2 decrease prevention* | See parameter *40.59 Set 1 decrease prevention*. | *No* |
| *41.60* | *Set 2 PID activation source* | See parameter *40.60 Set 1 PID activation source*. | *On* |
| *41.71* | *Set 2 compensation input source* | See parameter *40.71 Set 1 compensation input source*. | *AI1 percent* |
| *41.72* | *Set 2 compensation input 1* | See parameter *40.72 Set 1 compensation input 1*. | 0.00 |
| *41.73* | *Set 2 compensated output 1* | See parameter *40.73 Set 1 compensated output 1*. | 0.00 PID unit 1 |
| *41.74* | *Set 2 compensation input 2* | See parameter *40.74 Set 1 compensation input 2*. | 0.00 |
| *41.75* | *Set 2 compensated output 2* | See parameter *40.75 Set 1 compensated output 2*. | 0.00 PID unit 1 |
| *41.76* | *Set 2 compensation non-linearity* | See parameter *40.76 Set 1 compensation non-linearity*. | 0% |
| *41.79* | *Set 2 units* | See parameter *40.79 Set 1 units*. | *bar* |
| *41.80* | *Set 2 PID output min source* | Selects the source for set 2 PID output minimum. | *Set2 output min* |
| | None | None. | 0 |
| | Set2 output min | *41.36 Set 2 output min* | 1 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *41.81* | *Set 2 PID output max source* | Selects the source for set 2 PID output maximum. | *Set2 output max* |
| | None | None. | 0 |
| | Set2 output max | *41.37 Set 2 output max* | 1 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *41.89* | *Set 2 setpoint multiplier* | See parameter *40.89 Set 1 setpoint multiplier*. | 1.00 |
| *41.90* | *Set 2 feedback multiplier* | Defines the multiplier k used in formulas of parameter *41.10 Set 2 feedback function*. See parameter *40.90 Set 1 feedback multiplier*. | 1.00 |
| *43 Brake chopper* | | Settings for the internal brake chopper. | |
| *43.01* | *Braking resistor temperature* | Displays the estimated temperature of the brake resistor, or how close the brake resistor is to being too hot. The value is given in percent where 100% is the eventual temperature the resistor would reach when loaded long enough with its rated maximum load capacity (*43.09 Brake resistor Pmax cont*). The temperature calculation is based on the values of parameters *43.08*, *43.09* and *43.10*, and on the assumption that the resistor is installed as instructed by the manufacturer (ie it cools down as expected). This parameter is read-only. | - |
| | 0.0…120.0% | Estimated brake resistor temperature. | 1 = 1% |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *43.06* | *Brake chopper function* | Enables brake chopper control and selects the brake resistor overload protection method (calculation or measurement).<br>**Note:** Before enabling brake chopper control, ensure that<br>• a brake resistor is connected<br>• overvoltage control is switched off (parameter *30.30 Overvoltage control*)<br>• the supply voltage range (parameter *95.01 Supply voltage*) has been selected correctly. | *Disabled* |
| | Disabled | Brake chopper control disabled. | 0 |
| | Enabled with thermal model | Brake chopper control enabled with brake resistor protection based on the thermal model. If you select this, you must also specify the values needed by the model, ie, parameters *43.08*… *43.12*. See the resistor data sheet. | 1 |
| | Enabled without thermal model | Brake chopper control enabled without resistor overload protection based on the thermal model. This setting can be used, for example, if the resistor is equipped with a thermal switch that is wired to open the main contactor of the drive if the resistor overheats.<br>For more information, see chapter *Resistor braking* in the *Hardware manual* of the drive. | 2 |
| | Overvoltage peak protection | Brake chopper control enabled in an overvoltage condition. This setting is intended for situations where<br>• the braking chopper is not needed for runtime operation, ie, to dissipate the inertial energy of the motor,<br>• the motor is able to store a considerable amount magnetic energy in its windings, and<br>• the motor might, deliberately or inadvertently, be stopped by coasting.<br>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.<br>With this setting, the brake chopper is activated only whenever the DC voltage exceeds the overvoltage limit. During normal use, the brake chopper is not operating. | 3 |
| *43.07* | *Brake chopper run enable* | Selects the source for quick brake chopper on/off control.<br>0 = Brake chopper IGBT pulses are cut off<br>1 = Normal brake chopper IGBT modulation allowed. | *On* |
| | Off | 0. | 0 |
| | On | 1. | 1 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *43.08* | *Brake resistor thermal t* | Defines§ the thermal time constant for the brake resistor thermal model. | 0 s |
| | 0…10000 s | Brake resistor thermal time constant, ie, the rated time to achieve 63% temperature. | 1 = 1 s |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *43.09* | *Brake resistor Pmax cont* | Defines the maximum continuous load of the brake resistor that will eventually raise the resistor temperature to the maximum allowed value (= continuous heat dissipation capacity of the resistor in kW) but not above it. The value is used in the resistor overload protection based on the thermal model. See parameter *43.06 Brake chopper function* and the data sheet of the brake resistor used. | 0.00 kW |
| | 0.00… 10000.00 kW | Maximum continuous load of the brake resistor. | 1 = 1 kW |
| *43.10* | *Brake resistance* | Defines the resistance value of the brake resistor. The value is used for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper function*. | 0.0 ohm |
| | 0.0…1000.0 ohm | Brake resistor resistance value. | 1 = 1 ohm |
| *43.11* | *Brake resistor fault limit* | Selects the fault limit for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper function*. When the limit is exceeded, the drive trips on fault *7183 BR excess temperature*.<br>The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*. | 105% |
| | 0…150% | Brake resistor temperature fault limit. | 1 = 1% |
| *43.12* | *Brake resistor warning limit* | Selects the warning limit for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper function*. When the limit is exceeded, the drive generates warning *A793 BR excess temperature*.<br>The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*. | 95% |
| | 0…150% | Brake resistor temperature warning limit. | 1 = 1% |
| *45 Energy efficiency* | | Settings for the energy saving calculators as well as peak and energy loggers.<br>See also section *Diagnostics menu* (page *179*). | |
| *45.01* | *Saved GW hours* | Energy saved in GWh compared to direct-on-line motor connection. This parameter is incremented when *45.02 Saved MW hours* rolls over.<br>This parameter is read-only (see parameter *45.21 Energy calculations reset*). | - |
| | 0…65535 GWh | Energy savings in GWh. | 1 = 1 GWh |
| *45.02* | *Saved MW hours* | Energy saved in MWh compared to direct-on-line motor connection. This parameter is incremented when *45.03 Saved kW hours* rolls over.<br>When this parameter rolls over, parameter *45.01 Saved GW hours* is incremented.<br>This parameter is read-only (see parameter *45.21 Energy calculations reset*). | - |
| | 0…999 MWh | Energy savings in MWh. | 1 = 1 MWh |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *45.03* | *Saved kW hours* | Energy saved in kWh compared to direct-on-line motor connection.<br>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.<br>When this parameter rolls over, parameter *45.02 Saved MW hours* is incremented.<br>This parameter is read-only (see parameter *45.21 Energy calculations reset*). | - |
| | 0.0…999.9 kWh | Energy savings in kWh. | 10 = 1 kWh |
| *45.04* | *Saved energy* | Energy saved in kWh compared to direct-on-line motor connection.<br>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.<br>This parameter is read-only (see parameter *45.21 Energy calculations reset*). | - |
| | 0.0…214748364.0 kWh | Energy savings in kWh. | 1 = 1 kWh |
| *45.05* | *Saved money x1000* | Monetary savings in thousands compared to direct-on-line motor connection. This parameter is incremented when *45.06 Saved money* rolls over.<br>If you have not set the currency during the first start-up, you can specify it in **Main menu > Primary settings > Clock, region display > Units > Currency**.<br>This parameter is read-only (see parameter *45.21 Energy calculations reset*). | - |
| | 0…4294967295 thousands (unit x 1000) | Monetary savings in thousands of units. | 1 = 1 unit |
| *45.06* | *Saved money* | Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*).<br>When this parameter rolls over, parameter *45.05 Saved money x1000* is incremented.<br>If you have not set the currency during the first start-up, you can specify it in **Main menu > Primary settings > Clock, region display > Units > Currency**.<br>This parameter is read-only (see parameter *45.21 Energy calculations reset*). | - |
| | 0.00…999.99 units | Monetary savings. | 1 = 1 unit |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *45.07* | *Saved amount* | Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*).<br>If you have not set the currency during the first start-up, you can specify it in **Main menu > Primary settings > Clock, region display > Units > Currency**.<br>This parameter is read-only (see parameter *45.21 Energy calculations reset*). | - |
| | 0.00… 21474830.08 units | Monetary savings. | 1 = 1 unit |
| *45.08* | *CO2 reduction in kilotons* | Reduction in $CO_2$ emissions in metric kilotons compared to direct-on-line motor connection. This value is incremented when parameter *45.09 CO2 reduction in tons* rolls over.<br>This parameter is read-only (see parameter *45.21 Energy calculations reset*). | - |
| | 0…65535 metric kilotons | Reduction in $CO_2$ emissions in metric kilotons. | 1 = 1 metric kiloton |
| *45.09* | *CO2 reduction in tons* | Reduction in $CO_2$ emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh).<br>When this parameter rolls over, parameter *45.08 CO2 reduction in kilotons* is incremented.<br>This parameter is read-only (see parameter *45.21 Energy calculations reset*). | - |
| | 0.0…999.9 metric tons | Reduction in $CO_2$ emissions in metric tons. | 1 = 1 metric ton |
| *45.10* | *Total saved CO2* | Reduction in $CO_2$ emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh).<br>This parameter is read-only (see parameter *45.21 Energy calculations reset*). | - |
| | 0.0…214748300.8 metric tons | Reduction in $CO_2$ emissions in metric tons. | 1 = 1 metric ton |
| *45.11* | *Energy optimizer* | Enables/disables the energy optimization function. The function optimizes the motor flux so that total energy consumption and motor noise level are reduced when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1…20% depending on load torque and speed.<br>**Note:** With a permanent magnet motor and a synchronous reluctance motor, energy optimization is always enabled regardless of this parameter. | *Enable* |
| | Disable | Energy optimization disabled. | 0 |
| | Enable | Energy optimization enabled. | 1 |

**13**
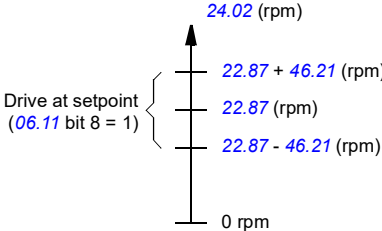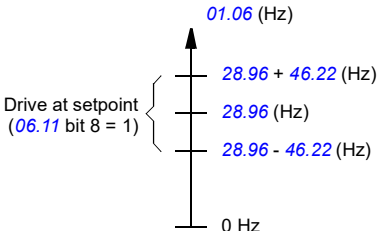
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *45.12* | *Energy tariff 1* | Defines energy tariff 1 (price of energy per kWh). Depending on the setting of parameter *45.14 Tariff selection*, either this value or *45.13 Energy tariff 2* is used for reference when monetary savings are calculated.<br>If you have not set the currency during the first start-up, you can specify it in **Main menu > Primary settings > Clock, region display > Units > Currency**.<br>**Note:** Tariffs are read only at the instant of selection, and are not applied retroactively. | 0.100 units |
| | 0.000… 4294966.296 units | Energy tariff 1. | - |
| *45.13* | *Energy tariff 2* | Defines energy tariff 2 (price of energy per kWh).<br>See parameter *45.12 Energy tariff 1*. | 0.200 units |
| | 0.000… 4294966.296 units | Energy tariff 2. | - |
| *45.14* | *Tariff selection* | Selects (or defines a source that selects) which pre-defined energy tariff is used.<br>0 = *45.12 Energy tariff 1*<br>1 = *45.13 Energy tariff 2* | *Energy tariff 1* |
| | Energy tariff 1 | 0. | 0 |
| | Energy tariff 2 | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *45.18* | *CO2 conversion factor* | Defines a factor for conversion of saved energy into $CO_2$ emissions (kg/kWh or tn/MWh). | 0.500 tn/MWh (metric ton) |
| | 0.000…65.535 tn/MWh | Factor for conversion of saved energy into $CO_2$ emissions. | 1 = 1 tn/MWh |
| *45.19* | *Comparison power* | Actual power that the motor absorbs when connected direct-on-line and operating the application. The value is used for reference when energy savings are calculated.<br>**Note:** The accuracy of the energy savings calculation is directly dependent on the accuracy of this value. If nothing is entered here, then the nominal motor power is used by the calculation, but that may inflate the energy savings reported as many motors do not absorb nameplate power. | 0.75 kW |
| | 0.00…10000000.00 kW | Motor power. | 1 = 1 kW |
| *45.21* | *Energy calculations reset* | Resets the savings counter parameters *45.01…45.10*. | *Done* |
| | Done | Reset not requested (normal operation), or reset complete. | 0 |
| | Reset | Reset the savings counter parameters. The value reverts automatically to *Done*. | 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *45.24* | *Hourly peak power value* | Value of the peak power during the last hour, that is, the most recent 60 minutes after the drive has been powered up. The parameter is updated once every 10 minutes unless the hourly peak is found in the most recent 10 minutes. In that case, the values is shown immediately. | 0.00 kW |
| | -3000.00 … 3000.00 kW | Peak power value. | 10 = 1 kW |
| *45.25* | *Hourly peak power time* | Time of the peak power value during the last hour. | 00:00:00 |
| | | Time. | N/A |
| *45.26* | *Hourly total energy (resettable)* | Total energy consumption during the last hour, that is, the most recent 60 minutes. You can reset the value by setting it to zero. | 0.00 kWh |
| | -3000.00 … 3000.00 kWh | Total energy. | 10 = 1 kWh |
| *45.27* | *Daily peak power value (resettable)* | Value of the peak power since midnight of the present day. You can reset the value by setting it to zero. | 0.00 kW |
| | -3000.00 … 3000.00 kW | Peak power value. | 10 = 1 kW |
| *45.28* | *Daily peak power time* | Time of the peak power since midnight of the present day. | 00:00:00 |
| | | Time. | N/A |
| *45.29* | *Daily total energy (resettable)* | Total energy consumption since midnight of the present day. You can reset the value by setting it to zero. | 0.00 kWh |
| | -30000.00 … 30000.00 kWh | Total energy. | 1 = 1 kWh |
| *45.30* | *Last day total energy* | Total energy consumption during the previous day, that is, between midnight of the previous day and midnight of the present day | 0.00 kWh |
| | -30000.00 … 30000.00 kWh | Total energy. | 1 = 1 kWh |
| *45.31* | *Monthly peak power value (resettable)* | Value of the peak power during the present month, that is, since midnight of the first day of the present month. You can reset the value by setting it to zero. | 0.00 kW |
| | -3000.00 … 3000.00 kW | Peak power value. | 10 = 1 kW |
| *45.32* | *Monthly peak power date* | Date of the peak power during the present month. | 1.1.1980 |
| | | Date. | N/A |
| *45.33* | *Monthly peak power time* | Time of the peak power during the present month. | 00:00:00 |
| | | Time. | N/A |
| *45.34* | *Monthly total energy (resettable)* | Total energy consumption from the beginning of the present month. You can reset the value by setting it to zero. | 0.00 kWh |
| | -1000000.00 … 1000000.00 kWh | Total energy. | 0.01 = 1 kWh |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *45.35* | *Last month total energy* | Total energy consumption during the previous month, that is, between midnight of the first day or the previous month and midnight of the first day of the present month. | 0.00 kWh |
| | -1000000.00 … 1000000.00 kWh | | 0.01 = 1 kWh |
| *45.36* | *Lifetime peak power value* | Value of the peak power over the drive lifetime. | 0.00 kW |
| | -3000.00 … 3000.00 kW | Peak power value. | 10 = 1 kW |
| *45.37* | *Lifetime peak power date* | Date of the peak power over the drive lifetime. | 1.1.1980 |
| | | Date. | N/A |
| *45.38* | *Lifetime peak power time* | Time of the peak power over the drive lifetime. | 00:00:00 |
| | | Time. | N/A |

| | | | |
|---|---|---|---|
| *46 Monitoring/scaling settings* | | Speed supervision settings; actual signal filtering; general scaling settings. | |
| *46.01* | *Speed scaling* | Defines the maximum speed value used to define the acceleration ramp rate and the initial speed value used to define the deceleration ramp rate (see parameter group *23 Speed reference ramp*). The speed acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.12 Maximum speed*). Also defines the 16-bit scaling of speed-related parameters. The value of this parameter corresponds to 20000, for example, in fieldbus communication. | 1500.00 rpm; 1800.00 rpm (*95.20* b0) |
| | 0.10…30000.00 rpm | Acceleration/deceleration terminal/initial speed. | 1 = 1 rpm |
| *46.02* | *Frequency scaling* | Defines the maximum frequency value used to define the acceleration ramp rate and the initial frequency value used to define deceleration ramp rate (see parameter group *28 Frequency reference chain*). The frequency acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.14 Maximum frequency*). Also defines the 16-bit scaling of frequency-related parameters. The value of this parameter corresponds to 20000, for example, in fieldbus communication. | 50.00 Hz; 60.00 Hz (*95.20* b0) |
| | 0.10…1000.00 Hz | Acceleration/deceleration terminal/initial frequency. | 10 = 1 Hz |
| *46.03* | *Torque scaling* | Defines the 16-bit scaling of torque parameters. The value of this parameter (in percent of nominal motor torque) corresponds to 10000, for example, in fieldbus communication. | 100.0% |
| | 0.1…1000.0% | Torque corresponding to 10000 on fieldbus. | 10 = 1% |
| *46.04* | *Power scaling* | Defines the 16-bit scaling of power parameters. The value of this parameter corresponds to 10000, for example, in fieldbus communication. The unit is selected by parameter *96.16 Unit selection*. For 32-bit scaling see parameter *46.43 Power decimals*. | 100 |
| | 0.1…1000 | Power corresponding to 100 on fieldbus. | 1 = 1 unit |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| *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.<br>For 32-bit scaling see parameter *46.44 Current decimals*. | 100 A |
| | 0…30000 A | | 1 = 1 A |
| *46.06* | *Speed ref zero scaling* | Defines a speed corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA A). For example, with a setting of 500, the fieldbus reference range of 0…20000 would correspond to a speed of 500…[*46.01*] rpm.<br>**Note:** This parameter is effective only with the ABB Drives communication profile. | 0.00 rpm |
| | 0.00 … 30000.00 rpm | Speed corresponding to minimum fieldbus reference. | 1 = 1 rpm |
| *46.07* | *Frequency ref zero scaling* | Defines a frequency corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA). For example, with a setting of 30, the fieldbus reference range of 0…20000 would correspond to a speed of 30…[*46.02*] Hz.<br>**Note:** This parameter is effective only with the ABB Drives communication profile. | 0.00 Hz |
| | 0.00 … 1000.00 Hz | Frequency corresponding to minimum fieldbus reference. | 10 = 1 Hz |
| *46.11* | *Filter time motor speed* | Defines a filter time for signals *01.01 Motor speed used* and *01.02 Motor speed estimated*. | 500 ms |
| | 2…20000 ms | Motor speed signal filter time. | 1 = 1 ms |
| *46.12* | *Filter time output frequency* | Defines a filter time for signal *01.06 Output frequency*. | 500 ms |
| | 2…20000 ms | Output frequency signal filter time. | 1 = 1 ms |
| *46.13* | *Filter time motor torque* | Defines a filter time for signal *01.10 Motor torque*. | 100 ms |
| | 2…20000 ms | Motor torque signal filter time. | 1 = 1 ms |
| *46.14* | *Filter time power* | Defines a filter time for signal *01.14 Output power*. | 100 ms |
| | 2…20000 ms | Output power signal filter time. | 1 = 1 ms |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *46.21* | *At speed hysteresis* | Defines the "at setpoint" limits for speed control of the drive. When the difference between reference (*22.87 Speed reference act 7*) and the speed (*24.02 Used speed feedback*) is smaller than *46.21 At speed hysteresis*, the drive is considered to be "at setpoint". This is indicated by bit 8 of *06.11 Main status word*.<br><br>*24.02* (rpm)<br><br>*22.87* + *46.21* (rpm)<br>Drive at setpoint (*06.11* bit 8 = 1) { *22.87* (rpm)<br>*22.87* - *46.21* (rpm)<br><br>0 rpm | 50.00 rpm |
| | 0.00…30000.00 rpm | Limit for "at setpoint" indication in speed control. | See par. *46.01* |
| *46.22* | *At frequency hysteresis* | Defines the "at setpoint" limits for frequency control of the drive. When the absolute difference between reference (*28.96 Frequency ref ramp input*) and actual frequency (*01.06 Output frequency*) is smaller than *46.22 At frequency hysteresis*, the drive is considered to be "at setpoint". This is indicated by bit 8 of *06.11 Main status word*.<br><br>*01.06* (Hz)<br><br>*28.96* + *46.22* (Hz)<br>Drive at setpoint (*06.11* bit 8 = 1) { *28.96* (Hz)<br>*28.96* - *46.22* (Hz)<br><br>0 Hz | 2.00 Hz |
| | 0.00…1000.00 Hz | Limit for "at setpoint" indication in frequency control. | See par. *46.02* |
| *46.31* | *Above speed limit* | Defines the trigger level for "above limit" indication in speed control. When actual speed exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.<br>This is also indicated by bit 10 in *06.11 Main status word*. | 1500.00 rpm; 1800.00 rpm (*95.20* b0) |
| | 0.00…30000.00 rpm | "Above limit" indication trigger level for speed control. | See par. *46.01* |
| *46.32* | *Above frequency limit* | Defines the trigger level for "above limit" indication in frequency control. When actual frequency exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.<br>This is also indicated by bit 10 in *06.11 Main status word*. | 50.00 Hz; 60.00 Hz (*95.20* b0) |
| | 0.00…1000.00 Hz | "Above limit" indication trigger level for frequency control. | See par. *46.02* |
| *46.41* | *kWh pulse scaling* | Defines the trigger level for the "kWh pulse" on for 50 ms. The output of the pulse is bit 9 of *05.22 Diagnostic word 3*. | 1.000 kWh |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0.001… 1000.000 kWh | "kWh pulse" on trigger level. | 1 = 1 kWh |
| *46.43* | *Power decimals* | Defines the number of decimals shown for parameter *99.10 Motor nominal power* on the panel and Drive composer PC tool. It also defines 32-bit scaling of power parameters.<br>The value of this parameter corresponds to the number of decimals assumed in the 32-bit integer fieldbus communication.<br>For 16-bit scaling, see parameter *46.04 Power scaling*. | 2 |
| | 0…3 | Number of decimals. | 1 = 1 |
| *46.44* | *Current decimals* | Defines the number of decimals shown for parameter *99.06 Motor nominal current* on the panel and Drive composer PC tool. It also defines 32-bit scaling of current parameters.<br>The value of this parameter corresponds to the number of decimals assumed in the 32-bit integer fieldbus communication.<br>For 16-bit scaling, see parameter *46.05 Current scaling*. | 2 |
| | 0…3 | Number of decimals. | 1 = 1 |
| *47 Data storage* | | Data storage parameters that can be written to and read from using other parameters' source and target settings.<br>Note that there are different storage parameters for different data types.<br>See also section *Data storage parameters* (page *181*). | |
| *47.01* | *Data storage 1 real32* | Data storage parameter 1. | 0.000 |
| | -2147483.000… 2147483.000 | 32-bit data. | - |
| *47.02* | *Data storage 2 real32* | Data storage parameter 2. | 0.000 |
| | -2147483.000… 2147483.000 | 32-bit data. | - |
| *47.03* | *Data storage 3 real32* | Data storage parameter 3. | 0.000 |
| | -2147483.000… 2147483.000 | 32-bit data. | - |
| *47.04* | *Data storage 4 real32* | Data storage parameter 4. | 0.000 |
| | -2147483.000… 2147483.000 | 32-bit data. | - |
| *47.11* | *Data storage 1 int32* | Data storage parameter 9. | 0 |
| | -2147483648… 2147483647 | 32-bit data. | - |
| *47.12* | *Data storage 2 int32* | Data storage parameter 10. | 0 |
| | -2147483648… 2147483647 | 32-bit data. | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *47.13* | *Data storage 3 int32* | Data storage parameter 11. | 0 |
| | -2147483648… 2147483647 | 32-bit data. | - |
| *47.14* | *Data storage 4 int32* | Data storage parameter 12. | 0 |
| | -2147483648… 2147483647 | 32-bit data. | - |
| *47.21* | *Data storage 1 int16* | Data storage parameter 17. | 0 |
| | -32768…32767 | 16-bit data. | 1 = 1 |
| *47.22* | *Data storage 2 int16* | Data storage parameter 18. | 0 |
| | -32768…32767 | 16-bit data. | 1 = 1 |
| *47.23* | *Data storage 3 int16* | Data storage parameter 19. | 0 |
| | -32768…32767 | 16-bit data. | 1 = 1 |
| *47.24* | *Data storage 4 int16* | Data storage parameter 20. | 0 |
| | -32768…32767 | 16-bit data. | 1 = 1 |

| | | | |
|---|---|---|---|
| *49 Panel port communication* | | Communication settings for the control panel port on the drive. | |
| *49.01* | *Node ID number* | Defines the node ID of the drive. All devices connected to the network must have a unique node ID.<br>**Note:** For networked drives, it is advisable to reserve ID 1 for spare/replacement drives. | 1 |
| | 1…32 | Node ID. | 1 = 1 |
| *49.03* | *Baud rate* | Defines the transfer rate of the link. | *115.2 kbps* |
| | 38.4 kbps | 38.4 kbit/s. | 1 |
| | 57.6 kbps | 57.6 kbit/s. | 2 |
| | 86.4 kbps | 86.4 kbit/s. | 3 |
| | 115.2 kbps | 115.2 kbit/s. | 4 |
| | 230.4 kbps | 230.4 kbit/s. | 5 |
| *49.04* | *Communication loss time* | Sets a timeout for control panel (or PC tool) communication. If a communication break lasts longer than the timeout, the action specified by parameter *49.05 Communication loss action* is taken. | 10.0 s |
| | 0.3…3000.0 s | Panel/PC tool communication timeout. | 10 = 1 s |
| *49.05* | *Communication loss action* | Selects how the drive reacts to a control panel (or PC tool) communication break. | *Fault* |
| | No action | No action taken. | 0 |
| | Fault | Drive trips on fault *7081 Control panel loss*. | 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Last speed | Drive generates warning *A7EE Panel loss* and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering.<br>⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break. | 2 |
| | Speed ref safe | Drive generates warning *A7EE Panel loss* and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used).<br>⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break. | 3 |
| *49.06* | *Refresh settings* | Applies the settings of parameters *49.01…49.05*.<br>**Note:** Refreshing may cause a communication break, so reconnecting the drive may be required. | *Done* |
| | Done | Refresh done or not requested. | 0 |
| | Configure | Refresh parameters *49.01…49.05*. The value reverts automatically to *Done*. | 1 |
| **50 Fieldbus adapter (FBA)** | | Fieldbus communication configuration.<br>See also chapter *Fieldbus control through a fieldbus adapter* (page *285*). | |
| *50.01* | *FBA A enable* | Enables/disables communication between the drive and fieldbus adapter A, and specifies the slot the adapter is installed into. | *Disable* |
| | Disable | Communication between drive and fieldbus adapter A disabled. | 0 |
| | Enable | Communication between drive and fieldbus adapter A enabled. The adapter is in slot 1. | 1 |
| *50.02* | *FBA A comm loss func* | Selects how the drive reacts upon a fieldbus communication break. The time delay is defined by parameter *50.03 FBA A comm loss t out*. | *No action* |
| | No action | No action taken. | 0 |
| | Fault | Drive trips on fault *7510 FBA A communication*. This only occurs if control is expected from the fieldbus (FBA A selected as source of start/stop/reference in the currently active control location). | 1 |
| | Last speed | Drive generates warning *A7C1 FBA A communication* and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the fieldbus.<br>The speed is determined on the basis of actual speed using 850 ms low-pass filtering.<br>⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break. | 2 |
| | Speed ref safe | Drive generates warning *A7C1 FBA A communication* and sets the speed to the value defined by parameter *22.41 Speed ref safe* (when speed reference is being used) or *28.41 Frequency ref safe* (when frequency reference is being used). This only occurs if control is expected from the fieldbus.<br>⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break. | 3 |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Fault always | Drive trips on fault *7510 FBA A communication*. This occurs even though no control is expected from the fieldbus. | 4 |
| | Warning | Drive generates warning *A7C1 FBA A communication*. This only occurs if control is expected from the fieldbus.<br>⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break. | 5 |
| *50.03* | *FBA A comm loss t out* | Defines the time delay before the action defined by parameter *50.02 FBA A comm loss func* is taken. Time count starts when the communication link fails to update the message.<br>**Note:** There is a 60-second boot-up delay immediately after power-up. During the delay, the communication break monitoring is disabled (but communication itself can be active). | 0.3 s |
| | 0.3…6553.5 s | Time delay. | 1 = 1 s |
| *50.04* | *FBA A ref1 type* | Selects the type and scaling of reference 1 received from fieldbus adapter A. The scaling of the reference is defined by parameters *46.01*…*46.04*, depending on which reference type is selected by this parameter. | *Speed or frequency* |
| | Speed or frequency | Type and scaling is chosen automatically according to the currently active operation mode as follows:<br><br>| Operation mode (see par. *19.01*) | Reference 1 type |<br>|---|---|<br>| Speed control | *Speed* |<br>| Frequency control | *Frequency* | | 0 |
| | Transparent | No scaling is applied (the 16-bit scaling is 1 = 1 unit). | 1 |
| | General | Generic reference with a 16-bit scaling of 100 = 1 (ie. integer and two decimals). | 2 |
| | Torque | The scaling is defined by parameter *46.03 Torque scaling*. | 3 |
| | Speed | The scaling is defined by parameter *46.01 Speed scaling*. | 4 |
| | Frequency | The scaling is defined by parameter *46.02 Frequency scaling*. | 5 |
| *50.05* | *FBA A ref2 type* | Selects the type and scaling of reference 2 received from fieldbus adapter A. The scaling of the reference is defined by parameters *46.01*…*46.04*, depending on which reference type is selected by this parameter. | *Speed or frequency* |
| | Speed or frequency | Type and scaling is chosen automatically according to the currently active operation mode as follows:<br><br>| Operation mode (see par. *19.01*) | Reference 2 type |<br>|---|---|<br>| Speed control | *Speed* |<br>| Frequency control | *Frequency* |<br><br>Select Speed (selection 4) or Frequency (selection 5) manually. | 0 |
| | Transparent | No scaling is applied (the 16-bit scaling is 1 = 1 unit). | 1 |
| | General | Generic reference with a 16-bit scaling of 100 = 1 (ie. integer and two decimals). | 2 |
| | Torque | The scaling is defined by parameter *46.03 Torque scaling*. | 3 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Speed | The scaling is defined by parameter *46.01 Speed scaling*. | 4 |
| | Frequency | The scaling is defined by parameter *46.02 Frequency scaling*. | 5 |
| *50.06* | *FBA A SW sel* | Selects the source of the Status word to be sent to the fieldbus network through fieldbus adapter A. | *Auto* |
| | Auto | Source of the Status word is chosen automatically. | 0 |
| | Transparent mode | The source selected by parameter *50.09 FBA A SW transparent source* is transmitted as the Status word to the fieldbus network through fieldbus adapter A. | 1 |
| *50.07* | *FBA A actual 1 type* | Selects the type and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter A. The scaling of the value is defined by parameters *46.01…46.04*, depending on which actual value type is selected by this parameter. | *Speed or frequency* |
| | Speed or frequency | Type and scaling is chosen automatically according to the currently active operation mode as follows: <br><br> | Operation mode (see par. *19.01*) | Actual value 1 type | <br>|---|---|<br>| Speed control | *Speed* |<br>| Frequency control | *Frequency* | | 0 |
| | Transparent | The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1. No scaling is applied (the 16-bit scaling is 1 = 1 unit). | 1 |
| | General | The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1 with a 16-bit scaling of 100 = 1 unit (ie. integer and two decimals). | 2 |
| | Torque | The scaling is defined by parameter *46.03 Torque scaling*. | 3 |
| | Speed | *01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*. | 4 |
| | Frequency | *01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*. | 5 |
| *50.08* | *FBA A actual 2 type* | Selects the type and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter A. The scaling of the value is defined by parameters *46.01…46.04*, depending on which actual value type is selected by this parameter. | *Speed or frequency* |
| | Speed or frequency | Type and scaling is chosen automatically according to the currently active operation mode as follows: <br><br> | Operation mode (see par. *19.01*) | Actual value 2 type | <br>|---|---|<br>| Speed control | *Speed* |<br>| Frequency control | *Frequency* | <br><br>Select Speed (selection 4) or Frequency (selection 5) manually. | 0 |
| | Transparent | The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1. No scaling is applied (the 16-bit scaling is 1 = 1 unit). | 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | General | The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1 with a 16-bit scaling of 100 = 1 unit (ie. integer and two decimals). | 2 |
| | Torque | *01.10 Motor torque* is sent as actual value 1. The scaling is defined by parameter *46.03 Torque scaling*. | 3 |
| | Speed | *01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*. | 4 |
| | Frequency | *01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*. | 5 |
| *50.09* | *FBA A SW transparent source* | Selects the source of the fieldbus status word when parameter *50.06 FBA A SW sel* is set to *Transparent mode*. | *Not selected* |
| | Not selected | No source selected. | - |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *50.10* | *FBA A act1 transparent source* | When parameter *50.07 FBA A actual 1 type* is set to *Transparent*, this parameter selects the source of actual value 1 transmitted to the fieldbus network through fieldbus adapter A. | *Not selected* |
| | Not selected | No source selected. | - |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *50.11* | *FBA A act2 transparent source* | When parameter *50.08 FBA A actual 2 type* is set to *Transparent*, this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter A. | *Not selected* |
| | Not selected | No source selected. | - |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *50.12* | *FBA A debug mode* | This parameter enables debug mode. Displays raw (unmodified) data received from and sent to fieldbus adapter A in parameters *50.13…50.18*. | *Disable* |
| | Disable | Debug mode disabled. | 0 |
| | Fast | Debug mode enabled. Cyclical data update is as fast as possible which increases CPU load on the drive. | 1 |
| *50.13* | *FBA A control word* | Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only. | - |
| | 00000000h… FFFFFFFFh | Control word sent by master to fieldbus adapter A. | - |
| *50.14* | *FBA A reference 1* | Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only. | - |
| | -2147483648… 2147483647 | Raw REF1 sent by master to fieldbus adapter A. | - |
| *50.15* | *FBA A reference 2* | Displays raw (unmodified) reference REF2 sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only. | - |
| | -2147483648… 2147483647 | Raw REF2 sent by master to fieldbus adapter A. | - |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *50.16* | *FBA A status word* | Displays the raw (unmodified) status word sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*.<br>This parameter is read-only. | - |
| | 00000000h…<br>FFFFFFFFh | Status word sent by fieldbus adapter A to master. | - |
| *50.17* | *FBA A actual value 1* | Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*.<br>This parameter is read-only. | - |
| | -2147483648…<br>2147483647 | Raw ACT1 sent by fieldbus adapter A to master. | - |
| *50.18* | *FBA A actual value 2* | Displays raw (unmodified) actual value ACT2 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*.<br>This parameter is read-only. | - |
| | -2147483648…<br>2147483647 | Raw ACT2 sent by fieldbus adapter A to master. | - |
| *51 FBA A settings* | | Fieldbus adapter A configuration. | |
| *51.01* | *FBA A type* | Displays the type of the connected fieldbus adapter module.<br>**0** = None. Module is not found or is not properly connected, or is disabled by parameter *50.01 FBA A enable*.<br>**1** = PROFIBUS-DP<br>**32** = CANopen<br>**37** = DeviceNet<br>**128** = Ethernet<br>**132** = PROFInet IO<br>**135** = EtherCAT<br>**136** = ETH Pwrlink (Ethernet Powerlink)<br>**485** = RS-485 comm<br>**101** = ControlNet<br>**47808** = BACnet/IP<br>**2222 =** Ethernet/IP<br>**502 =** Modbus/TCP<br>This parameter is read-only. | - |
| *51.02* | *FBA A Par2* | Parameters *51.02…51.26* are adapter module-specific. For more information, see the documentation of the fieldbus adapter module. Note that not all of these parameters are necessarily in use. | 0 |
| | 0…65535 | Fieldbus adapter configuration parameter. | 1 = 1 |
| … | … | … | … |
| *51.26* | *FBA A Par26* | See parameter *51.02 FBA A Par2*. | - |
| | 0…65535 | Fieldbus adapter configuration parameter. | 1 = 1 |
| *51.27* | *FBA A par refresh* | Validates any changed fieldbus adapter module configuration settings. After refreshing, the value reverts automatically to *Done*.<br>**Note:** This parameter cannot be changed while the drive is running. | *Done* |
| | Done | Refreshing done. | 0 |
| | Configure | Refreshing. | 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *51.28* | *FBA A par table ver* | Displays the parameter table revision of the fieldbus adapter module mapping file (stored in the memory of the drive). In format axyz, where ax = major table revision number; yz = minor table revision number. This parameter is read-only. | - |
| | | Parameter table revision of adapter module. | - |
| *51.29* | *FBA A drive type code* | Displays the drive type code in the fieldbus adapter module mapping file (stored in the memory of the drive). This parameter is read-only. | - |
| | 0…65535 | Drive type code stored in the mapping file. | 1 = 1 |
| *51.30* | *FBA A mapping file ver* | Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. This parameter is read-only. | - |
| | 0…65535 | Mapping file revision. | 1 = 1 |
| *51.31* | *D2FBA A comm status* | Displays the status of the fieldbus adapter module communication | *Not configured* |
| | Not configured | Adapter is not configured. | 0 |
| | Initializing | Adapter is initializing. | 1 |
| | Time out | A timeout has occurred in the communication between the adapter and the drive. | 2 |
| | Configuration error | Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times. | 3 |
| | Off-line | Fieldbus communication is off-line. | 4 |
| | On-line | Fieldbus communication is on-line, or fieldbus adapter has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter. | 5 |
| | Reset | Adapter is performing a hardware reset. | 6 |
| *51.32* | *FBA A comm SW ver* | Displays the common program revision of the adapter module in format axyz, where a = major revision number, xy = minor revision number, z = correction number or letter. Example: 190A = revision 1.90A. | |
| | | Common program revision of adapter module. | - |
| *51.33* | *FBA A appl SW ver* | Displays the application program revision of the adapter module in format axyz, where a = major revision number, xy = minor revision number, z = correction number or letter. Example: 190A = revision 1.90A. | |
| | | Application program version of adapter module. | - |
| **52 FBA A data in** | | Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved. | |
| *52.01* | *FBA A data in1* | Parameters *52.01*…*52.12* select data to be transferred from the drive to the fieldbus controller through fieldbus adapter A. | *None* |
| | None | None. | 0 |
| | CW 16bit | Control Word (16 bits) | 1 |
| | Ref1 16bit | Reference REF1 (16 bits) | 2 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Ref2 16bit | Reference REF2 (16 bits) | 3 |
| | SW 16bit | Status Word (16 bits) | 4 |
| | Act1 16bit | Actual value ACT1 (16 bits) | 5 |
| | Act2 16bit | Actual value ACT2 (16 bits) | 6 |
| | Reserved | | 7…10 |
| | CW 32bit | Control Word (32 bits) | 11 |
| | Ref1 32bit | Reference REF1 (32 bits) | 12 |
| | Ref2 32bit | Reference REF2 (32 bits) | 13 |
| | SW 32bit | Status Word (32 bits) | 14 |
| | Act1 32bit | Actual value ACT1 (32 bits) | 15 |
| | Act2 32bit | Actual value ACT2 (32 bits) | 16 |
| | Reserved | | 17…23 |
| | SW2 16bit | Status Word 2 (16 bits) | 24 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| … | … | … | … |
| *52.12* | *FBA A data in12* | See parameter *52.01 FBA A data in1*. | *None* |
| **53 FBA A data out** | | Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved. | |
| *53.01* | *FBA A data out1* | Parameters *53.01…53.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A. | *None* |
| | None | None. | 0 |
| | CW 16bit | Control Word (16 bits) | 1 |
| | Ref1 16bit | Reference REF1 (16 bits) | 2 |
| | Ref2 16bit | Reference REF2 (16 bits) | 3 |
| | Reserved | | 7…10 |
| | CW 32bit | Control Word (32 bits) | 11 |
| | Ref1 32bit | Reference REF1 (32 bits) | 12 |
| | Ref2 32bit | Reference REF2 (32 bits) | 13 |
| | Reserved | | 14…20 |
| | CW2 16bit | Control Word 2 (16 bits) | 21 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| … | … | … | … |
| *53.12* | *FBA A data out12* | See parameter *53.01 FBA A data out1*. | *None* |
| **58 Embedded fieldbus** | | Configuration of the embedded fieldbus (EFB) interface. See also chapter *Modbus RTU control through the embedded fieldbus interface (EFB)* (page *209*). | |
| *58.01* | *Protocol enable* | Enables/disables the embedded fieldbus interface and selects the protocol to use. | *None* |
| | None | None (communication disabled). | 0 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 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 |
| *58.02* | *Protocol ID* | Displays the protocol ID and revision. First 4 bits specify the protocol ID and last 12 bits specify the revision. This parameter is read-only. | - |
| | | Protocol ID and revision. | 1 = 1 |
| *58.03* | *Node address* | Defines the node address of the drive on the fieldbus link. Values 1…247 are allowable. Also called Station ID, MAC Address or Device Address. Two devices with the same address are not allowed on-line. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). | 1 |
| | 0…255 | Node address (values 1…247 are allowed). | 1 = 1 |
| *58.04* | *Baud rate* | Selects the transfer rate of the fieldbus link. When using selection *Autodetect*, the parity setting of the bus must be known and configured in parameter *58.05 Parity*. When parameter *58.04 Baud rate* is set to *Autodetect*, the EFB settings must be refreshed with parameter *58.06*. The bus is monitored for a period of time and the detected baud rate is set as the value of this parameter. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). | Modbus RTU: *19.2 kbps* BACnet MS/TP: *Autodetect* N2: *9.6 kbps* |
| | Autodetect | Baud rate detected automatically. | 0 |
| | 4.8 kbps | 4.8 kbit/s. | 1 |
| | 9.6 kbps | 9.6 kbit/s. | 2 |
| | 19.2 kbps | 19.2 kbit/s. | 3 |
| | 38.4 kbps | 38.4 kbit/s. | 4 |
| | 57.6 kbps | 57.6 kbit/s. | 5 |
| | 76.8 kbps | 76.8 kbit/s. | 6 |
| | 115.2 kbps | 115.2 kbit/s. | 7 |
| *58.05* | *Parity* | <u>Modbus RTU, N2 only:</u> Selects the type of parity bit and number of stop bits. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). | *8 EVEN 1* |
| | 8 NONE 1 | Eight data bits, no parity bit, one stop bit. | 0 |
| | 8 NONE 2 | Eight data bits, no parity bit, two stop bits. | 1 |
| | 8 EVEN 1 | Eight data bits, even parity bit, one stop bit. | 2 |
| | 8 ODD 1 | Eight data bits, odd parity bit, one stop bit. | 3 |
| *58.06* | *Communication control* | Takes changed EFB settings in use, or activates silent mode. | *Enabled* |
| | Enabled | Normal operation. | 0 |
| | Refresh settings | Refreshes settings (parameters *58.01*…*58.05*, *58.14*…*58.17*, *58.25*, *58.28*…*58.34*) and takes changed EFB configuration settings in use. Reverts automatically to *Enabled*. | 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Silent mode | Activates silent mode (no messages are transmitted). Silent mode can be terminated by activating the *Refresh settings* selection of this parameter. | 2 |
| *58.07* | *Communication diagnostics* | Displays the status of the EFB communication. This parameter is read-only. Note that the name is only visible when the error is present (bit value is 1). | - |

| Bit | Name | Description |
|---|---|---|
| 0 | Init failed | 1 = EFB initialization failed |
| 1 | Addr config err | 1 = Node address not allowed by protocol |
| 2 | Silent mode | 1 = Drive not allowed to transmit |
| | | 0 = Drive allowed to transmit |
| 3 | Autobauding | 1 = Automatic detection of baud rate is in use (see parameter *58.04*) |
| 4 | Wiring error | 1 = Errors detected (A/B wires possibly swapped) |
| 5 | Parity error | 1 = Error detected: check parameters *58.04* and *58.05* |
| 6 | Baud rate error | 1 = Error detected: check parameters *58.05* and *58.04* |
| 7 | No bus activity | 1 = 0 bytes received during last 5 seconds |
| 8 | No packets | 1 = 0 packets (addressed to any device) detected during last 5 seconds |
| 9 | Noise or addressing error | 1 = Errors detected (interference, or another device with the same address on line) |
| 10 | Comm loss | 1 = 0 packets addressed to the drive received within timeout (*58.16*) |
| 11 | CW/Ref loss | 1 = No control word or references received within timeout (*58.16*) |
| 12 | Reserved | |
| 13 | Protocol 1 | 1 = Duplicate ID detected on the network. Used for BACnet. |
| 14 | | |
| 15 | Internal error | 1 = Internal error occurred. Contact your local ABB representative. |

| | | | |
|---|---|---|---|
| | 0000h…FFFFh | EFB communication status. | 1 = 1 |
| *58.08* | *Received packets* | Displays a count of valid packets addressed to the drive. During normal operation, this number increases constantly. Can be reset from the control panel by pressing the Reset softkey for 3 seconds. | 0 |
| | 0…4294967295 | Number of received packets addressed to the drive. | 1 = 1 |
| *58.09* | *Transmitted packets* | Displays a count of valid packets transmitted by the drive. During normal operation, this number increases constantly. Can be reset from the control panel by pressing the Reset softkey for 3 seconds. | 0 |
| | 0…4294967295 | Number of transmitted packets. | 1 = 1 |
| *58.10* | *All packets* | Displays a count of valid packets addressed to any device on the bus. During normal operation, this number increases constantly. Can be reset from the control panel by pressing the Reset softkey for 3 seconds. | 0 |
| | 0…4294967295 | Number of all received packets. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *58.11* | *UART errors* | Displays a count of character errors received by the drive. An increasing count indicates a configuration problem on the bus.<br>Can be reset from the control panel by pressing the Reset softkey for 3 seconds. | 0 |
| | 0…4294967295 | Number of UART errors. | 1 = 1 |
| *58.12* | *CRC errors* | Displays a count of packets with a CRC error received by the drive. An increasing count indicates interference on the bus.<br>Can be reset from the control panel by pressing the Reset softkey for 3 seconds. | 0 |
| | 0…4294967295 | Number of CRC errors. | 1 = 1 |
| *58.13* | *Token counter* | <u>BACnet MS/TP only:</u> Contains a count of the number of times this device has received the token. Used for diagnostic purposes. | 0 |
| | 0…4294967295 | Counter | 1 = 1 |
| *58.14* | *Communication loss action* | Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).<br>See also parameters *58.15 Communication loss mode* and *58.16 Communication loss time*. | *No action* |
| | No action | No action taken (monitoring disabled). | 0 |
| | Fault | Drive monitors communication loss when start/stop is expected from the EFB on the currently active control location.<br>The drive trips on fault *6681 EFB comm loss* if control in the currently active control location is expected from the EFB or reference is coming from the EFB, and the communication is lost. | 1 |
| | Last speed | Drive generates warning *A7CE EFB comm loss* and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. This occurs if control or reference is expected from the EFB.<br>⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break. | 2 |
| | Speed ref safe | Drive generates warning *A7CE EFB comm loss* and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). This occurs if control or reference is expected from the EFB.<br>⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break. | 3 |
| | Fault always | Drive continuously monitors for communication loss. Drive trips on fault *6681 EFB comm loss*. This happens even though the drive is in a control location where the EFB start/stop or reference is not used. | 4 |
| | Warning | Drive generates warning *A7CE EFB comm loss*. This occurs even though no control is expected from the EFB.<br>⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break. | 5 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *58.15* | *Communication loss mode* | Defines which message types reset the timeout counter for detecting an EFB communication loss.<br>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*).<br>See also parameters *58.14 Communication loss action* and *58.16 Communication loss time*. | *Cw / Ref1 / Ref2* |
| | Any message | Any message addressed to the drive resets the timeout. | 1 |
| | Cw / Ref1 / Ref2 | A write of the control word or a reference resets the timeout. | 2 |
| *58.16* | *Communication loss time* | Sets a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified by parameter *58.14 Communication loss action* is taken.<br>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*).<br>See also parameter *58.15 Communication loss mode*.<br>**Note:** There is a 30-second boot-up delay immediately after power-up. | 30.0 s |
| | 0.0…6000.0 s | EFB communication timeout. | 1 = 1 |
| *58.17* | *Transmit delay* | <u>Modbus RTU, N2 only:</u> Defines a minimum response delay in addition to any fixed delay imposed by the protocol.<br>Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). | 0 ms |
| | 0…65535 ms | Minimum response delay. | 1 = 1 |
| *58.18* | *EFB control word* | <u>Modbus RTU, BACnet MS/TP only:</u> Displays the raw (unmodified) control word sent by the Modbus controller to the drive. For debugging purposes.<br>This parameter is read-only. | - |
| | 00000000h… FFFFFFFFh | Control word sent by Modbus controller to the drive. | 1 = 1 |
| *58.19* | *EFB status word* | <u>Modbus RTU, BACnet MS/TP only:</u> Displays the raw (unmodified) status word for debugging purposes.<br>This parameter is read-only. | - |
| | 00000000h… FFFFFFFFh | Status word sent by the drive to the Modbus controller. | 1 = 1 |
| *58.25* | *Control profile* | <u>Modbus RTU only:</u> Defines the communication profile used by the Modbus protocol.<br>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*).<br>See section *About the control profiles* on page *218* | *ABB Drives* |
| | ABB Drives | ABB Drives control profile (with a 16-bit control word) | 0 |
| | DCU Profile | DCU control profile (with a 16 or 32-bit control word) | 5 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *58.26* | *EFB ref1 type* | Modbus RTU only: Selects the type and scaling of reference 1 received through the embedded fieldbus interface.<br>The scaled reference is displayed by *03.09 EFB reference 1*. | *Speed or frequency* |
| | Speed or frequency | Type and scaling is chosen automatically according to the currently active operation mode as follows.<br><br>| **Operation mode**<br>(see par. *19.01*) | **Reference 1 type** |<br>\| --- \| --- \|<br>\| Speed control \| *Speed* \|<br>\| Frequency control \| *Frequency* \| | 0 |
| | Transparent | No scaling is applied. | 1 |
| | General | Generic reference without a specific unit. Scaling: 1 = 100. | 2 |
| | Torque | Torque reference. The scaling is defined by parameter *46.03 Torque scaling*. | 3 |
| | Speed | Speed reference. The scaling is defined by parameter *46.01 Speed scaling*. | 4 |
| | Frequency | Frequency reference. The scaling is defined by parameter *46.02 Frequency scaling*. | 5 |
| *58.27* | *EFB ref2 type* | Modbus RTU only: Selects the type and scaling of reference 2 received through the embedded fieldbus interface. The scaled reference is displayed by *03.10 EFB reference 2* | *Speed or frequency* |
| *58.28* | *EFB act1 type* | Modbus RTU only: Selects the type of actual value 1. | *Speed or frequency* |
| | Speed or frequency | Type and scaling is chosen automatically according to the currently active operation mode as follows.<br><br>| **Operation mode**<br>(see par. *19.01*) | **Actual 1 type** |<br>\| --- \| --- \|<br>\| Speed control \| *Speed* \|<br>\| Frequency control \| *Frequency* \| | 0 |
| | Transparent | No scaling is applied. | 1 |
| | General | Generic reference without a specific unit. Scaling: 1 = 100. | 2 |
| | Torque | Scaling is defined by parameter *46.03 Torque scaling*. | 3 |
| | Speed | Scaling is defined by parameter *46.01 Speed scaling*. | 4 |
| | Frequency | Scaling is defined by parameter *46.02 Frequency scaling*. | 5 |
| *58.29* | *EFB act2 type* | Modbus RTU only: Selects the type of actual value 2.<br>For the selections, see parameter *58.28 EFB act1 type*. | *Transparent* |
| *58.30* | *EFB status word transparent source* | N2 only: Selects the source of actual value 1 when parameter *58.28 EFB act1 type* is set to *Transparent*. | *Not selected* |
| | Not selected | None. | 0 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *58.31* | *EFB act1 transparent source* | Modbus RTU only: Selects the source of actual value 1 when parameter *58.28 EFB act1 type* is set to *Transparent*. | *Not selected* |
| | Not selected | None. | 0 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *58.32* | *EFB act2 transparent source* | Modbus RTU, N2 only: Selects the source of actual value 2 when parameter *58.29 EFB act2 type* is set to *Transparent*. | *Not selected* |
| | Not selected | None. | 0 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *58.33* | *Addressing mode* | Modbus RTU only: Defines the mapping between parameters and holding registers in the 400101…465535 Modbus register range.<br>Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). | *Mode 0* |
| | Mode 0 | 16-bit values (groups 1…99, indexes 1…99):<br>Register address = 400000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 2200 + 80 = 402280.<br>32-bit values (groups 1…99, indexes 1…99):<br>Register address = 420000 + 200 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 420000 + 4400 + 160 = 424560. | 0 |
| | Mode 1 | 16-bit values (groups 1…255, indexes 1…255):<br>Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712. | 1 |
| | Mode 2 | 32-bit values (groups 1…127, indexes 1…255):<br>Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 11264 + 160 = 411424. | 2 |
| *58.34* | *Word order* | Modbus RTU only: Selects in which order 16-bit registers of 32-bit parameters are transferred.<br>For each register, the first byte contains the high order byte and the second byte contains the low order byte.<br>Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). | *LO-HI* |
| | HI-LO | The first register contains the high order word, the second contains the low order word. | 0 |
| | LO-HI | The first register contains the low order word, the second contains the high order word. | 1 |
| *58.40* | *Device object ID* | BACnet MS/TP only: The Device object ID must be unique across all BACnet devices in the building network. Valid values are in range 0…4194303 The default Device object ID (4194303) is invalid per the BACnet specification.<br>Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). | 4194303 |
| | 0…4194303 | ID. | |
| *58.41* | *Max master* | BACnet MS/TP only: The highest master address for devices on the BACnet MS/TP bus.<br>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*). | 127 |
| | 0…127 | Address. | 1 = 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *58.42* | *Max info frames* | BACnet MS/TP only: The maximum number of information frames the device may transmit before it must pass the token. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). | 1 |
| | 0…10 | Maximum number information frames. | 1 = 1 |
| *58.43* | *Max APDU retries* | BACnet MS/TP only: Number of retries to send when no response is seen to confirmed requests. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). | 3 |
| | 0…10 | Number of retries. | 1 = 1 |
| *58.44* | *APDU timeout* | BACnet MS/TP only: The amount of time in seconds between retransmissions when an expected acknowledgement has not been received. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). | 10 s |
| | 0…60 s | Timeout. | 1 = 1 |
| *58.101* | *Data I/O 1* | Modbus RTU, BACnet MS/TP only: Defines the address in the drive which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus register 1 (400001). The master defines the type of the data (input or output). The value is transmitted in a Modbus frame consisting of two 16-bit words. If the value is 16-bit, it is transmitted in the LSW (least significant word). If the value is 32-bit, the subsequent parameter is also reserved for it and must be set to *None*. | *CW 16bit* |
| | None | No mapping, register is always zero. | 0 |
| | CW 16bit | *ABB Drives* profile: 16-bit ABB drives control word; *DCU Profile*: lower 16 bits of the DCU control word | 1 |
| | Ref1 16bit | Reference REF1 (16 bits) | 2 |
| | Ref2 16bit | Reference REF2 (16 bits) | 3 |
| | SW 16bit | *ABB Drives* profile: 16-bit ABB drives status word; *DCU Profile*: lower 16 bits of the DCU status word | 4 |
| | Act1 16bit | Actual value ACT1 (16 bits) | 5 |
| | Act2 16bit | Actual value ACT2 aha(16 bits) | 6 |
| | Reserved | | 7…10 |
| | CW 32bit | Control Word (32 bits) | 11 |
| | Ref1 32bit | Reference REF1 (32 bits) | 12 |
| | Ref2 32bit | Reference REF2 (32 bits) | 13 |
| | SW 32bit | Status Word (32 bits) | 14 |
| | Act1 32bit | Actual value ACT1 (32 bits) | 15 |
| | Act2 32bit | Actual value ACT2 (32 bits) | 16 |
| | Reserved | | 17…20 |
| | CW2 16bit | *ABB Drives* profile: not used; *DCU Profile*: upper 16 bits of the DCU control word | 21 |
| | SW2 16bit | *ABB Drives* profile: not used / always zero; *DCU Profile*: upper 16 bits of the DCU status word | 24 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Reserved | | 25…30 |
| | RO/DIO control word | Parameter *10.99 RO/DIO control word*. | 31 |
| | AO1 data storage | Parameter *13.91 AO1 data storage*. | 32 |
| | AO2 data storage | Parameter *13.92 AO2 data storage*. | 33 |
| | Reserved | | 34…39 |
| | Feedback data storage | Parameter *40.91 Feedback data storage*. | 40 |
| | Setpoint data storage | Parameter *40.92 Setpoint data storage*. | 41 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *58.102* | *Data I/O 2* | <u>Modbus RTU, BACnet MS/TP only:</u> Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400002.<br>For the selections, see parameter *58.101 Data I/O 1*. | *Ref1 16bit* |
| *58.103* | *Data I/O 3* | <u>Modbus RTU, BACnet MS/TP only:</u> Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400003.<br>For the selections, see parameter *58.101 Data I/O 1*. | *Ref2 16bit* |
| *58.104* | *Data I/O 4* | <u>Modbus RTU, BACnet MS/TP only:</u> Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400004.<br>For the selections, see parameter *58.101 Data I/O 1*. | *SW 16bit* |
| *58.105* | *Data I/O 5* | <u>Modbus RTU, BACnet MS/TP only:</u> Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400005.<br>For the selections, see parameter *58.101 Data I/O 1*. | *Act1 16bit* |
| *58.106* | *Data I/O 6* | <u>Modbus RTU, BACnet MS/TP only:</u> Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400006.<br>For the selections, see parameter *58.101 Data I/O 1*. | *Act2 16bit* |
| *58.107* | *Data I/O 7* | <u>Modbus RTU, BACnet MS/TP only:</u> Parameter selector for Modbus register address 400007.<br>For the selections, see parameter *58.101 Data I/O 1*. | *None* |
| … | … | … | … |
| *58.114* | *Data I/O 14* | <u>Modbus RTU, BACnet MS/TP only:</u> Parameter selector for Modbus register address 400014.<br>For the selections, see parameter *58.101 Data I/O 1*. | *None* |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| **70 Override** | | Enabling/disabling of override function, override activation signal and override speed/frequency.<br>See control chain diagram *Override* on page *320* | |
| *70.01* | *Override status* | Shows the override status.<br>This parameter is read-only. | - |

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

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *70.02* | *Override enable* | Enables the override function. | *Off* |
| | Off | Override disabled. | 0 |
| | On | Override enabled. | 1 |
| | On, critical | Allows for an infinite number of fault resets. To be able use this selection, first set parameter *70.20 Override fault handling* to value *Autoreset*. | 2 |
| *70.03* | *Override activation source* | Selects the source of the override activation.<br>Value 0 of the source deactivates the override.<br>Value 1 of the source activates the override. | *Not used* |
| | Not used | 0. | 0 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 1 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 2 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 3 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 4 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 5 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 6 |
| | -DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 7 |
| | -DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 8 |
| | -DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 9 |
| | -DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 10 |
| | -DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 11 |
| | -DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 12 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *70.04* | *Override reference source* | Selects the source for the speed used in the override mode. | |
| | Constant speed | Constant speed used as the reference. | 0 |
| | AI1 | *12.12 AI1 scaled value* (page *361*). | 1 |
| | AI2 | *12.22 AI2 scaled value* (page *363*). | 2 |
| | Override speed/freq | Parameter *70.06 Override frequency* or *70.07 Override speed* is used as the reference. | 3 |
| | Motor potentiometer | *22.80 Motor potentiometer ref act* (output of the Floating point control (Motor potentiometer)). | 4 |
| | Stop | The output of the drive is shut off and the motor no longer runs. Override is displayed on the panel but the motor does not run. Drive follows the specified stop type. | 5 |
| | Process PID set 1 | *40.01 Process PID output actual* (page *463*). | |
| *70.05* | *Override direction* | Selects the source of the motor direction used in the override mode. | *Forward* |
| | Forward | Direction is forward. | 0 |
| | Reverse | Direction is reverse. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | -DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 8 |
| | -DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 9 |
| | -DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 10 |
| | -DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 11 |
| | -DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 12 |
| | -DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 13 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *70.06* | *Override frequency* | Defines the frequency used as reference in the override mode if *70.04 Override reference source* is set to *Override speed/freq* and the drive is in frequency mode. | 0.0 Hz |
| | -500.0…500.0 Hz | Override frequency. | 1 = 1 Hz |
| *70.07* | *Override speed* | Defines the speed used in as reference the override mode if *70.04 Override reference source* is set to *Override speed/freq* and the drive is in speed mode. | 0.0 Hz |
| | 30000.0… 30000.0 rpm | Override speed. | 1 = rpm |

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

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

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *70.20* | *Override fault handling* | Faults are grouped into high priority faults and low priority faults. The following faults are high priority, and they are displayed and they will stop the drive: *2310 Overcurrent*, *2330 Earth leakage*, *2340 Short circuit*, *3210 DC link overvoltage*, *5090 STO hardware failure*, *5091 Safe torque off*, *FA81 Safe torque off 1*, *FA82 Safe torque off 2*. Other faults are low priority faults. Active low priority faults are reset when the drive enters override mode. Low priority faults are ignored when the drive is in override mode. | *Fault on high priority* |
| | Fault on high priority | Fault on high priority faults. The fault must be reset from the control panel or from a digital input. | 0 |
| | Autoreset | Fault on high priority faults (except STO related faults) with automatic fault reset and run. See the list of high priority faults above. See parameter *70.21 Override auto reset trials*. | 1 |
| *70.21* | *Override auto reset trials* | Defines the number of automatic fault resets the drive performs during override operation. When the parameter is set to 0, reset trials are made continuously during the override operation. A value of 1…5 defines a specific number of automatic reset trials. | 5 |
| | 0…5 | Number of automatic reset trials. | 1 = 1 |
| *70.22* | *Override auto reset time* | Defines the time the drive will wait after a fault before attempting an automatic fault reset. | 5.0 s |
| | 5.0…120.0 s | Auto reset delay time. | 10 = 1 s |
| *70.40* | *Override log 1 start date* | Displays the start date of the last Override activation. | 01.01.1980 |
| | | Start date. | |

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

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

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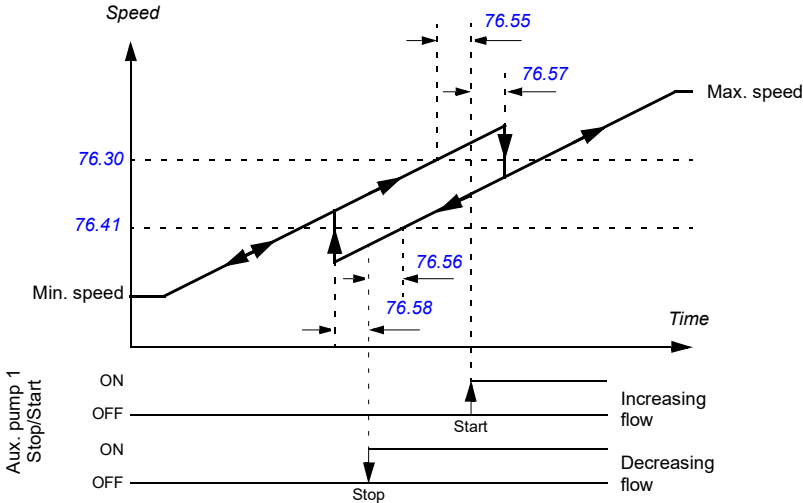
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| **71 External PID1** | | Configuration of external PID.<br>See control chain diagrams *External PID setpoint and feedback source selection*, and *External PID controller* on pages *317* and *318*, respectively | |
| *71.01* | *External PID act value* | See parameter *40.01 Process PID output actual*. | - |
| *71.02* | *Feedback act value* | See parameter *40.02 Process PID feedback actual*. | - |
| *71.03* | *Setpoint act value* | See parameter *40.03 Process PID setpoint actual*. | - |
| *71.04* | *Deviation act value* | See parameter *40.04 Process PID deviation actual*. | - |
| *71.06* | *PID status word* | Displays status information on process external PID control. This parameter is read-only. | - |

| Bit | Name | Value |
|---|---|---|
| 0 | PID active | 1 = Process PID control active. |
| 1 | Reserved | |
| 2 | Output frozen | 1 = Process PID controller output frozen. Bit is set if parameter *71.38 Output freeze enable* is TRUE, or the deadband function is active (bit 9 is set). |
| 3…6 | Reserved | |
| 7 | Output limit high | 1 = PID output is being limited by par. *71.37*. |
| 8 | Output limit low | 1 = PID output is being limited by par. *71.36*. |
| 9 | Deadband active | 1 = Deadband is active. |
| 10…11 | Reserved | |
| 12 | Internal setpoint active | 1 = Internal setpoint active (see par. *71.16*…*71.23*) |
| 13…15 | Reserved | |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h…FFFFh | Process PID control status word. | 1 = 1 |
| *71.07* | *PID operation mode* | See parameter *40.07 Process PID operation mode*. | *Off* |
| *71.08* | *Feedback 1 source* | See parameter *40.08 Set 1 feedback 1 source*. | *AI2 percent* |
| *71.11* | *Feedback filter time* | See parameter *40.11 Set 1 feedback filter time*. | 0.000 s |
| *71.14* | *Setpoint scaling* | Defines, together with parameter *71.15 Output scaling*, a general scaling factor for the external PID control chain. The scaling can be utilized when, for example, the process setpoint is input in Hz, and the output of the PID controller is used as an rpm value in speed control. In this case, this parameter might be set to 50, and parameter *71.15* to the nominal motor speed at 50 Hz.<br>In effect, the output of the PID controller [*71.15*] when deviation (setpoint - feedback) = [*71.14*] and [*71.32*] = 1.<br>**Note:** The scaling is based on the ratio between *71.14* and *71.15*. For example, the values 50 and 1500 would produce the same scaling as 1 and 3. | 100.00 |
| | -200000.00…200000.0 | Process setpoint base. | 1 = 1 |
| *71.15* | *Output scaling* | See parameter *71.14 Setpoint scaling*. | 100.00 |
| | -200000.00…200000.0 | Process PID controller output base. | 1 = 1 |
| *71.16* | *Setpoint 1 source* | See parameter *40.16 Set 1 setpoint 1 source*. | *AI1 percent* |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *71.19* | *Internal setpoint sel1* | See parameter *40.19 Set 1 internal setpoint sel1*. | *Not selected* |
| *71.20* | *Internal setpoint sel2* | See parameter *40.20 Set 1 internal setpoint sel2*. | *Not selected* |
| *71.21* | *Internal setpoint 1* | See parameter *40.21 Set 1 internal setpoint 1*. | 0.00% |
| *71.22* | *Internal setpoint 2* | See parameter *40.22 Set 1 internal setpoint 2*. | 0.00% |
| *71.23* | *Internal setpoint 3* | See parameter *40.23 Set 1 internal setpoint 3*. | 0.00% |
| *71.26* | *Setpoint min* | See parameter *40.26 Set 1 setpoint min*. | 0.00% |
| *71.27* | *Setpoint max* | See parameter *40.27 Set 1 setpoint max*. | 200000.00% |
| *71.31* | *Deviation inversion* | See parameter *40.31 Set 1 deviation inversion*. | *Not inverted (Ref - Fbk)* |
| *71.32* | *Gain* | See parameter *40.32 Set 1 gain*. | 1.00 |
| *71.33* | *Integration time* | See parameter *40.33 Set 1 integration time*. | 60.0 s |
| *71.34* | *Derivation time* | See parameter *40.34 Set 1 derivation time*. | 0.000 s |
| *71.35* | *Derivation filter time* | See parameter *40.35 Set 1 derivation filter time*. | 0.0 s |
| *71.36* | *Output min* | See parameter *40.36 Set 1 output min*. | -200000.00% |
| *71.37* | *Output max* | See parameter *40.37 Set 1 output max*. | 200000.00% |
| *71.38* | *Output freeze enable* | See parameter *40.38 Set 1 output freeze enable*. | *Not selected* |
| *71.39* | *Deadband range* | The control program compares the absolute value of parameter *71.04 Deviation act value* to the deadband range defined by this parameter. If the absolute value is within the deadband range for the time period defined by parameter *71.40 Deadband delay*, PID's deadband mode is activated and *71.06 PID status word* bit 9 *Deadband active* is set. Then PID's output is frozen and *71.06 PID status word* bit 2 *Output frozen* is set. If the absolute value is equal or greater than the deadband range, PID's deadband mode is deactivated. | 0.0% |
| | 0.0…200000.0 | Range | 1 = 1 |
| *71.40* | *Deadband delay* | Defines the deadband delay for the deadband function. See parameter *71.39 Deadband range*. | 0.0 s |
| | 0.0…3600.0 s | Delay | 1 = 1 s |
| *71.58* | *Increase prevention* | See parameter *40.58 Set 1 increase prevention*. | *No* |
| *71.59* | *Decrease prevention* | See parameter *40.59 Set 1 decrease prevention*. | *No* |
| *71.62* | *Internal setpoint actual* | See parameter *40.62 PID internal setpoint actual*. | 0.00% |
| *71.79* | *External PID units* | Unit used for external PID. | *%* |
| | | See parameter *40.79 Set 1 units*. | |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| **76 PFC configuration** | | PFC (Pump and fan control) and Autochange configuration parameters.<br>See also section *Single pump and fan control (PFC)* on page *145*. | |
| 76.01 | PFC status | Displays the running/stopped status of the PFC motors. PFC1, PFC2, PFC3 and PFC4 always correspond to the 1st…4th motor of the PFC system. If *76.74 Autochange auxiliary PFC* auxiliary PFC is set to *Aux motors only*, PFC1 represents the motor connected to the drive and PFC2 the first auxiliary motor (the 2nd motor of the system). If *76.74* is set to *All motors*, PFC1 is the first motor, PFC2 the 2nd. The drive can be connected to any of these motors depending on the Autochange functionality. | - |

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

| No. | Name/Value | Description | Def/FbEq16 |
|-----|------------|-------------|------------|
| | 0000h…FFFFh | Status of the PFC relay outputs. | 1 = 1 |
| 76.02 | PFC system status | Displays the status of the PFC system in text format. Provides a quick PFC system overview, for example, if the parameter is added to the Home view on the control panel. | - |
| | PFC disabled | PFC (Pump and fan control) is enabled. | 0 |
| | PFC enabled (not started) | PFC is enabled but not started. | 1 |
| | SPFC enabled (not started) | SPFC (Soft pump and fan control) is enabled but not started. | 2 |
| | MPFC enabled | Reserved. | 3 |
| | Running with VSD | The drive is controlling one pump/fan motor, no auxiliary motors are used. | |
| | Running with VSD + 1 Aux | One auxiliary motor has been taken in use. | 101 |
| | Running with VSD + 2 Aux | Two auxiliary motor have been taken in use. | 102 |
| | Running with VSD + 3 Aux | Three auxiliary motor have been taken in use. | 103 |
| | Starting Aux1 | Auxiliary motor 1 is being started. | 200 |
| | Starting Aux2 | Auxiliary motor 2 is being started. | 201 |
| | Starting Aux2 | Auxiliary motor 3 is being started. | 202 |
| | Stopping Aux1 | Auxiliary motor 1 is being stopped. | 300 |
| | Stopping Aux2 | Auxiliary motor 2 is being stopped. | 301 |
| | Stopping Aux2 | Auxiliary motor 3 is being stopped. | 302 |
| | Autochange active | Autochange, that is, automatic rotation of the start order is active. | 400 |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | No auxiliary motors available to be started | No auxiliary motors are available to be started, for example, all are already running, or a motor in not available due to maintenance. | 500 |
| | Regulator bypass active | Direct-on-line pumps are automatically started and stopped. | 600 |
| | MPFC connection ok | Reserved. | 700 |
| | PID sleep | PID sleep is in use, and the pump can be stopped in during low demand. | 800 |
| | PID sleep boost | PID sleep with extended sleep time is in use, and the pump can be stopped in during low demand. | 801 |
| | Invalid configuration | PFC configuration is invalid. | 4 |
| | PFC inactive (local control) | PFC is inactive because the drive is in local control. | 5 |
| | PFC inactive (invalid operation mode) | PFC is inactive because of an invalid operation mode. | 6 |
| | Drive motor interlocked | The motor connected to the drive is interlocked (not available). Warning *D503 VSD controlled PFC motor interlocked* (page *197*) is generated. | 7 |
| | All motors interlocked | All motors are interlocked (not available). Warning *D502 All motors interlocked* (page *197*) is generated. | 8 |
| | PFC inactive (ext1 active) | PFC is inactive because external control location EXT1 is in use. PFC is supported in EXT2 only. | 9 |
| *76.11* | *Pump/fan status 1* | Shows the status of pump or fan 1. | - |

| Bit | Name | Value |
|-----|------|-------|
| 0 | Ready | 0 = False, 1 = True |
| 1 | Reserved | |
| 2 | Running | 0 = False, 1 = True |
| 3…4 | Reserved | |
| 5 | In PFC control | 0 = False, 1 = True |
| 6…10 | Reserved | |
| 11 | Interlocked | 0 = False, 1 = True |
| 12…15 | Reserved | |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | 0000h…FFFFh | Status of pump or fan 1. | 1 = 1 |
| *76.12* | *Pump/fan status 2* | See parameter *76.11 Pump/fan status 1* | - |
| *76.13* | *Pump/fan status 3* | See parameter *76.11 Pump/fan status 1* | - |
| *76.14* | *Pump/fan status 4* | See parameter *76.11 Pump/fan status 1* | - |
| *76.21* | *PFC configuration* | Selects the multi-pump/fan control (PFC) mode. | *Off* |
| | Off | PFC disabled. | 0 |
| | Reserved | | 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | PFC | PFC enabled. One pump at a time is controlled by the drive. The remaining pumps are direct-on-line pumps that are started and stopped by the drive logic<br><br>The frequency (group *28 Frequency reference chain*) / speed (group *22 Speed reference selection*) reference must be defined as PID for the PFC functionality to work properly. | 2 |
| | SPFC | SPFC enabled. See section *Settings* on page *152*. | 3 |
| *76.25* | *Number of motors* | Total number of motors used in the application, including the motor connected directly to the drive. | 1 |
| | 1…4 | Number of motors. | 1 = 1 |
| *76.26* | *Min number of motors allowed* | Minimum number of motors running simultaneously. | 1 |
| | 0…4 | Minimum number of motors. | 1 = 1 |
| *76.27* | *Max number of motors allowed* | Maximum number of motors running simultaneously. | 1 |
| | 1…4 | Maximum number of motors. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *76.30* | *Start point 1* | Defines the start speed (Hz/rpm) for the first auxiliary motor. As the motor speed or frequency exceeds the limit defined by this parameter, a new auxiliary motor is started.<br><br>To avoid nuisance starts of the second auxiliary motor, the speed of the variable speed motor should be higher than the start speed for the duration defined by parameter *76.55 Start delay*. If the speed decreases below the start speed, the auxiliary motor is not started.<br><br>To maintain the process conditions during the start of the second auxiliary motor, a speed hold on time can be defined with parameter *76.57 Speed hold on*. Certain pump types do not produce significant flow with low frequencies. The speed hold on time can be used to compensate the time needed to accelerate the second auxiliary motor to a speed where it produces flow. The start of the second auxiliary motor is not aborted if the speed of the first auxiliary motor decreases | Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0) |



| | 0.00…32767.00 rpm/Hz | Speed/frequency | 1 = 1 unit |
|---|---|---|---|
| *76.31* | *Start point 2* | Defines the start speed (Hz/rpm) for the second auxiliary motor. See parameter *76.31 Start point 1*. | Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0) |
| *76.32* | *Start point 3* | Defines the start speed (Hz/rpm) for the third auxiliary motor. See parameter *76.31 Start point 1*. | Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0) |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *76.41* | *Stop point 1* | Defines the stop speed (Hz/rpm) for the first auxiliary motor. When the speed of the motor connected directly to the drive falls below this value and one auxiliary motor is running, the stop delay defined by parameter *76.56 Stop delay* is started. If the speed is still at the same level or lower when the stop delay elapses, the first auxiliary motor stops.<br>The running speed of the drive is increased by [*Start point 1* - *Stop point 1*] after the auxiliary motor stops. | Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0) |
| | 0.00…32767.00 rpm/Hz | Speed/frequency | 1 = 1 unit |
| *76.42* | *Stop point 2* | Defines the stop speed (Hz/rpm) for the second auxiliary motor. See parameter *76.41 Stop point 1*. | Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0) |
| *76.43* | *Stop point 3* | Defines the stop speed (Hz/rpm) for the third auxiliary motor. See parameter *76.41 Stop point 1*. | Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0) |
| *76.55* | *Start delay* | Defines the delay time for starting the auxiliary motors. See parameter *76.31 Start point 1*. | 10.00 s |
| | 0.00…12600.00 s | Time delay. | 1 = 1 s |
| *76.56* | *Stop delay* | Defines the delay time for starting the auxiliary motors. See parameter *76.31 Stop point 1*. | 10.00 s |
| | 0.00…12600.00 s | Time delay. | 1 = 1 s |
| *76.57* | *Speed hold on* | Hold time for auxiliary motor switch-on. See parameter *76.31 Start point 1*. | 0.00 s |
| | 0.00…1000.00 s | Time. | 1 = 1 s |
| *76.58* | *Speed hold off* | Hold time for auxiliary motor switch-off. See parameter *76.31 Stop point 1*. | 0.00 s |
| | 0.00…1000.00 s | Time. | 1 = 1 s |
| *76.59* | *PFC contactor delay* | Start delay for the motor that is directly controlled by the drive. This does not affect the starting of the auxiliary motors.<br>⚠ **WARNING!** There must always be a delay set if the motors are equipped with star-delta starters. The delay must be set longer than the time setting of the starter. After the motor is switched on by the relay output of the drive, there must be enough time for the star-delta starter to first switch to star and then back to delta before the motor is connected to the drive. | 0.50 s |
| | 0.20…600.00 s | Time delay. | 1 = 1 s |
| *76.60* | *PFC ramp acceleration time* | Defines the acceleration time for the drive motor speed compensation, when an auxiliary motor is stopped. This ramp time is also used for the drive motor to accelerate after an autochange has occurred.<br>The parameter sets the ramp-up time as seconds from zero to maximum frequency (not from the previous reference to the new reference). | 1.00 s |
| | 0.00…1800.00 s | Time. | 1 = 1 s |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *76.61* | *PFC ramp deceleration time* | Defines the deceleration time for the drive motor speed compensation, when an auxiliary motor is started. This ramp time is also used for the drive motor to decelerate after an autochange has occurred.<br>The parameter sets the ramp-up time as seconds from maximum to zero frequency (not from the previous reference to the new reference). | 1.00 s |
| | 0.00…1800.00 s | Time. | 1 = 1 s |
| *76.70* | *Autochange* | Defines the way the autochange is triggered.<br>In all cases except *Even wear*, the start order is moved one step forward each time the autochange occurs. If the start order initially is 1-2-3-4, after the first autochange the order will be 2-3-4-1, etc.<br>For *Even wear*, the start order will be determined so that the running times of all motors remain within the defined limit.<br>**Note:** Autochange only occurs when the speed of the drive is below the speed defined by parameter *76.73 Autochange level*.<br>See also section *Autochange* on page *148*. | *Not selected* |
| | Not selected | Autochange disabled. | 0 |
| | Selected | Rising edge starts the autochange if autochange conditions are met. | 1 |
| | DI1 | Autochange triggered by the rising edge of digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Autochange triggered by the rising edge of digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Autochange triggered by the rising edge of digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Autochange triggered by the rising edge of digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Autochange triggered by the rising edge of digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Autochange triggered by the rising edge of digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Timed function 1 | Autochange triggered by timed function 1 (bit 0 of *34.01 Timed functions status* (see page *439*)). | 8 |
| | Timed function 2 | Autochange triggered by timed function 2 (bit 1 of *34.01 Timed functions status* (see page *439*)). | 9 |
| | Timed function 3 | Autochange triggered by timed function 3 (bit 2 of *34.01 Timed functions status* (see page *439*)). | 10 |
| | Fixed interval | Autochange is done when the interval determined in the parameter *76.71 Autochange interval* has elapsed. | 11 |
| | All stop | Autochange is done when all the motors are stopped.<br>The PID sleep feature (parameters *40.43 Set 1 sleep level* … *40.48 Set 1 wake-up delay*) must be used for the drive to stop when the process demand is low. | 12 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Even wear | The running time of the motors are balanced by the drive. When the difference in running time between the motors with the least and most running hours exceeds the time defined by parameter *76.72 Maximum wear imbalance*, the autochange occurs.<br>The running hours of the motors can be found in group *77 PFC maintenance and monitoring* | 13 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| 76.71 | *Autochange interval* | Specifies the interval that is used in setting *Fixed interval* of parameter *76.70 Autochange*. | 1.00 h |
| | 0.00…42949672.95 h | Time. | 1 = 1 h |
| 76.72 | *Maximum wear imbalance* | Specifies the maximum wear imbalance, or difference in running times between any motor, used by the *Even wear* setting of parameter *76.70 Autochange*. | 10.00 h |
| | 0.00…1000000.00 h | Time. | 1 = 1 h |
| 76.73 | *Autochange level* | Upper speed limit for the Autochange to occur. The Autochange occurs when:<br>• the condition defined in *76.70 Autochange* is fulfilled and,<br>• the speed of the drive motor *01.03 Motor speed %* is below the speed limit defined in this parameter.<br>**Note:** When the value is selected as 0%, this speed limit check is disabled. | 100.0% |
| | 0.0…300.0% | Speed/frequency in percentage of the nominal speed or frequency of the drive motor. | 1 = 1% |
| 76.74 | *Autochange auxiliary PFC* | Selects whether only auxiliary motors or all motors are included in the Autochange function. | *Aux motors only* |
| | All motors | All motors, including the one connected to the drive participates in the autochange. The Autochange logic will connect the drive to each of the motors according to setting of parameter *76.70 Autochange*.<br>**Note:** The first motor (PFC1) also requires the appropriate hardware contactor connections and PFC1 must be defined in one of the relay output source parameters. | 0 |
| | Aux motors only | Only auxiliary (direct-on-line) motors are affected by the autochange function.<br>**Note:** PFC1 refers to the motor that is fixed to the drive and must not be selected in any of the relay output source parameters. Only the starting order of the auxiliary motors will be rotated. | 1 |
| 76.81 | *PFC 1 interlock* | Defines if the PFC motor 1 can be started. An interlocked PFC motor cannot be started.<br>0 = Interlocked (not available)<br>1 = Available. | *Available. PFC motor is available* |
| | Interlocked. PFC motor is not in use | PFC motor is interlocked and not available. | 0 |
| | Available. PFC motor is available | PFC motor is available. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 8 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 9 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 10 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *76.82* | *PFC 2 interlock* | See parameter *76.81 PFC 1 interlock*. | *Available. PFC motor is available* |
| *76.83* | *PFC 3 interlock* | See parameter *76.81 PFC 1 interlock*. | *Available. PFC motor is available* |
| *76.84* | *PFC 4 interlock* | See parameter *76.81 PFC 1 interlock*. | *Available. PFC motor is available* |
| *76.95* | *Regulator bypass control* | Defines if direct-on-line pumps are automatically started and stopped. This setting can be used in applications with a low number of sensors and low accuracy requirements. | *Disable* |
| | Disable | Automatic starting and stopping is disabled. | 0 |
| | Enable | Automatic starting and stopping is enabled. | 1 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |

| **77 PFC maintenance and monitoring** | | PFC (Pump and fan control) maintenance and monitoring parameters. | |
|---|---|---|---|
| *77.10* | *PFC runtime change* | Enables the reset, or arbitrary setting, of *77.11 Pump/fan 1 running time* … *77.14 Pump/fan 4 running time*. | *Done* |
| | Done | The parameter automatically reverts back to this value. | 0 |
| | Set any PFC run time | Enables the setting of *77.11 Pump/fan 1 running time* … *77.14 Pump/fan 4 running time* to an arbitrary value. | 1 |
| | Reset PFC1 run time | Resets parameter *77.11 Pump/fan 1 running time*. | 2 |
| | Reset PFC2 run time | Resets parameter *77.12 Pump/fan 2 running time*. | 3 |
| | Reset PFC3 run time | Resets parameter *77.13 Pump/fan 3 running time*. | 4 |
| | Reset PFC4 run time | Resets parameter *77.14 Pump/fan 4 running time*. | 4 |
| *77.11* | *Pump/fan 1 running time* | Running time counter of pump/fan 1. Can be set or reset by parameter *77.10 PFC runtime change*. | 0.00 h |
| | 0.00… 42949672.95 h | Time | 1 = 1 h |
| *77.12* | *Pump/fan 2 running time* | See parameter *77.11 Pump/fan 1 running time*. | 0.00 h |
| *77.13* | *Pump/fan 3 running time* | See parameter *77.11 Pump/fan 1 running time*. | 0.00 h |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *77.14* | *Pump/fan 4 running time* | See parameter *77.11 Pump/fan 1 running time*. | 0.00 h |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *80 Flow calculation and protection* | | Actual flow calculation. | |
| *80.01* | *Actual flow* | Actual system flow that is either calculated from the pressure difference, measured directly or estimated from the pump curves.<br>The calculation method is selected with parameter *80.13 Flow feedback function*.<br>See control chain diagram *PID flow calculation* on page *313*. | - |
| | -200000.00… 200000.00 | Calculated flow. | 1 = 1 |
| *80.02* | *Actual flow* | Shows the percentage of parameter *80.01 Actual flow* from *80.15 Maximum flow*. | 0.00 |
| | -100.00…100.00% | Flow percentage. | 100 = 1% |
| *80.11* | *Flow feedback 1 source* | Selects the source for the flow feedback 1. | *Not selected* |
| | Not selected | Feedback not used. | 0 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 1 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 2 |
| | Freq in scaled | *11.39 Freq in 1 scaled value* (see page *356*). | 3 |
| | AI1 percent | *12.101 AI1 percent value* (see page *364*). | 8 |
| | AI2 percent | *12.102 AI2 percent value* (see page *364*). | 9 |
| | Feedback data storage | *40.91 Feedback data storage* (see page *479*). | 10 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *80.12* | *Flow feedback 2 source* | Selects the source for the flow feedback 2. | *Not selected* |
| | Not selected | Feedback not used. | 0 |
| | AI1 scaled | *12.12 AI1 scaled value* (see page *361*). | 1 |
| | AI2 scaled | *12.22 AI2 scaled value* (see page *363*). | 2 |
| | Freq in scaled | *11.39 Freq in 1 scaled value* (see page *356*). | 3 |
| | AI1 percent | *12.101 AI1 percent value* (see page *364*). | 8 |
| | AI2 percent | *12.102 AI2 percent value* (see page *364*). | 9 |
| | Feedback data storage | *40.91 Feedback data storage* (see page *479*). | 10 |
| | *Other* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *80.13* | *Flow feedback function* | Selects a function between the flow feedback sources selected by parameters *80.11 Flow feedback 1 source* and *80.12 Flow feedback 2 source*.<br>The result of the function (for any selection) is multiplied by parameter *80.14 Flow feedback multiplier*. | *In1* |
| | In1 | Use *80.11 Flow feedback 1 source* directly as the flow value. | 0 |
| | In2 | Use *80.12 Flow feedback 2 source* directly as the flow value. | 1 |
| | Reserved | | 2…7 |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | sqrt(In1) | Flow is calculated as a square root of a differential pressure measurement:<br><br>$$k\sqrt{\Delta P}$$<br><br>The differential pressure value is selected with *80.11 Flow feedback 1 source*. | 8 |
| | sqrt(In1-In2) | Flow is calculated as a square root of two measured absolute pressure measurements:<br><br>$$k\sqrt{(P_1 - P_2)}$$<br><br>The pressure measurement sources are selected with *80.11 Flow feedback 1 source* and *80.12 Flow feedback 2 source*. | 9 |
| *80.14* | *Flow feedback multiplier* | Defines the multiplier (k) used with the flow calculation The output value of *80.13 Flow feedback function* is multiplied by this value. | 1.00 |
| | -200000.00… 200000.00 | Multiplier. | 1 = 1 |
| *80.15* | *Maximum flow* | Defines the nominal maximum flow of the system. This value is used to calculate the actual flow percentage value so that the value 100% for *80.02* corresponds to the value of this parameter. | 1000.00 |
| | -200000.00… 200000.00 | Limit for maximum flow protection. | 1 = 1 |

| | | | |
|-----|-----------|-------------|------------|
| **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.<br><br>⚠ **WARNING!** An incorrect setting may cause the motor to rush uncontrollably, or the brake chopper or resistor to overload.<br><br>**Note:** The selections shown depend on the hardware of the drive. If only one voltage range is valid for the drive in question, it is selected by default. | *Automatic / not selected* |
| | Automatic / not selected | No voltage range selected. The drive will not start modulating before a range is selected, unless parameter *95.02 Adaptive voltage limits* is set to *Enable*, in which case the drive estimates the supply voltage itself. | 0 |
| | 380…415 V | 380…415 V | 2 |
| | 440…480 V | 440…480 V | 3 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *95.02* | *Adaptive voltage limits* | Enables adaptive voltage limits.<br>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.<br>This function is also useful if the AC supply voltage to the drive is high, as the warning levels are raised accordingly. | *Enable* |
| | Disable | Adaptive voltage limits disabled. | 0 |
| | Enable | Adaptive voltage limits enabled. | 1 |
| *95.03* | *Estimated AC supply voltage* | AC supply voltage estimated by calculation. Estimation is done every time the drive is powered up and is based on the rise speed of voltage level of the DC bus while the drive charges the DC bus. | - |
| | 0…65535 V | Voltage. | 10 = 1 V |
| *95.04* | *Control board supply* | Specifies how the control board of the drive is powered. | *Internal 24V* |
| | Internal 24V | The drive control board is powered from the drive power unit it is connected to. | 0 |
| | External 24V | The drive control board is powered from an external power supply. | 1 |
| *95.15* | *Special HW settings* | Contains hardware-related settings that can be enabled and disabled by toggling the specific bits.<br>**Note:**<br>• The installation of the hardware specified by this parameter may require derating of drive output, or impose other limitations. Refer to (ATEX) the hardware manual of the drive. | 00000000h |

| Bit | Name | Information |
|---|---|---|
| 0 | EX motor | 1 = The driven motor is an Ex (ATEX) motor provided by ABB for potentially explosive atmospheres. This sets the required minimum switching frequency for ABB Ex (ATEX) motors.<br>**Notes:**<br>• For non-ABB Ex (ATEX) motors, use parameters *97.01* and *97.02* to define the correct minimum switching frequency.<br>• If you have a multimotor system, contact your local ABB representative |
| 1 | ABB Sine filter | 1 = An ABB sine filter is connected to the output of the drive. |
| 2…15 | Reserved | |

| | | |
|---|---|---|
| 00000000h…<br>FFFFFFFFh | Hardware options configuration word. | 1 = 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *95.20* | *HW options word 1* | Specifies hardware-related options that require differentiated parameter defaults.<br>This parameter is not affected by a parameter restore. | - |

| Bit | Name | Value |
|-----|------|-------|
| 0 | Supply frequency 60 Hz | See section *Differences in the default values between 50 Hz and 60 Hz supply frequency settings* on page *549*.0 = 50 Hz.<br>1 = 60 Hz. |
| 1…12 | Reserved | |
| 13 | du/dt filter activation | When active, an external du/dt filter is connected to the drive/inverter output. The setting will limit the output switching frequency, and force the fan of the drive/inverter module to full speed.<br>0 = du/dt filter inactive.<br>1 = du/dt filter active. |
| 14…15 | Reserved | |

| | 0000h…FFFFh | Hardware options configuration word. | 1 = 1 |
|-----|-----------|-------------|------------|
| *95.21* | *HW options word 2* | Specifies more hardware-related options that require differentiated parameter defaults. See parameter *95.20 HW options word 1*.<br>⚠ **WARNING!** After switching any bits in this word, recheck the values of the affected parameters. | - |

| Bit | Name | Information |
|-----|------|-------------|
| 0…4 | Reserved | |
| 5 | Bypass present | 1 = Bypass is used. |
| 5…15 | Reserved | |

| | 0000b…0101b | Hardware options configuration word 2. | 1 = 1 |
|-----|-----------|-------------|------------|
| *95.200* | *Cooling fan mode* | Cooling fan operation mode. | *Auto* |
| | Auto | Fan runs normally: Fan on/off, fan speed reference can autochange according to the drive state. | 0 |
| | Always on | Fan always runs at 100% speed reference. | 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| **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.

Drive supports multiple languages. The languages are divided in three firmware packages: Global, European and Asian.
The default package is Global package that supports languages marked with **X** and **G**. European delta supports languages marked with **X** and **E**. Asian delta supports languages marked with **X** and **A**. | *English* |

| Language | Global package | European | Asian |
|---|---|---|---|
| English | **X** | **X** | **X** |
| German | **X** | **X** | **X** |
| Spanish | **X** | **X** | **X** |
| Portuguese | **X** | **X** | **X** |
| French | **X** | **X** | **X** |
| Chinese (Simplified) | **X** | **X** | **X** |
| Dutch | **G** | | |
| Italian | **G** | | |
| Danish | **G** | | |
| Finnish | **G** | | |
| Swedish | **G** | | |
| Russian | **G** | | |
| Turkish | **G** | | |
| Polish | | **E** | |
| Czech | | **E** | |
| Greek (Ellinika) | | **E** | |
| Hungarian (Magyar) | | **E** | |
| Hebrew | | **(E)** | |
| Korean | | | **A** |
| Japanese | | | **A** |
| Thai | | | **A** |

X   = Common language, available in all packages
G   = Available in Global package only
E   = Available in European package only
(E) = Will be available later
A   = Available in Asian package only

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | | The drives include the language package corresponding to the order's geographical location. **No plus code or other actions are needed.**<br>**Examples:**<br>• If the order is placed in Sweden, the drives will be delivered with the Global package (default package).<br>• If the order is placed in Poland, the drives will be updated with European package before the delivery.<br>• If the order is placed in Japan, the drives will be updated with Asian package before the delivery.<br>All the language package variants are available from your local drives support.<br>**Notes:**<br>• Not all languages listed below are necessarily supported.<br>• This parameter does not affect the languages visible in the Drive composer PC tool. (Those are specified under **View > Settings > Drive default language**.) | |
| | Not selected | None. | 0 |
| | English | English. Included in all packages. | 1033 |
| | Deutsch | German. Included in all packages. | 1031 |
| | Italiano | Italian. Included in Global package. | 1040 |
| | Español | Spanish. Included in all packages. | 3082 |
| | Portugues | Portuguese. Included in all packages. | 2070 |
| | Nederlands | Dutch. Included in Global package. | 1043 |
| | Français | French. Included in all packages. | 1036 |
| | Dansk | Danish. Included in Global package. | 1030 |
| | Suomi | Finnish. Included in Global package. | 1035 |
| | Svenska | Swedish. Included in Global package. | 1053 |
| | Russki | Russian. Included in Global package. | 1049 |
| | Polski | Polish. Included in European package. | 1045 |
| | Chinese (Simplified, PRC) | Simplified Chinese. Included in all packages. | 2052 |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *96.02* | *Pass code* | Pass codes can be entered into this parameter to activate further access levels (see parameter *96.03 Access level status*) or to configure the user lock.<br>Entering "358" toggles the parameter lock, which prevents the changing of all other parameters through the control panel or the Drive composer PC tool.<br>Entering the user pass code (by default, "10000000") enables parameters *96.100…96.102*, which can be used to define a new user pass code and to select the actions that are to be prevented.<br>Entering an invalid pass code will close the user lock if open, ie, hide parameters *96.100…96.102*. After entering the code, check that the parameters are in fact hidden. If they are not, enter another (random) pass code.<br>**Note:** You must change the default user pass code to maintain a high level of cybersecurity. <u>Store the code in a safe place</u> – **THE PROTECTION CANNOT BE DISABLED EVEN BY ABB** <u>if the code is lost.</u><br>See also section *Parameter checksum calculation* (page *181*). | |
| | 0…99999999 | Pass code. | - |
| *96.03* | *Access level status* | Shows which access levels have been activated by pass codes entered into parameter *96.02 Pass code*. | 0001b |

| Bit | Name |
|---|---|
| 0 | End user |
| 1 | Service |
| 2 | Advanced programmer |
| 3…9 | Reserved |
| 10 | Override parameter lock |
| 11 | OEM access level 1 |
| 12 | OEM access level 2 |
| 13 | OEM access level 3 |
| 14 | Parameter lock |
| 15 | Reserved |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 00000000h…<br>FFFFFFFFh | Active access levels. | - |
| *96.04* | *Macro select* | Selects the control macro. See chapter *Default I/O configuration* (page *77*) for more information.<br>After a selection is made, the parameter reverts automatically to *Done*. | *Done* |
| | Done | Macro selection complete; normal operation. | 0 |
| | HVAC default | Factory default (page *78*). For scalar motor control. You cannot select HVAC default with this parameter but only in the **Primary settings** menu, see page *77*. | 1 |
| *96.05* | *Macro active* | Shows which control macro is currently selected. See chapter *Default I/O configuration* (page *77*) for more information.<br>To change the macro, use parameter *96.04 Macro select*. | *HVAC default* |
| | HVAC default | Factory default (page *78*). For scalar motor control. | 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| 96.06 | *Parameter restore* | Restores the original settings of the control program, ie, parameter default values.<br>**Note:** This parameter cannot be changed while the drive is running. | *Done* |
| | Done | Restoring is completed. | 0 |
| | Restore defaults | Restores all editable parameter values to default values, except<br>• motor data and ID run results<br>• I/O extension module settings<br>• end user texts, such as customized warnings and faults<br>• control panel/PC communication settings<br>• fieldbus adapter settings<br>• control macro selection and the parameter defaults implemented by it<br>• parameter *95.01 Supply voltage*<br>• differentiated defaults implemented by parameters *95.20 HW options word 1* and *95.21 HW options word 2*<br>• user lock configuration parameters *96.100…96.102.* | 8 |
| | Clear all | Restores all editable parameter values to default values, except<br>• end user texts, such as customized warnings and faults<br>• control panel/PC communication settings<br>• parameter *95.01 Supply voltage*<br>• differentiated defaults implemented by parameters *95.20 HW options word 1* and *95.21 HW options word 2*<br>• user lock configuration parameters *96.100…96.102.*<br>• group *49 Panel port communication* parameters. | 62 |
| | Reset all fieldbus settings | Restores all fieldbus and communication related settings to default values.<br>**Note:** Fieldbus, control panel and PC tool communication are interrupted during the restore. | 32 |
| | Reset home view | Restores the home view layout back to show the values of the default parameters defined by the control macro in use | 512 |
| | Reset end user texts | Restores all end user texts to default values, including the contact info, customized fault and warning texts, PID unit and currency unit. | 1024 |
| | Reset motor data | Restores all motor nominal values and motor ID run results to default values. | 2 |
| | All to factory defaults | Restores all drive parameters and settings back to initial factory values, except<br>• differentiated defaults implemented by parameters *95.20 HW options word 1* and *95.21 HW options word 2*. | 34560 |
| 96.07 | *Parameter save manually* | Saves the valid parameter values to the permanent memory on the drive control unit to ensure that operation can continue after cycling the power. Save the parameters with this parameter<br>• to store values sent from the fieldbus<br>• 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.<br>**Note:** A new parameter value is saved automatically when changed from the PC tool or control panel but not when altered through a fieldbus adapter connection. | *Done* |
| | Done | Save completed. | 0 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | 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).<br>The value reverts to 0 automatically. | *No action* |
| | No action | 1 = No action. | 0 |
| | Reboot | 1 = Reboot the control unit. | 1 |
| *96.10* | *User set status* | Shows the status of the user parameter sets.<br>This parameter is read-only.<br>See also section *Data storage parameters* (page *181*). | - |
| | n/a | No user parameter sets have been saved. | 0 |
| | Loading | A user set is being loaded. | 1 |
| | Saving | A user set is being saved. | 2 |
| | Faulted | Invalid or empty parameter set. | 3 |
| | User1 IO active | User set 1 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*. | 4 |
| | User2 IO active | User set 2 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*. | 5 |
| | User3 IO active | User set 3 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*. | 6 |
| | User4 IO active | User set 4 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*. | 7 |
| | Reserved | | 8…19 |
| | User1 backup | User set 1 has been saved or loaded. | 20 |
| | User2 backup | User set 2 has been saved or loaded. | 21 |
| | User3 backup | User set 3 has been saved or loaded. | 22 |
| | User4 backup | User set 4 has been saved or loaded. | 23 |
| *96.11* | *User set save/load* | Enables the saving and restoring of up to four custom sets of parameter settings. See section *User parameter sets* (page *175*).<br>The set that was in use before powering down the drive is in use after the next power-up.<br>**Notes:**<br>• Hardware configuration settings, such as I/O extension module and fieldbus configuration parameters (groups 14…16, 47, 51…58 and 92…93, and parameter *50.01 FBA A enable*), and forced input/output values (such as *10.03 DI force selection* and *10.04 DI forced data*) are not included in user parameter sets.<br>• Parameter changes made after loading a set are not automatically stored – they must be saved using this parameter.<br>• If no sets have been saved, attempting to load a set will create all sets from the currently active parameter settings.<br>• Switching between sets is only possible with the drive stopped. | *No action* |
| | No action | Load or save operation complete; normal operation. | 0 |
| | User set I/O mode | Load user parameter set using parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*. | 1 |
| | Load set 1 | Load user parameter set 1. | 2 |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | Load set 2 | Load user parameter set 2. | 3 |
| | Load set 3 | Load user parameter set 3. | 4 |
| | Load set 4 | Load user parameter set 4. | 5 |
| | Reserved | | 6…17 |
| | Save to set 1 | Save user parameter set 1. | 18 |
| | Save to set 2 | Save user parameter set 2. | 19 |
| | Save to set 3 | Save user parameter set 3. | 20 |
| | Save to set 4 | Save user parameter set 4. | 21 |
| *96.12* | *User set I/O mode in1* | When parameter *96.11 User set save/load* is set to *User set I/O mode*, selects the user parameter set together with parameter *96.13 User set I/O mode in2* as follows: | *Not selected* |

| Status of source defined by par. *96.12* | Status of source defined by par. *96.13* | User parameter set selected |
|---|---|---|
| 0 | 0 | Set 1 |
| 1 | 0 | Set 2 |
| 0 | 1 | Set 3 |
| 1 | 1 | Set 4 |

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| | Not selected | 0. | 0 |
| | Selected | 1. | 1 |
| | DI1 | Digital input DI1 (*10.02 DI delayed status*, bit 0). | 2 |
| | DI2 | Digital input DI2 (*10.02 DI delayed status*, bit 1). | 3 |
| | DI3 | Digital input DI3 (*10.02 DI delayed status*, bit 2). | 4 |
| | DI4 | Digital input DI4 (*10.02 DI delayed status*, bit 3). | 5 |
| | DI5 | Digital input DI5 (*10.02 DI delayed status*, bit 4). | 6 |
| | DI6 | Digital input DI6 (*10.02 DI delayed status*, bit 5). | 7 |
| | Reserved | | 8…17 |
| | Timed function 1 | Bit 0 of *34.01 Timed functions status* (see page *439*). | 18 |
| | Timed function 2 | Bit 1 of *34.01 Timed functions status* (see page *439*). | 19 |
| | Timed function 3 | Bit 2 of *34.01 Timed functions status* (see page *439*). | 20 |
| | Reserved | | 21…23 |
| | Supervision 1 | Bit 0 of *32.01 Supervision status* (see page *432*). | 24 |
| | Supervision 2 | Bit 1 of *32.01 Supervision status* (see page *432*). | 25 |
| | Supervision 3 | Bit 2 of *32.01 Supervision status* (see page *432*). | 26 |
| | *Other [bit]* | Source selection (see *Terms and abbreviations* on page *322*). | - |
| *96.13* | *User set I/O mode in2* | See parameter *96.12 User set I/O mode in1*. | *Not selected* |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *96.16* | *Unit selection* | Selects the unit of parameters indicating power, temperature and torque. | 0000b |

| Bit | Name | Information | |
|---|---|---|---|
| 0 | Power unit | 0 = kW | |
| | | 1 = hp | |
| 1 | Reserved | | |
| 2 | Temperature unit | 0 = °C | |
| | | 1 = °F | |
| 3 | Reserved | | |
| 4 | Torque unit | 0 = Nm (N·m) | |
| | | 1 = lbft (lb·ft) | |
| 5…15 | Reserved | | |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 0000h… FFFFh | Unit selection word. | 1 = 1 |
| *96.20* | *Time sync primary source* | Defines the 1st priority external source for synchronization of the drive's time and date. | *Panel link* |
| | Internal | No external source selected. | 0 |
| | | | 1…2 |
| | Fieldbus A | Fieldbus interface A. | 3 |
| | | | 4…5 |
| | Embedded FB | Embedded fieldbus interface. | 6 |
| | Reserved | | 7 |
| | Panel link | Control panel, or Drive composer PC tool connected to the control panel. | 8 |
| | Ethernet tool link | Drive composer PC tool through an FENA module. | 9 |
| *96.51* | *Clear fault and event logger* | Clears all events from the drive's fault and event logs. See section *Warning/fault history* on page *186*. | *Done* |
| | Done | 0 = No action | 0 |
| | Reset | 1 = Clear the loggers. | 1 |
| *96.54* | *Checksum action* | Selects how the drive reacts<br>• when *96.55 Checksum control word*, bit 8 = 1 (Approved checksum A): if the parameter checksum *96.68 Actual checksum A* does not match *96.71 Approved checksum A*, and/or<br>• when *96.55 Checksum control word*, bit 9 = 1 (Approved checksum B): if the parameter checksum *96.69 Actual checksum B* does not match *96.72 Approved checksum B*. | *No action* |
| | No action | No action taken. (The checksum feature is not in use.) | 0 |
| | Pure event | Drive generates an event log entry *B686 Checksum mismatch*. | 1 |
| | Warning | Drive generates warning *A686 Checksum mismatch*. | 2 |
| | Warning and prevent start | Drive generates warning *A686 Checksum mismatch*. Starting the drive is prevented. | 3 |
| | Fault | Drive trips on fault *6200 Checksum mismatch*. | 4 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *96.55* | *Checksum control word* | Bits 8…9 select which comparison(s) are made:<br>• Bit 8 = 1 (Approved checksum A): *96.68 Actual checksum A* is compared to *96.71 Approved checksum A*, and/or<br>• Bit 9 = 1 (Approved checksum A): if *96.69 Actual checksum B* is compared to *96.72 Approved checksum B*.<br>Bits 12…13 select approved (reference) checksum parameter(s) into which the actual checksum(s) from parameter(s) are copied:<br>• Bit 12 = 1 (Set approved checksum A): Value of *96.68 Actual checksum A* is copied into *96.71 Approved checksum A*, and/or<br>• Bit 13 = 1 (Set approved checksum B): Value of *96.69 Actual checksum B* copied into *96.72 Approved checksum B*. | 00000000h |

| Bit | Name | Description |
|---|---|---|
| 0…7 | Reserved | |
| 8 | Approved checksum A | 1 = Enabled: Checksum A (*96.71*) is observed. 0 = Disabled. |
| 9 | Approved checksum B | 1 = Enabled: Checksum B (*96.72*) is observed. 0 = Disabled. |
| 10…11 | Reserved | |
| 12 | Set approved checksum A | 1 = Set: Copy value of *96.68* into *96.71*. 0 = Done (copy has been made). |
| 13 | Set approved checksum B | 1 = Set: Copy value of *96.69* into *96.72*. 0 = Done (copy has been made). |
| 14…15 | Reserved | |

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 00000000…FFFFFFFFh | Checksum control word. | 1 = 1 |
| *96.68* | *Actual checksum A* | Displays the actual parameter configuration checksum. Checksum A calculation does not include<br>• fieldbus settings.<br>The parameters included in the calculation are user editable parameters in parameter groups 10…13, 15, 19…25, 28, 30…32, 34…37, 40…41, 43, 45…46, 70…74, 76, 80, 94…99.<br>See also section *Parameter checksum calculation* (page *181*). | 0h |
| | 00000000h…FFFFFFFFh | Actual checksum. | - |
| *96.69* | *Actual checksum B* | Displays the actual parameter configuration checksum B. Checksum B calculation does not include<br>• fieldbus settings<br>• motor data settings<br>• energy data settings.<br>The parameters included in the calculation are user editable parameters in parameter groups 10…13, 15, 19…25, 28, 30…32, 34, 35…37, 40…41, 43, 46, 70…74, 76, 80, 94…97.<br>See also section *Parameter checksum calculation* (page *181*). | 0h |
| | 00000000h…FFFFFFFFh | Actual checksum. | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *96.70* | *Disable adaptive program* | Enables/disables the adaptive program (if present). See also section *Adaptive programming* (page *89*). | *Yes* |
| | No | Adaptive program enabled. | 0 |
| | Yes | Adaptive program disabled. | 1 |
| *96.71* | *Approved checksum A* | Approved (reference) checksum A. | 0h |
| | 00000000h… FFFFFFFFh | Approved checksum A. | - |
| *96.72* | *Approved checksum B* | Approved (reference) checksum B. | 0h |
| | 00000000h… FFFFFFFFh | Approved checksum B. | - |
| *96.78* | *550 Compatibility mode* | Enables/disables a Modbus user to access a select set of parameters using 550 register numbering. | *Disable* |
| | Disable | 1 = Using 550 register numbering disabled. | 0 |
| | Enable | 0 = Using 550 register numbering enabled. | 1 |
| *96.100* | *Change user pass code* | *(Visible when user lock is open)* To change the current user pass code, enter a new code into this parameter as well as *96.101 Confirm user pass code*. A warning will be active until the new pass code is confirmed. To cancel changing the pass code, close the user lock without confirming. To close the lock, enter an invalid pass code in parameter *96.02 Pass code*, activate parameter *96.08 Control board boot*, or cycle the power. See also section *Parameter checksum calculation* (page *181*). | 10000000 |
| | 10000000… 99999999 | New user pass code. | - |
| *96.101* | *Confirm user pass code* | *(Visible when user lock is open)* Confirms the new user pass code entered in *96.100 Change user pass code*. | |
| | 10000000… 99999999 | Confirmation of new user pass code. | - |

**13**
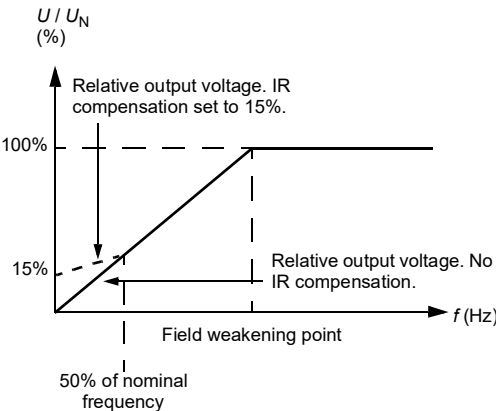
| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *96.102* | *User lock functionality* | *(Visible when user lock is open)*<br>Selects the actions or functionalities to be prevented by the user lock. Note that the changes made take effect only when the user lock is closed. See parameter *96.02 Pass code*.<br>**Note:** We recommend you select all the actions and functionalities unless otherwise required by the application. | 0000h |

| Bit | Name | Information |
|---|---|---|
| 0 | Disable ABB access levels | 1 = ABB access levels (service, advanced programmer, etc.; see *96.03*) disabled |
| 1 | Freeze parameter lock state | 1 = Changing the parameter lock state prevented, ie, pass code 358 has no effect |
| 2 | Disable file download | 1 = Loading of files to drive prevented. This applies to<br>• firmware upgrades<br>• parameter restore<br>• loading an adaptive program<br>• changing home view of control panel<br>• editing drive texts<br>• editing the favorite parameters list on control panel<br>• configuration settings made through control panel such as time/date formats and enabling/disabling clock display. |
| 3…4 | Reserved | |
| 5 | Override lock | 1 = Override locked. Group *70 Override* parameters and reference or control chain parameters that have been selected to be used for override are write protected. |
| 6 | Reserved | |
| 7 | Disable panel Bluetooth | 1 = Bluetooth disabled on ACS-AP-W control panel. If the drive is part of a panel bus, Bluetooth is disabled on all panels. |
| 8…10 | Reserved | |
| 11 | Disable OEM access level 1 | 1 = OEM access level 1 disabled |
| 12 | Disable OEM access level 2 | 1 = OEM access level 2 disabled |
| 13 | Disable OEM access level 3 | 1 = OEM access level 3 disabled |
| 14…15 | Reserved | |

| | | | |
|---|---|---|---|
| | 0000h…FFFFh | Selection of actions to be prevented by user lock. | - |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| **97 Motor control** | | Switching frequency; slip gain; voltage reserve; flux braking; anti-cogging (signal injection); IR compensation. | |
| 97.01 | *Switching frequency reference* | Defines the switching frequency of the drive that is used as long as the drive stays below the thermal limit. Higher switching frequency results in lower acoustic motor noise. Lower switching frequency generates less switching losses and reduce EMC emissions. **Notes:** • If you have a multimotor system, contact your local ABB representative. • With an ABB EX motor, follow the instructions given in the ABB EX motor documentation. | *4 kHz* |
| | 2 kHz | 2 kHz. | 2 |
| | 4 kHz | 4 kHz. | 4 |
| | 8 kHz | 8 kHz. | 8 |
| | 12 kHz | 12 kHz. | 12 |
| 97.02 | *Minimum switching frequency* | Lowest switching frequency value that is allowed. Depends on the frame size. When drive is reaching the thermal limit, it will automatically start to reduce the switching frequency until the minimum allowed value is reached. Once the minimum has been reached, the drive will automatically start limiting the output current to keep the temperature below the thermal limit. Inverter temperature is shown by parameter *05.11 Inverter temperature*. **Note:** • With an ABB EX motor, follow the instructions given in the ABB EX motor documentation. | *2 kHz* |
| | 1.5 kHz | 1.5 kHz. Not for all frame sizes. | |
| | 2 kHz | 2 kHz. | 2 |
| | 4 kHz | 4 kHz. | 4 |
| | 8 kHz | 8 kHz. | 8 |
| | 12 kHz | 12 kHz. | 12 |
| 97.03 | *Slip gain* | Defines the slip gain which is used to improve the estimated motor slip. 100% means full slip gain; 0% means no slip gain. The default value is 100%. Other values can be used if a static speed error is detected despite having the setting at full slip gain. **Example** (with nominal load and nominal slip of 40 rpm): A 1000 rpm constant speed reference is given to the drive. Despite having full slip gain (= 100%), a manual tachometer measurement from the motor axis gives a speed value of 998 rpm. The static speed error is 1000 rpm - 998 rpm = 2 rpm. To compensate the error, the slip gain should be increased to 105% (2 rpm / 40 rpm = 5%). | 100% |
| | 0…200% | Slip gain. | 1 = 1% |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *97.04* | *Voltage reserve* | Defines the minimum allowed voltage reserve. When the voltage reserve has decreased to the set value, the drive enters the field weakening area. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. If the intermediate circuit DC voltage $U_{dc}$ = 550 V and the voltage reserve is 5%, the RMS value of the maximum output voltage in steady-state operation is 0.95 × 550 V / sqrt(2) = 369 V The dynamic performance of the motor control in the field weakening area can be improved by increasing the voltage reserve value, but the drive enters the field weakening area earlier. | -2% |
| | -4…50% | Voltage reserve. | 1 = 1% |
| *97.05* | *Flux braking* | Defines the level of flux braking power. (Other stopping and braking modes can be configured in parameter group *21 Start/stop mode*). **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. | *Disabled* |
| | Disabled | Flux braking is disabled. | 0 |
| | Moderate | Flux level is limited during the braking. Deceleration time is longer compared to full braking. | 1 |
| | Full | Maximum braking power. Almost all available current is used to convert the mechanical braking energy to thermal energy in the motor. ⚠ **WARNING!** Using full flux braking heats up the motor especially in cyclic operation. Make sure that the motor can withstand this if you have a cyclic application. | 2 |
| *97.08* | *Optimizer minimum torque* | This parameter can be used to improve the control dynamics of a synchronous reluctance motor or a salient permanent magnet synchronous motor. As a rule of thumb, define a level to which the output torque must rise with minimum delay. This will increase the motor current and improve the torque response at low speeds. | 0.0% |
| | 0.0 … 1600.0% | Optimizer torque limit. | 10 = 1% |
| *97.11* | *TR tuning* | Rotor time constant tuning. This parameter can be used to improve torque accuracy in closed-loop control of an induction motor. Normally, the motor identification run provides sufficient torque accuracy, but manual fine-tuning can be applied in exceptionally demanding applications to achieve optimal performance. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. | 100% |
| | 25…400% | Rotor time constant tuning. | 1 = 1% |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| *97.13* | *IR compensation* | Defines the relative output voltage boost at zero speed (IR compensation). The function is useful in applications with a high break-away torque where vector control cannot be applied. | % |
| | |  Typical IR compensation values are shown below | |
| | | **3-phase $U_N$ = 400 V (380…415 V) drives** | |
| | | $P_N$ (kW): 3, 7.5, 15, 37, 132 — IR compensation (%): 2.3, 1.7, 1.3, 1.1, 0.6 | |
| | | See also section *IR compensation for scalar motor control* on page *121*). | |
| | 0.00…50.00% | Voltage boost at zero speed in percent of nominal motor voltage. | 1 = 1% |
| *97.15* | *Motor model temperature adaptation* | Enables the motor model temperature adaptation. Estimated motor temperature can be used to adapt temperature dependent parameters (for example, resistances) of motor model. | *Disabled* |
| | Disabled | Temperature adaptation disabled. | 0 |
| | Estimated temperature | Temperature adaptation with motor temperature estimate (parameter *35.01 Motor estimated temperature*). | 1 |
| *97.16* | *Stator temperature factor* | Tunes the motor temperature dependence of stator parameters (stator resistance). | 50% |
| | 0…200% | Tuning factor. | 1 = 1% |
| *97.17* | *Rotor temperature factor* | Tunes the motor temperature dependence of rotor parameters (eg. rotor resistance). | 100% |
| | 0…200% | Tuning factor. | 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.<br>**Note:**<br>• The U/f function cannot be used with energy optimization; if *45.11 Energy optimizer* is set to *Enable*, parameter *97.20 U/F ratio* is ignored. | *Squared* |
| | Linear | Linear ratio for constant torque applications. | 0 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | 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 |
| *97.49* | *Slip gain for scalar* | Sets gain for slip compensation in percent when the drive is operating in scalar control mode. A squirrel-cage motor slips under load. Increasing the frequency as the motor torque increases compensates for the slip. **Note:** This parameter is only effective in scalar motor control mode (parameter *99.04 Motor control mode* is set to *Scalar*). | 0% |
| | 0 … 200% | 0% = No slip compensation. 0 … 200% = Increasing slip compensation. 100% means full slip compensation according to parameter *99.08 Motor nominal frequency* and *99.09 Motor nominal speed*. | 1 = 1% |
| *97.94* | *IR comp max frequency* | Sets the frequency at which IR compensation set by parameter *97.13 IR compensation* reaches 0 V. Unit is percent of the motor nominal frequency. | 50.0% |
| | 1.0 … 200.0% | Frequency. | 1 = 1% |
| **98 User motor parameters** | | Motor values supplied by the user that are used in the motor model. These parameters are useful for non-standard motors, or to just get more accurate motor control of the motor on site. A better motor model always improves the shaft performance. | |
| *98.01* | *User motor model mode* | Activates the motor model parameters *98.02*…*98.12* and *98.14*. **Notes**: • Parameter value is automatically set to zero when ID run is selected by parameter *99.13 ID run requested*. The values of parameters *98.02*…*98.12* are then updated according to the motor characteristics identified during the ID run. • Measurements made directly from the motor terminals during the ID run are likely to produce slightly different values than those on a data sheet from a motor manufacturer. • This parameter cannot be changed while the drive is running. | *Not selected* |
| | Not selected | Parameters *98.02*…*98.12* inactive. | 0 |
| | Motor parameters | The values of parameters *98.02*… *98.12* are used as the motor model. | 1 |
| *98.02* | *Rs user* | Defines the stator resistance $R_S$ of the motor model. With a star-connected motor, $R_S$ is the resistance of one winding. With a delta-connected motor, $R_S$ is one-third of the resistance of one winding. | 0.00000 p.u. |
| | 0.00000…0.50000 p.u. | Stator resistance in per unit. | - |
| *98.03* | *Rr user* | Defines the rotor resistance $R_R$ of the motor model. **Note:** This parameter is valid only for asynchronous motors. | 0.00000 p.u. |
| | 0.00000…0.50000 p.u. | Rotor resistance in per unit. | - |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *98.04* | *Lm user* | Defines the main inductance $L_M$ of the motor model.<br>**Note:** This parameter is valid only for asynchronous motors. | 0.00000 p.u. |
| | 0.00000…10.00000 p.u. | Main inductance in per unit. | - |
| *98.05* | *SigmaL user* | Defines the leakage inductance $\sigma L_S$.<br>**Note:** This parameter is valid only for asynchronous motors. | 0.00000 p.u. |
| | 0.00000…1.00000 p.u. | Leakage inductance in per unit. | - |
| *98.06* | *Ld user* | Defines the direct axis (synchronous) inductance.<br>**Note:** This parameter is valid only for permanent magnet motors. | 0.00000 p.u. |
| | 0.00000…10.00000 p.u | Direct axis inductance in per unit. | - |
| *98.07* | *Lq user* | Defines the quadrature axis (synchronous) inductance.<br>**Note:** This parameter is valid only for permanent magnet motors. | 0.00000 p.u. |
| | 0.00000…10.00000 p.u | Quadrature axis inductance in per unit. | - |
| *98.08* | *PM flux user* | Defines the permanent magnet flux.<br>**Note:** This parameter is valid only for permanent magnet motors. | 0.00000 p.u. |
| | 0.00000… 2.00000 p.u | Permanent magnet flux in per unit. | - |
| *98.09* | *Rs user SI* | Defines the stator resistance $R_S$ of the motor model. | 0.00000 ohm |
| | 0.00000…100.00000 ohm | Stator resistance. | - |
| *98.10* | *Rr user SI* | Defines the rotor resistance $R_R$ of the motor model.<br>**Note:** This parameter is valid only for asynchronous motors. | 0.00000 ohm |
| | 0.00000…100.00000 ohm | Rotor resistance. | - |
| *98.11* | *Lm user SI* | Defines the main inductance $L_M$ of the motor model.<br>**Note:** This parameter is valid only for asynchronous motors. | 0.00 mH |
| | 0.00…100000.00 mH | Main inductance. | 1 = 10000 mH |
| *98.12* | *SigmaL user SI* | Defines the leakage inductance $\sigma L_S$.<br>**Note:** This parameter is valid only for asynchronous motors. | 0.00 mH |
| | 0.00…100000.00 mH | Leakage inductance. | 1 = 10000 mH |
| *98.13* | *Ld user SI* | Defines the direct axis (synchronous) inductance.<br>**Note:** This parameter is valid only for permanent magnet motors. | 0.00 mH |
| | 0.00…100000.00 mH | Direct axis inductance. | 1 = 10000 mH |
| *98.14* | *Lq user SI* | Defines the quadrature axis (synchronous) inductance.<br>**Note:** This parameter is valid only for permanent magnet motors. | 0.00 mH |
| | 0.00…100000.00 mH | Quadrature axis inductance. | 1 = 10000 mH |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| **99 Motor data** | | Motor configuration settings. | |
| 99.03 | *Motor type* | Selects the motor type.<br>**Note:** This parameter cannot be changed while the drive is running. | *Asynchronous motor* |
| | Asynchronous motor | Standard squirrel cage AC induction motor (asynchronous induction motor). | 0 |
| | Permanent magnet motor | Permanent magnet motor. Three-phase AC synchronous motor with permanent magnet rotor and sinusoidal BackEMF voltage.<br>**Note:** With permanent magnet motors special attention must be paid on setting the motor nominal values correctly in parameter group *99 Motor data*. You must use vector control. If the nominal BackEMF voltage of the motor is not available, a full ID run should be performed for improving performance. | 1 |
| | SynRM | Synchronous reluctance motor. Three-phase AC synchronous motor with salient pole rotor without permanent magnets. With synchronous reluctance motors you must use vector control. | 2 |
| 99.04 | *Motor control mode* | Selects the motor control mode. | *Scalar* |
| | Vector | Vector control. Vector control has better accuracy than scalar control but cannot be used in all situations (see selection *Scalar* below).<br>Requires motor identification run (ID run). See parameter *99.13 ID run requested*.<br>**Note:** In vector control the drive performs a standstill ID run at the first start if ID run has not been previously performed. A new start command is required after standstill ID run.<br>**Note:** To achieve a better motor control performance, you can perform a normal ID run without load.<br>See also section *Operating modes of the drive* (page *87*)). | 0 |
| | Scalar | Scalar control. Suitable for most applications, if top performance is not required.<br>Motor identification run is not required.<br>**Note:** Scalar control must be used in the following situations:<br>• 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)<br>• if the nominal current of the motor is less than 1/6 of the nominal output current of the drive<br>• if the drive is used with no motor connected (for example, for test purposes).<br>**Note:** Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the inverter.<br>See also section *Operating modes of the drive* (page *87*). | 1 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *99.06* | *Motor nominal current* | Defines the nominal motor current. Must be equal to the value on the motor rating plate. If multiple motors are connected to the drive, enter the total current of the motors.<br>**Notes:**<br>• Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the drive.<br>• This parameter cannot be changed while the drive is running.<br>For 16-bit scaling, see parameter *46.05 Current scaling*. | 0.0 A |
| | 0.0…6400.0 A | Nominal current of the motor. The allowable range is 1/6…2 × $I_N$ of the drive (0…2 × $I_N$ with scalar control mode). | 1 = 0.01 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.<br>**Notes:**<br>• 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.<br>• 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.<br>• This parameter cannot be changed while the drive is running. | 0.0 V |
| | 0.0…960.0 V | Nominal voltage of the motor. | 10 = 1 V |
| *99.08* | *Motor nominal frequency* | Defines the nominal motor frequency. This setting must match the value on the rating plate of the motor.<br>**Note:** This parameter cannot be changed while the drive is running. | 50.00 Hz |
| | 0.00…500.00 Hz | Nominal frequency of the motor. | 10 = 1 Hz |
| *99.09* | *Motor nominal speed* | Defines the nominal motor speed. The setting must match the value on the rating plate of the motor.<br>**Note:** This parameter cannot be changed while the drive is running. | 0 rpm |
| | 0…30000 rpm | Nominal speed of the motor. | 1 = 1 rpm |
| *99.10* | *Motor nominal power* | Defines the nominal motor power. The setting must match the value on the rating plate of the motor. If multiple motors are connected to the drive, enter the total power of the motors. The unit is selected by parameter *96.16 Unit selection*.<br>**Note:** This parameter cannot be changed while the drive is running.<br>For 16-bit scaling, see parameter *46.04 Power scaling*. | 0.00 kW or hp |
| | 0.00… 10000.00 kW or 0.00… 13404.83 hp | Nominal power of the motor. | 1 = 0.01 unit |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *99.11* | *Motor nominal cos ?* | Defines the cosphi of the motor for a more accurate motor model. The value is not obligatory, but is useful with an asynchronous motor, especially when performing a standstill identification run. With a permanent magnet or synchronous reluctance motor, this value is not needed.<br>**Notes:**<br>• Do not enter an estimated value. If you do not know the exact value, leave the parameter at zero.<br>• This parameter cannot be changed while the drive is running. | 0.00 |
| | 0.00…1.00 | Cosphi of the motor. | 100 = 1 |
| *99.12* | *Motor nominal torque* | Defines the nominal motor shaft torque for a more accurate motor model. Not obligatory. The unit is selected by parameter *96.16 Unit selection*.<br>**Note:** This parameter cannot be changed while the drive is running. | 0.000 N·m or lb·ft |
| | 0.000…4000000.000 N·m or 0.000…2950248.597 lb·ft | Nominal motor torque. | 1 = 100 unit |

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| No. | Name/Value | Description | Def/FbEq16 |
|-----|-----------|-------------|------------|
| 99.13 | *ID run requested* | Selects the type of the motor identification routine (ID run) performed at the next start of the drive. During the ID run, the drive will identify the characteristics of the motor for optimum motor control.<br><br>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.<br><br>After the ID run, the drive stops and this parameter is automatically set to *None*.<br><br>**Notes:**<br>• To ensure that the ID run can work properly, the drive limits in group *30* (maximum speed and minimum speed, and maximum torque and minimum torque) must to be large enough (the range specified by the limits must be wide enough). If, for example, speed limits are less than the motor nominal speed, the ID run cannot be completed.<br>• 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%.<br>• With scalar control mode (*99.04 Motor control mode* = *Scalar*), the ID run is not requested automatically. However, an ID run can be performed for more accurate torque estimation.<br>• Once the ID run is activated, it can be canceled by stopping the drive.<br>• The ID run must be performed every time any of the motor parameters (*99.04*, *99.06*…*99.12*) have been changed.<br>• Ensure that the Safe Torque Off and emergency stop circuits (if any) are closed during the ID run.<br>• Mechanical brake (if present) is not opened by the logic for the ID run.<br>• This parameter cannot be changed while the drive is running. | *None* |
| | None | No motor ID run is requested. This mode can be selected only if the ID run (*Normal* / *Reduced* / *Standstill*) has already been performed once. | 0 |
| | Normal | Normal ID run. Guarantees good control accuracy for all cases. The ID run takes about 90 seconds. This mode should be selected whenever it is possible.<br><br>**Notes:**<br>• If the load torque will be higher than 20% of motor nominal torque, or if the machinery is not able to withstand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run.<br>• Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction.<br><br>⚠ **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN! | 1 |

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| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| | Reduced | Reduced ID run. This mode should be selected instead of the *Normal* ID Run if<br>• mechanical losses are higher than 20% (ie. the motor cannot be de-coupled from the driven equipment), or if<br>• 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).<br>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).<br>**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.<br>⚠ **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN! | 2 |
| | Standstill | Standstill ID run. The motor is injected with DC current. With an AC induction (asynchronous) motor, the motor shaft is not rotated. With a permanent magnet motor, the shaft can rotate up to half a revolution.<br>**Note:** This mode should be selected only if the *Normal* or *Reduced* ID run is not possible due to the restrictions caused by the connected mechanics (for example, with lift or crane applications). | 3 |
| | Reserved | | 4…6 |
| | Reserved | | 7 |
| | Adaptive | Adaptive ID run. Improves the motor model accuracy during normal operation of the drive.<br>The drive performs a Standstill ID run first. Motor parameters are then updated with better accuracy during an adaptation sequence when following user's driving profile. When the adaptation is complete, parameters *99.14 Last ID run performed* changes from Standstill to Adaptive. Motor parameters are updated automatically and the user is not required to update any other parameter.<br>**Notes:**<br>• For vector control only.<br>• For frame sizes R1…R4 only. | 8 |
| *99.14* | *Last ID run performed* | Shows the type of ID run that was performed last. For more information about the different modes, see the selections of parameter *99.13 ID run requested*. | *None* |
| | None | No ID run has been performed. | 0 |
| | Normal | *Normal* ID run. | 1 |
| | Reduced | *Reduced* ID run. | 2 |
| | Standstill | *Standstill* ID run. | 3 |
| | Reserved | | 4…6 |
| | Reserved | | 7 |
| | Adaptive | *Adaptive* ID run | 8 |

**13**

| No. | Name/Value | Description | Def/FbEq16 |
|---|---|---|---|
| *99.15* | *Motor polepairs calculated* | Calculated number of pole pairs in the motor. | 0 |
| | 0…1000 | Number of pole pairs. | 1 = 1 |
| *99.16* | *Motor phase order* | Switches the rotation direction of motor. This parameter can be used if the motor turns in the wrong direction (for example, because of the wrong phase order in the motor cable), and correcting the cabling is considered impractical.<br>**Note:**<br>• Changing this parameter does not affect speed reference polarities, so positive speed reference will rotate the motor forward. The phase order selection just ensures that "forward" is in fact the correct direction. | *U V W* |
| | U V W | Normal. | 0 |
| | U W V | Reversed rotation direction. | 1 |

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## Differences in the default values between 50 Hz and 60 Hz supply frequency settings

Parameter *95.20 HW options word 1* bit 0 *Supply frequency 60 Hz* changes the drive parameter default values according to the supply frequency, 50 Hz or 60 Hz. The bit is set according to the market before the drive is delivered.

If you need to change from 50 Hz to 60 Hz, or vice versa, change the value of the bit and then do a complete reset to the drive. After that you have to reselect the macro to be used.

The table below shows the parameters whose default values depend on the supply frequency setting. The supply frequency setting, with the type designation of the drive, also affects Group *99 Motor data* parameter values though these parameters are not listed in the table.

| No | Name | *95.20 HW options word 1* bit *Supply frequency 60 Hz* = **50 Hz** | *95.20 HW options word 1* bit *Supply frequency 60 Hz* = **60 Hz** |
|---|---|---|---|
| *11.45* | *Freq in 1 at scaled max* | 1500.000 | 1800.000 |
| *12.20* | *AI1 scaled at AI1 max* | 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 |
| *30.12* | *Maximum speed* | 1500.00 rpm | 1800.00 rpm |
| *30.14* | *Maximum frequency* | 50.00 Hz | 60.00 Hz |
| *31.26* | *Stall speed limit* | 150.00 rpm | 180.00 rpm |
| *31.27* | *Stall frequency limit* | 15.00 Hz | 18.00 Hz |
| *31.30* | *Overspeed trip margin* | 500.00 rpm | 500.00 rpm |
| *46.01* | *Speed scaling* | 1500.00 rpm | 1800.00 rpm |
| *46.02* | *Frequency scaling* | 50.00 Hz | 60.00 Hz |
| *46.31* | *Above speed limit* | 1500.00 rpm | 1800.00 rpm |
| *46.32* | *Above frequency limit* | 50.00 Hz | 60.00 Hz |

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# 14

# Additional parameter data

## What this chapter contains

This chapter lists the parameters with some additional data such as their ranges and 32-bit fieldbus scaling. For parameter descriptions, see chapter *Parameters* (page *321*).

## Terms and abbreviations

| Term | Definition |
| --- | --- |
| Actual signal | Signal measured or calculated by the drive. Usually can only be monitored but not adjusted; some counter-type signals can however be reset. |
| Analog src | Analog source: the parameter can be set to the value of another parameter by choosing "Other", and selecting the source parameter from a list.<br><br>In addition to the "Other" selection, the parameter may offer other pre-selected settings. |
| Binary src | Binary source: the value of the parameter can be taken from a specific bit in another parameter value ("Other"). Sometimes the value can be fixed to 0 (false) or 1 (true). In addition, the parameter may offer other pre-selected settings. |
| Data | Data parameter |
| FbEq32 | 32-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 32-bit value is selected for transmission to an external system.<br><br>The corresponding 16-bit scalings are listed in chapter *Parameters* (page *321*). |
| List | Selection list. |

| Term | Definition |
|------|------------|
| No. | Parameter number. |
| PB | Packed Boolean (bit list). |
| Real | Real number. |
| Type | Parameter type. See *Analog src*, *Binary src*, *List*, *PB*, *Real*. |

## Fieldbus addresses

Refer to the *User's manual* of the fieldbus adapter.

# Parameter groups 1…9

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| **01 Actual values** | | | | | |
| 01.01 | Motor speed used | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 01.02 | Motor speed estimated | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 01.03 | Motor speed % | *Real* | -1000.00…1000.00 | % | 100 = 1% |
| 01.06 | Output frequency | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 01.07 | Motor current | *Real* | 0.00…30000.00 | A | 100 = 1 A |
| 01.08 | Motor current % of motor nom | *Real* | 0.0…1000.0 | % | 10 = 1% |
| 01.09 | Motor current % of drive nom | *Real* | 0.0…1000.0 | % | 10 = 1% |
| 01.10 | Motor torque | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 01.11 | DC voltage | *Real* | 0.00…2000.00 | V | 100 = 1 V |
| 01.13 | Output voltage | *Real* | 0…2000 | V | 1 = 1 V |
| 01.14 | Output power | *Real* | -32768.00…32767.00 | kW or hp | 100 = 1 unit |
| 01.15 | Output power % of motor nom | *Real* | -300.00…300.00 | % | 100 = 1% |
| 01.16 | Output power % of drive nom | *Real* | -300.00…300.00 | % | 100 = 1% |
| 01.17 | Motor shaft power | *Real* | -32768.00…32767.00 | kW or hp | 100 = 1 unit |
| 01.18 | Inverter GWh counter | *Real* | 0…65535 | GWh | 1 = 1 GWh |
| 01.19 | Inverter MWh counter | *Real* | 0…1000 | MWh | 1 = 1 MWh |
| 01.20 | Inverter kWh counter | *Real* | 0…1000 | kWh | 1 = 1 kWh |
| 01.24 | Flux actual % | *Real* | 0…200 | % | 1 = 1% |
| 01.30 | Nominal torque scale | *Real* | 0.000…4000000 | N·m or lb·ft | 1000 = 1 unit |
| 01.50 | Current hour kWh | *Real* | 0.00…1000000.00 | kWh | 100 = 1 kWh |
| 01.51 | Previous hour kWh | *Real* | 0.00…1000000.00 | kWh | 100 = 1 kWh |
| 01.52 | Current day kWh | *Real* | 0.00…1000000.00 | kWh | 100 = 1 kWh |
| 01.53 | Previous day kWh | *Real* | 0.00…1000000.00 | kWh | 100 = 1 kWh |
| 01.54 | Cumulative inverter energy | *Real* | -200000000.0…200000000.0 | kWh | 1 = 1 kWh |
| 01.55 | Inverter GWh counter (resettable) | *Real* | 0…65535 | GWh | 1 = 1 GWh |
| 01.56 | Inverter MWh counter (resettable) | *Real* | 0…1000 | MWh | 1 = 1 MWh |
| 01.57 | Inverter kWh counter (resettable) | *Real* | 0…1000 | kWh | 1 = 1 kWh |
| 01.58 | Cumulative inverter energy (resettable) | *Real* | -200000000.0…200000000.0 | kWh | 1 = 1 kWh |
| 01.61 | Abs motor speed used | | 0.00…30000.00 | rpm | 100 = 1 rpm |
| 01.62 | Abs motor speed % | | 0.00…1000.00% | % | 100 = 1% |
| 01.63 | Abs output frequency | | 0.00…500.00 Hz | Hz | 100 = 1 Hz |
| 01.64 | Abs motor torque | | 0.0…1600.0 | % | 10 = 1% |
| 01.65 | Abs output power | | 0.00…32767.00 | kW | 100 = 1 kW |
| 01.66 | Abs output power % motor nom | | 0.00…300.00 | % | 100 = 1% |
| 01.67 | Abs output power % drive nom | | 0.00…300.00 | % | 100 = 1% |

| No. | Name | Type | Range | Unit | FbEq32 |
|------|------|------|-------|------|--------|
| 01.68 | Abs motor shaft power | | 0.00…32767.00 | kW | 100 = 1 kW |
| **03 Input references** | | | | | |
| 03.01 | Panel reference | *Real* | -100000.00…100000.00 | - | 100 = 1 |
| 03.02 | Panel reference remote | *Real* | -100000.00…100000.00 | - | 100 = 1 |
| 03.05 | FB A reference 1 | *Real* | -100000.00…100000.00 | - | 100 = 1 |
| 03.06 | FB A reference 2 | *Real* | -100000.00…100000.00 | - | 100 = 1 |
| 03.09 | EFB reference 1 | *Real* | -30000.00…30000.00 | - | 100 = 1 |
| 03.10 | EFB reference 2 | *Real* | -30000.00…30000.00 | - | 100 = 1 |
| **04 Warnings and faults** | | | | | |
| 04.01 | Tripping fault | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.02 | Active fault 2 | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.03 | Active fault 3 | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.06 | Active warning 1 | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.07 | Active warning 2 | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.08 | Active warning 3 | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.11 | Latest fault | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.12 | 2nd latest fault | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.13 | 3rd latest fault | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.16 | Latest warning | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.17 | 2nd latest warning | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.18 | 3rd latest warning | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.40 | Event word 1 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 04.41 | Event word 1 bit 0 code | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.43 | Event word 1 bit 1 code | *Data* | 0000h…FFFFh | - | 1 = 1 |
| 04.45, 04.47, 04.49, … | … | … | … | … | |
| 04.71 | Event word 1 bit 15 code | *Data* | 0000h…FFFFh | - | 1 = 1 |
| **05 Diagnostics** | | | | | |
| 05.01 | On-time counter | *Real* | 0…65535 | d | 1 = 1 d |
| 05.02 | Run-time counter | *Real* | 0…65535 | d | 1 = 1 d |
| 05.03 | Hours run | *Real* | 0.0…429496729.5 | h | 10 = 1 h |
| 05.04 | Fan on-time counter | *Real* | 0…65535 | d | 1 = 1 d |
| 05.10 | Control board temperature | *Real* | -100…300 | °C or °F | 10 = 1 ° |
| 05.11 | Inverter temperature | *Real* | -40.0…160.0 | % | 10 = 1% |
| 05.20 | Diagnostic word 1 | *PB* | 0000h…FFFFh | - | |
| 05.21 | Diagnostic word 2 | *PB* | 0000h…FFFFh | - | |
| 05.22 | Diagnostic word 3 | *PB* | 0000h…FFFFh | - | |
| 05.80 | Motor speed at fault | *Real* | -30000…30000.00 | rpm | 100 = 1 rpm |
| 05.81 | Output frequency at fault | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 05.82 | DC voltage at fault | *Real* | 0.00…2000.00 | V | 100 = 1 V |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 05.83 | Motor current at fault | *Real* | 0.00…30000.00 | A | 100 = 1 A |
| 05.84 | Motor torque at fault | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 05.85 | Main status word at fault | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 05.86 | DI delayed status at fault | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 05.87 | Inverter temperature at fault | *Real* | -40.0…160.0 | % | 10 = 1% |
| 05.88 | Reference used at fault | *Real* | -500.00…500.00 or -30000.00…30000.00 | Hz or rpm | 100 = 1 unit |
| 05.89 | HVAC status word at fault | *PB* | 0000h…FFFFh | - | 1 = 1 |
| **06 Control and status words** | | | | | |
| 06.01 | Main control word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 06.11 | Main status word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 06.16 | Drive status word 1 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 06.17 | Drive status word 2 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 06.18 | Start inhibit status word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 06.19 | Speed control status word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 06.20 | Constant speed status word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 06.21 | Drive status word 3 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 06.22 | HVAC status word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 06.29 | MSW bit 10 selection | *Binary src* | - | - | 1 = 1 |
| 06.30 | MSW bit 11 selection | *Binary src* | - | - | 1 = 1 |
| 06.31 | MSW bit 12 selection | *Binary src* | - | - | 1 = 1 |
| 06.32 | MSW bit 13 selection | *Binary src* | - | - | 1 = 1 |
| 06.33 | MSW bit 14 selection | *Binary src* | - | - | 1 = 1 |
| **07 System info** | | | | | |
| 07.03 | Drive rating id | *List* | 0…999 | - | 1 = 1 |
| 07.04 | Firmware name | *List* | - | - | 1 = 1 |
| 07.05 | Firmware version | *Data* | - | - | 1 = 1 |
| 07.06 | Loading package name | *List* | - | - | 1 = 1 |
| 07.07 | Loading package version | *Data* | - | - | 1 = 1 |
| 07.11 | Cpu usage | *Real* | 0…100 | % | 1 = 1% |
| 07.25 | Customization package name | *Data* | - | - | 1 = 1 |
| 07.26 | Customization package version | *Data* | - | - | 1 = 1 |
| 07.30 | Adaptive program status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 07.31 | AP sequence state | *Data* | 0…20 | - | 1 = 1 |
| 07.35 | Drive configuration | | 0000h…FFFFh | | |
| 07.36 | Drive configuration 2 | | 0000h…FFFFh | | |

# Parameter groups 10…99

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| **10 Standard DI, RO** | | | | | |
| 10.01 | DI status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 10.02 | DI delayed status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 10.03 | DI force selection | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 10.04 | DI forced data | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 10.05 | DI1 ON delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.06 | DI1 OFF delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.07 | DI2 ON delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.08 | DI2 OFF delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.09 | DI3 ON delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.10 | DI3 OFF delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.11 | DI4 ON delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.12 | DI4 OFF delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.13 | DI5 ON delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.14 | DI5 OFF delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.15 | DI6 ON delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.16 | DI6 OFF delay | *Real* | 0.0 … 3000.0 | s | 10 = 1 s |
| 10.21 | RO status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 10.22 | RO force selection | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 10.23 | RO forced data | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 10.24 | RO1 source | *Binary src* | - | - | 1 = 1 |
| 10.25 | RO1 ON delay | *Real* | 0.0…3000.0 | s | 10 = 1 s |
| 10.26 | RO1 OFF delay | *Real* | 0.0…3000.0 | s | 10 = 1 s |
| 10.27 | RO2 source | *Binary src* | - | - | 1 = 1 |
| 10.28 | RO2 ON delay | *Real* | 0.0…3000.0 | s | 10 = 1 s |
| 10.29 | RO2 OFF delay | *Real* | 0.0…3000.0 | s | 10 = 1 s |
| 10.30 | RO3 source | *Binary src* | - | - | 1 = 1 |
| 10.31 | RO3 ON delay | *Real* | 0.0…3000.0 | s | 10 = 1 s |
| 10.32 | RO3 OFF delay | *Real* | 0.0…3000.0 | s | 10 = 1 s |
| 10.99 | RO/DIO control word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 10.101 | RO1 toggle counter | *Real* | 0…4294967000 | - | 1 = 1 |
| 10.102 | RO2 toggle counter | *Real* | 0…4294967000 | - | 1 = 1 |
| 10.103 | RO3 toggle counter | *Real* | 0…4294967000 | - | 1 = 1 |
| **11 Standard DIO, FI, FO** | | | | | |
| 11.02 | DIO delayed status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 11.03 | DIO force selection | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 11.04 | DIO force data | *PB* | 0000h…FFFFh | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 11.05 | DIO1 configuration | *List* | 0, 2 | - | 1 = 1 |
| 11.06 | DIO1 output source | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 11.07 | DIO1 ON delay | *Real* | 0.0…3000.0 | s | 10 = 1 s |
| 11.08 | DIO1 OFF delay | *Real* | 0.0…3000.0 | s | 10 = 1 s |
| 11.17 | DI4 configuration | *List* | 0…1 | - | 1 = 1 |
| 11.21 | DI5 configuration | *List* | 0…1 | - | 1 = 1 |
| 11.38 | Freq in 1 actual value | *Real* | 0…16000 | Hz | 1 = 1 Hz |
| 11.39 | Freq in 1 scaled value | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 11.42 | Freq in 1 min | *Real* | 0…16000 | Hz | 1 = 1 Hz |
| 11.43 | Freq in 1 max | *Real* | 0…16000 | Hz | 1 = 1 Hz |
| 11.44 | Freq in 1 at scaled min | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 11.45 | Freq in 1 at scaled max | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 11.46 | Freq in 2 actual value | *Real* | 0…16000 | Hz | 1 = 1 Hz |
| 11.47 | Freq in 2 scaled value | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 11.50 | Freq in 2 min | *Real* | 0…16000 | Hz | 1 = 1 Hz |
| 11.51 | Freq in 2 max | *Real* | 0…16000 | Hz | 1 = 1 Hz |
| 11.52 | Freq in 2 at scaled min | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 11.53 | Freq in 2 at scaled max | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 11.54 | Freq out 1 actual value | *Real* | 0…16000 | Hz | 1 = 1 Hz |
| 11.55 | Freq out 1 source | *Analog src* | - | - | 1 = 1 |
| 11.58 | Freq out 1 src min | *Real* | -32768.000…32767.000 | - | 1 = 1 |
| 11.59 | Freq out 1 src max | *Real* | -32768.000…32767.000 | - | 1 = 1 |
| 11.60 | Freq out 1 at src min | *Real* | 0…16000 | Hz | 1 = 1 Hz |
| 11.61 | Freq out 1 at src max | *Real* | 0…16000 | Hz | 1 = 1 Hz |
| **12 Standard AI** | | | | | |
| 12.02 | AI force selection | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 12.03 | AI supervision function | *List* | 0…4 | - | 1 = 1 |
| 12.04 | AI supervision selection | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 12.11 | AI1 actual value | *Real* | 0.000…22.000 mA or 0.000…11.000 V | mA or V | 1000 = 1 unit |
| 12.12 | AI1 scaled value | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 12.13 | AI1 forced value | *Real* | 0.000…20.000 mA or 0.000…10.000 V | mA or V | 1000 = 1 unit |
| 12.15 | AI1 unit selection | *List* | 2, 10 | - | 1 = 1 |
| 12.16 | AI1 filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 12.17 | AI1 min | *Real* | 0.000…20.000 mA or 0.000…10.000 V | mA or V | 1000 = 1 unit |
| 12.18 | AI1 max | *Real* | 0.000…22.000 mA or 0.000…11.000 V | mA or V | 1000 = 1 unit |
| 12.19 | AI1 scaled at AI1 min | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 12.20 | AI1 scaled at AI1 max | *Real* | -32768.000…32767.000 | - | 1000 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 12.21 | AI2 actual value | *Real* | 0.000…22.000 mA or 0.000…11.000 V | mA or V | 1000 = 1 unit |
| 12.22 | AI2 scaled value | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 12.23 | AI2 forced value | *Real* | 0.000…20.000 mA or 0.000…10.000 V | mA or V | 1000 = 1 unit |
| 12.25 | AI2 unit selection | *List* | 2, 10 | - | 1 = 1 |
| 12.26 | AI2 filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 12.27 | AI2 min | *Real* | 0.000…20.000 mA or 0.000…10.000 V | mA or V | 1000 = 1 unit |
| 12.28 | AI2 max | *Real* | 0.000…22.000 mA or 0.000…11.000 V | mA or V | 1000 = 1 unit |
| 12.29 | AI2 scaled at AI2 min | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 12.30 | AI2 scaled at AI2 max | *Real* | -32768.000…32767.000 | - | 1000 = 1 |
| 12.101 | AI1 percent value | *Real* | 0.00…100.00 | % | 100 = 1% |
| 12.102 | AI2 percent value | *Real* | 0.00…100.00 | % | 100 = 1% |
| **13 Standard AO** | | | | | |
| 13.02 | AO force selection | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 13.11 | AO1 actual value | *Real* | 0.000…22.000 or 0.000…11000 V | mA | 1000 = 1 mA |
| 13.12 | AO1 source | *Analog src* | - | - | 1 = 1 |
| 13.13 | AO1 forced value | *Real* | 0.000…22.000 or 0.000…11000 V | mA | 1000 = 1 mA |
| 13.15 | AO1 unit selection | *List* | 2, 10 | - | 1 = 1 |
| 13.16 | AO1 filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 13.17 | AO1 source min | *Real* | -32768.0…32767.0 | - | 10 = 1 |
| 13.18 | AO1 source max | *Real* | -32768.0…32767.0 | - | 10 = 1 |
| 13.19 | AO1 out at AO1 src min | *Real* | 0.000…22.000 or 0.000…11000 V | mA | 1000 = 1 mA |
| 13.20 | AO1 out at AO1 src max | *Real* | 0.000…22.000 or 0.000…11000 V | mA | 1000 = 1 mA |
| 13.21 | AO2 actual value | *Real* | 0.000…22.000 | mA | 1000 = 1 mA |
| 13.22 | AO2 source | *Analog src* | - | - | 1 = 1 |
| 13.23 | AO2 forced value | *Real* | 0.000…22.000 | mA | 1000 = 1 mA |
| 13.26 | AO2 filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 13.27 | AO2 source min | *Real* | -32768.0…32767.0 | - | 10 = 1 |
| 13.28 | AO2 source max | *Real* | -32768.0…32767.0 | - | 10 = 1 |
| 13.29 | AO2 out at AO2 src min | *Real* | 0.000…22.000 | mA | 1000 = 1 mA |
| 13.30 | AO2 out at AO2 src max | *Real* | 0.000…22.000 | mA | 1000 = 1 mA |
| 13.91 | AO1 data storage | *Real* | -327.68…327.67 | - | 100 = 1 |
| 13.92 | AO2 data storage | *Real* | -327.68…327.67 | - | 100 = 1 |
| **19 Operation mode** | | | | | |
| 19.01 | Actual operation mode | *List* | 1…6, 10, 20 | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 19.11 | Ext1/Ext2 selection | *Binary src* | - | - | 1 = 1 |
| 19.18 | HAND/OFF disable source | *Binary src* | - | - | 1 = 1 |
| 19.19 | HAND/OFF disable action | *List* | 0…2 | - | 1 = 1 |
| **20 Start/stop/direction** | | | | | |
| 20.01 | Ext1 commands | *List* | 0…6, 11…12, 14 | - | 1 = 1 |
| 20.02 | Ext1 start trigger type | *List* | 0…1 | - | 1 = 1 |
| 20.03 | Ext1 in1 source | *Binary src* | - | - | 1 = 1 |
| 20.04 | Ext1 in2 source | *Binary src* | - | - | 1 = 1 |
| 20.05 | Ext1 in3 source | *Binary src* | - | - | 1 = 1 |
| 20.06 | Ext2 commands | *List* | 0…6, 11…12, 14 | - | 1 = 1 |
| 20.07 | Ext2 start trigger type | *List* | 0…1 | - | 1 = 1 |
| 20.08 | Ext2 in1 source | *Binary src* | - | - | 1 = 1 |
| 20.09 | Ext2 in2 source | *Binary src* | - | - | 1 = 1 |
| 20.10 | Ext2 in3 source | *Binary src* | - | - | 1 = 1 |
| 20.21 | Direction | *List* | 0…2 | - | 1 = 1 |
| 20.40 | Run permissive | *Binary src* | - | - | 1 = 1 |
| 20.41 | Start interlock 1 | *Binary src* | - | - | 1 = 1 |
| 20.42 | Start interlock 2 | *Binary src* | - | - | 1 = 1 |
| 20.43 | Start interlock 3 | *Binary src* | - | - | 1 = 1 |
| 20.44 | Start interlock 4 | *Binary src* | - | - | 1 = 1 |
| 20.45 | Start interlock stop mode | *Binary src* | - | - | 1 = 1 |
| 20.46 | Run permissive text | *Binary src* | - | - | 1 = 1 |
| 20.47 | Start interlock 1 text | *Binary src* | - | - | 1 = 1 |
| 20.48 | Start interlock 2 text | *Binary src* | - | - | 1 = 1 |
| 20.49 | Start interlock 3 text | *Binary src* | - | - | 1 = 1 |
| 20.50 | Start interlock 4 text | *Binary src* | - | - | 1 = 1 |
| 20.51 | Start interlock condition | *Binary src* | - | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| **21 Start/stop mode** | | | | | |
| 21.01 | Start mode | *List* | 0…2 | - | 1 = 1 |
| 21.02 | Magnetization time | *Real* | 0…10000 | ms | 1 = 1 ms |
| 21.03 | Stop mode | *List* | 0…2 | - | 1 = 1 |
| 21.04 | Emergency stop mode | *List* | 0…2 | - | 1 = 1 |
| 21.05 | Emergency stop source | *Binary src* | - | - | 1 = 1 |
| 21.06 | Zero speed limit | *Real* | 0.00…30000.00 | rpm | 100 = 1 rpm |
| 21.07 | Zero speed delay | *Real* | 0…30000 | ms | 1 = 1 ms |
| 21.08 | DC current control | *PB* | 0000b…0011b | - | 1 = 1 |
| 21.09 | DC hold speed | *Real* | 0.00…1000.00 | rpm | 100 = 1 rpm |
| 21.10 | DC current reference | *Real* | 0.0…100.0 | % | 10 = 1% |
| 21.11 | Post magnetization time | *Real* | 0…3000 | s | 1 = 1 s |
| 21.14 | Pre-heating input source | *Binary src* | - | - | 1 = 1 |
| 21.15 | Pre-heating time delay | *Real* | 0…3000 | s | 1 = 1 s |
| 21.16 | Pre-heating current | *Real* | 0.0…30.0 | % | 10 = 1% |
| 21.18 | Auto restart time | *Real* | 0.0, 0.1…10.0 | s | 10 = 1 s |
| 21.19 | Scalar start mode | *List* | 0…6 | - | 1 = 1 |
| 21.21 | DC hold frequency | *Real* | 0.00…1000.00 | Hz | 100 = 1 Hz |
| 21.22 | Start delay | *Real* | 0.00…60.00 | s | 100 = 1 s |
| 21.23 | Smooth start | *Real* | 0…2 | - | 1 = 1 |
| 21.24 | Smooth start current | *Real* | 10.0…100.0 | % | 100 = 1% |
| 21.25 | Smooth start speed | *Real* | 2.0…100.0 | % | 100 = 1% |
| 21.26 | Torque boost current | *Real* | 15.0…300.0 | % | 100 = 1% |
| 21.30 | Speed compensated stop mode | *Real* | 0…3 | - | 1 = 1 |
| 21.31 | Speed comp stop delay | *Real* | 0.00…1000.00 | s | 100 = 1 s |
| 21.32 | Speed comp stop threshold | *Real* | 0…100 | % | 1 = 1% |
| 21.34 | Force auto restart | *List* | 0…1 | - | 1 = 1 |
| 21.35 | Preheating power | *Real* | 0.00 … 10.00 | kW | 100 = 1 |
| 21.36 | Preheating unit | *List* | 0…1 | - | 1 = 1 |
| **22 Speed reference selection** | | | | | |
| 22.01 | Speed ref unlimited | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.11 | Ext1 speed ref1 | *Analog src* | - | - | 1 = 1 |
| 22.12 | Ext1 speed ref2 | *Analog src* | - | - | 1 = 1 |
| 22.13 | Ext1 speed function | *List* | 0…5 | - | 1 = 1 |
| 22.18 | Ext2 speed ref1 | *Analog src* | - | - | 1 = 1 |
| 22.19 | Ext2 speed ref2 | *Analog src* | - | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 22.20 | Ext2 speed function | *List* | 0…5 | - | 1 = 1 |
| 22.21 | Constant speed function | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 22.22 | Constant speed sel1 | *Binary src* | - | - | 1 = 1 |
| 22.23 | Constant speed sel2 | *Binary src* | - | - | 1 = 1 |
| 22.24 | Constant speed sel3 | *Binary src* | - | - | 1 = 1 |
| 22.26 | Constant speed 1 | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.27 | Constant speed 2 | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.28 | Constant speed 3 | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.29 | Constant speed 4 | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.30 | Constant speed 5 | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.31 | Constant speed 6 | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.32 | Constant speed 7 | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.41 | Speed ref safe | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.51 | Critical speed function | *PB* | 00b…11b | - | 1 = 1 |
| 22.52 | Critical speed 1 low | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.53 | Critical speed 1 high | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.54 | Critical speed 2 low | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.55 | Critical speed 2 high | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.56 | Critical speed 3 low | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.57 | Critical speed 3 high | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.71 | Motor potentiometer function | *List* | 0…3 | - | 1 = 1 |
| 22.72 | Motor potentiometer initial value | *Real* | -32768.00…32767.00 | - | 100 = 1 |
| 22.73 | Motor potentiometer up source | *Binary src* | - | - | 1 = 1 |
| 22.74 | Motor potentiometer down source | *Binary src* | - | - | 1 = 1 |
| 22.75 | Motor potentiometer ramp time | *Real* | 0.0…3600.0 | s | 10 = 1 s |
| 22.76 | Motor potentiometer min value | *Real* | -32768.00…32767.00 | - | 100 = 1 |
| 22.77 | Motor potentiometer max value | *Real* | -32768.00…32767.00 | - | 100 = 1 |
| 22.80 | Motor potentiometer ref act | *Real* | -32768.00…32767.00 | - | 100 = 1 |
| 22.86 | Speed reference act 6 | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 22.87 | Speed reference act 7 | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| **23 Speed reference ramp** | | | | | |
| 23.01 | Speed ref ramp input | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 23.02 | Speed ref ramp output | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 23.11 | Ramp set selection | *Binary src* | - | - | 1 = 1 |
| 23.12 | Acceleration time 1 | *Real* | 0.000…1800.000 | s | 1000 = 1 s |
| 23.13 | Deceleration time 1 | *Real* | 0.000…1800.000 | s | 1000 = 1 s |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 23.14 | Acceleration time 2 | *Real* | 0.000…1800.000 | s | 1000 = 1 s |
| 23.15 | Deceleration time 2 | *Real* | 0.000…1800.000 | s | 1000 = 1 s |
| 23.23 | Emergency stop time | *Real* | 0.000…1800.000 | s | 1000 = 1 s |
| 23.28 | Variable slope enable | *List* | 0…1 | - | 1 = 1 |
| 23.29 | Variable slope rate | *Real* | 2…30000 | ms | 1 = 1 ms |
| **24 Speed reference conditioning** | | | | | |
| 24.01 | Used speed reference | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 24.02 | Used speed feedback | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 24.03 | Speed error filtered | *Real* | -30000.0…30000.0 | rpm | 100 = 1 rpm |
| 24.04 | Speed error inverted | *Real* | -30000.0…30000.0 | rpm | 100 = 1 rpm |
| 24.11 | Speed correction | *Real* | -10000.00…10000.00 | rpm | 100 = 1 rpm |
| 24.12 | Speed error filter time | *Real* | 0…10000 | ms | 1 = 1 ms |
| **25 Speed control** | | | | | |
| 25.01 | Torque reference speed control | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 25.02 | Speed proportional gain | *Real* | 0.00…250.00 | - | 100 = 1 |
| 25.03 | Speed integration time | *Real* | 0.00…1000.00 | s | 100 = 1 s |
| 25.04 | Speed derivation time | *Real* | 0.000…10.000 | s | 1000 = 1 s |
| 25.05 | Derivation filter time | *Real* | 0…10000 | ms | 1 = 1 ms |
| 25.06 | Acc comp derivation time | *Real* | 0.00…1000.00 | s | 100 = 1 s |
| 25.07 | Acc comp filter time | *Real* | 0.0…1000.0 | ms | 10 = 1 ms |
| 25.15 | Proportional gain em stop | *Real* | 1.00…250.00 | - | 100 = 1 |
| 25.53 | Torque prop reference | *Real* | -30000.0…30000.0 | % | 10 = 1% |
| 25.54 | Torque integral reference | *Real* | -30000.0…30000.0 | % | 10 = 1% |
| 25.55 | Torque deriv reference | *Real* | -30000.0…30000.0 | % | 10 = 1% |
| 25.56 | Torque acc compensation | *Real* | -30000.0…30000.0 | % | 10 = 1% |
| **28 Frequency reference chain** | | | | | |
| 28.01 | Frequency ref ramp input | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.02 | Frequency ref ramp output | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.11 | Ext1 frequency ref1 | *Analog src* | - | - | 1 = 1 |
| 28.12 | Ext1 frequency ref2 | *Analog src* | - | - | 1 = 1 |
| 28.13 | Ext1 frequency function | *List* | 0…5 | - | 1 = 1 |
| 28.15 | Ext2 frequency ref1 | *Analog src* | - | - | 1 = 1 |
| 28.16 | Ext2 frequency ref2 | *Analog src* | - | - | 1 = 1 |
| 28.17 | Ext2 frequency function | *List* | 0…5 | - | 1 = 1 |
| 28.21 | Constant frequency function | *PB* | 00b…11b | - | 1 = 1 |
| 28.22 | Constant frequency sel1 | *Binary src* | - | - | 1 = 1 |

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| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 28.23 | Constant frequency sel2 | *Binary src* | - | - | 1 = 1 |
| 28.24 | Constant frequency sel3 | *Binary src* | - | - | 1 = 1 |
| 28.26 | Constant frequency 1 | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.27 | Constant frequency 2 | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.28 | Constant frequency 3 | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.29 | Constant frequency 4 | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.30 | Constant frequency 5 | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.31 | Constant frequency 6 | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.32 | Constant frequency 7 | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.41 | Frequency ref safe | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.51 | Critical frequency function | *PB* | 00b…11b | - | 1 = 1 |
| 28.52 | Critical frequency 1 low | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.53 | Critical frequency 1 high | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.54 | Critical frequency 2 low | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.55 | Critical frequency 2 high | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.56 | Critical frequency 3 low | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.57 | Critical frequency 3 high | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.71 | Freq ramp set selection | *Binary src* | - | - | 1 = 1 |
| 28.72 | Freq acceleration time 1 | *Real* | 0.000…1800.000 | s | 1000 = 1 s |
| 28.73 | Freq deceleration time 1 | *Real* | 0.000…1800.000 | s | 1000 = 1 s |
| 28.74 | Freq acceleration time 2 | *Real* | 0.000…1800.000 | s | 1000 = 1 s |
| 28.75 | Freq deceleration time 2 | *Real* | 0.000…1800.000 | s | 1000 = 1 s |
| 28.76 | Freq ramp in zero source | *Binary src* | - | - | 1 = 1 |
| 28.92 | Frequency ref act 3 | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.96 | Frequency ref act 7 | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 28.97 | Frequency ref unlimited | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| **30 Limits** | | | | | |
| 30.01 | Limit word 1 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 30.02 | Torque limit status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 30.11 | Minimum speed | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 30.12 | Maximum speed | *Real* | -30000.00…30000.00 | rpm | 100 = 1 rpm |
| 30.13 | Minimum frequency | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 30.14 | Maximum frequency | *Real* | -500.00…500.00 | Hz | 100 = 1 Hz |
| 30.17 | Maximum current | *Real* | 0.00…30000.00 | A | 100 = 1 A |
| 30.18 | Torq lim sel | *Binary src* | - | - | 1 = 1 |
| 30.19 | Minimum torque 1 | *Real* | -1600.0…0.0 | % | 10 = 1% |
| 30.20 | Maximum torque 1 | *Real* | 0.0…1600.0 | % | 10 = 1% |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 30.21 | Min torque 2 source | *Analog src* | - | - | 1 = 1 |
| 30.22 | Max torque 2 source | *Analog src* | - | - | 1 = 1 |
| 30.23 | Minimum torque 2 | *Real* | -1600.0…0.0 | % | 10 = 1% |
| 30.24 | Maximum torque 2 | *Real* | 0.0…1600.0 | % | 10 = 1% |
| 30.26 | Power motoring limit | *Real* | 0.00…600.00 | % | 100 = 1% |
| 30.27 | Power generating limit | *Real* | -600.00…0.00 | % | 100 = 1% |
| 30.30 | Overvoltage control | *List* | 0…1 | - | 1 = 1 |
| 30.31 | Undervoltage control | *List* | 0…1 | - | 1 = 1 |
| 30.35 | Thermal current limitation | *List* | 0…1 | - | 1 = 1 |
| 30.36 | Speed limit selection | *Binary src* | - | - | 1 = 1 |
| 30.37 | Minimum speed source | *Analog src* | - | - | 1 = 1 |
| 30.38 | Maximum speed source | *Analog src* | - | - | 1 = 1 |
| **31 Fault functions** | | | | | |
| 31.01 | External event 1 source | *Binary src* | - | - | 1 = 1 |
| 31.02 | External event 1 type | *List* | 0…1 | - | 1 = 1 |
| 31.03 | External event 2 source | *Binary src* | - | - | 1 = 1 |
| 31.04 | External event 2 type | *List* | 0…1 | - | 1 = 1 |
| 31.05 | External event 3 source | *Binary src* | - | - | 1 = 1 |
| 31.06 | External event 3 type | *List* | 0…1 | - | 1 = 1 |
| 31.07 | External event 4 source | *Binary src* | - | - | 1 = 1 |
| 31.08 | External event 4 type | *List* | 0…1 | - | 1 = 1 |
| 31.09 | External event 5 source | *Binary src* | - | - | 1 = 1 |
| 31.10 | External event 5 type | *List* | 0…1 | - | 1 = 1 |
| 31.11 | Fault reset selection | *Binary src* | - | - | 1 = 1 |
| 31.12 | Autoreset selection | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 31.13 | Selectable fault | *Real* | 0000h…FFFFh | - | 1 = 1 |
| 31.14 | Number of trials | *Real* | 0…5 | - | 1 = 1 |
| 31.15 | Total trials time | *Real* | 1.0…600.0 | s | 10 = 1 s |
| 31.16 | Delay time | *Real* | 0.0…120.0 | s | 10 = 1 s |
| 31.19 | Motor phase loss | *List* | 0…1 | - | 1 = 1 |
| 31.20 | Earth fault | *List* | 0…2 | - | 1 = 1 |
| 31.21 | Supply phase loss | *List* | 0…1 | - | 1 = 1 |
| 31.22 | STO indication run/stop | *List* | 0… | - | 1 = 1 |
| 31.23 | Wiring or earth fault | *List* | 0…1 | - | 1 = 1 |

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| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 31.24 | Stall function | *List* | 0…2 | - | 1 = 1 |
| 31.25 | Stall current limit | *Real* | 0.0…1600.0 | % | 10 = 1% |
| 31.26 | Stall speed limit | *Real* | 0.00…10000.00 | rpm | 100 = 1 rpm |
| 31.27 | Stall frequency limit | *Real* | 0.00…1000.00 | Hz | 100 = 1 Hz |
| 31.28 | Stall time | *Real* | 0…3600 | s | 1 = 1 s |
| 31.30 | Overspeed trip margin | *Real* | 0.00…10000.00 | rpm | 100 = 1 rpm |
| 31.31 | Frequency trip margin | *Real* | 0.00…10000.00 | Hz | 100 = 1 Hz |
| 31.32 | Emergency ramp supervision | *Real* | 0…300 | % | 1 = 1% |
| 31.33 | Emergency ramp supervision delay | *Real* | 0…100 | s | 1 = 1 s |
| **32 Supervision** | | | | | |
| 32.01 | Supervision status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 32.05 | Supervision 1 function | *List* | 0…7 | - | 1 = 1 |
| 32.06 | Supervision 1 action | *List* | 0…3 | - | 1 = 1 |
| 32.07 | Supervision 1 signal | *Analog src* | - | - | 1 = 1 |
| 32.08 | Supervision 1 filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 32.09 | Supervision 1 low | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.10 | Supervision 1 high | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.11 | Supervision 1 hysteresis | *Real* | 0.00…100000.00 | - | 100 = 1 |
| 32.15 | Supervision 2 function | *List* | 0…7 | - | 1 = 1 |
| 32.16 | Supervision 2 action | *List* | 0…3 | - | 1 = 1 |
| 32.17 | Supervision 2 signal | *Analog src* | - | - | 1 = 1 |
| 32.18 | Supervision 2 filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 32.19 | Supervision 2 low | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.20 | Supervision 2 high | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.21 | Supervision 2 hysteresis | *Real* | 0.00…100000.00 | - | 100 = 1 |
| 32.25 | Supervision 3 function | *List* | 0…7 | - | 1 = 1 |
| 32.26 | Supervision 3 action | *List* | 0…3 | - | 1 = 17 |
| 32.27 | Supervision 3 signal | *Analog src* | - | - | 1 = 1 |
| 32.28 | Supervision 3 filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 32.29 | Supervision 3 low | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.30 | Supervision 3 high | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.31 | Supervision 3 hysteresis | *Real* | 0.00…100000.00 | - | 100 = 1 |
| 32.35 | Supervision 4 function | *List* | 0…7 | - | 1 = 1 |
| 32.36 | Supervision 4 action | *List* | 0…3 | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 32.37 | Supervision 4 signal | *Analog src* | - | - | 1 = 1 |
| 32.38 | Supervision 4 filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 32.39 | Supervision 4 low | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.40 | Supervision 4 high | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.41 | Supervision 4 hysteresis | *Real* | 0.00…100000.00 | - | 100 = 1 |
| 32.45 | Supervision 5 function | *List* | 0…7 | - | 1 = 1 |
| 32.46 | Supervision 5 action | *List* | 0…3 | - | 1 = 1 |
| 32.47 | Supervision 5 signal | *Analog src* | - | - | 1 = 1 |
| 32.48 | Supervision 5 filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 32.49 | Supervision 5 low | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.50 | Supervision 5 high | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.51 | Supervision 5 hysteresis | *Real* | 0.00…100000.00 | - | 100 = 1 |
| 32.55 | Supervision 6 function | *List* | 0…7 | - | 1 = 1 |
| 32.56 | Supervision 6 action | *List* | 0…3 | - | 1 = 1 |
| 32.57 | Supervision 6 signal | *Analog src* | - | - | 1 = 1 |
| 32.58 | Supervision 6 filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 32.59 | Supervision 6 low | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.60 | Supervision 6 high | *Real* | -21474836.00… 21474836.00 | - | 100 = 1 |
| 32.61 | Supervision 6 hysteresis | *Real* | 0.00…100000.00 | - | 100 = 1 |
| **34 Timed functions** | | | | | |
| 34.01 | Timed functions status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.02 | Timer status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.04 | Season/exception day status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.10 | Timed functions enable | *Binary src* | - | - | 1 = 1 |
| 34.11 | Timer 1 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.12 | Timer 1 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.13 | Timer 1 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.14 | Timer 2 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.15 | Timer 2 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.16 | Timer 2 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.17 | Timer 3 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.18 | Timer 3 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.19 | Timer 3 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.20 | Timer 4 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 34.21 | Timer 4 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.22 | Timer 4 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.23 | Timer 5 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.24 | Timer 5 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.25 | Timer 5 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.26 | Timer 6 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.27 | Timer 6 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.28 | Timer 6 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.29 | Timer 7 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.30 | Timer 7 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.31 | Timer 7 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.32 | Timer 8 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.33 | Timer 8 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.34 | Timer 8 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.35 | Timer 9 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.36 | Timer 9 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.37 | Timer 9 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.38 | Timer 10 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.39 | Timer 10 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.40 | Timer 10 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.41 | Timer 11 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.42 | Timer 11 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.43 | Timer 11 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.44 | Timer 12 configuration | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.45 | Timer 12 start time | Time | 00:00:00…23:59:59 | s | 1 = 1 s |
| 34.46 | Timer 12 duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| 34.60 | Season 1 start date | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.61 | Season 2 start date | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.62 | Season 3 start date | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.63 | Season 4 start date | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.70 | Number of active exceptions | *Real* | 0…16 | - | 1 = 1 |
| 34.71 | Exception types | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.72 | Exception 1 start | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.73 | Exception 1 length | *Real* | 0…60 | d | 1 = 1 d |
| 34.74 | Exception 2 start | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.75 | Exception 2 length | *Real* | 0…60 | d | 1 = 1 d |
| 34.76 | Exception 3 start | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.77 | Exception 3 length | *Real* | 0…60 | d | 1 = 1 d |
| 34.78 | Exception day 4 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.79 | Exception day 5 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.80 | Exception day 6 | Date | 01.01…31.12 | d | 1 = 1 d |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 34.81 | Exception day 7 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.82 | Exception day 8 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.83 | Exception day 9 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.84 | Exception day 10 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.85 | Exception day 11 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.86 | Exception day 12 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.87 | Exception day 13 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.88 | Exception day 14 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.89 | Exception day 15 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.90 | Exception day 16 | Date | 01.01…31.12 | d | 1 = 1 d |
| 34.100 | Timed function 1 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.101 | Timed function 2 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.102 | Timed function 3 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.110 | Boost time function | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 34.111 | Boost time activation source | *Binary src* | - | - | 1 = 1 |
| 34.112 | Boost time duration | Duration | 00 00:00…07 00:00 | min | 1 = 1 min |
| **35 Motor thermal protection** | | | | | |
| 35.01 | Motor estimated temperature | *Real* | -60…1000 °C or -76…1832 °F | °C or °F | 1 = 1 ° |
| 35.02 | Measured temperature 1 | *Real* | -60…5000 °C or -76…9032 °F, 0 ohm or [*35.12*] ohm | °C, °F or ohm | 1 = 1 unit |
| 35.03 | Measured temperature 2 | *Real* | -60…5000 °C or -76…9032 °F, 0 ohm or [*35.12*] ohm | °C, °F or ohm | 1 = 1 unit |
| 35.05 | Motor overload level | *Real* | 0.0…100.0% | % | 100 = 1% |
| 35.11 | Temperature 1 source | *List* | 0…2, 5…8, 11…16, 19, 21, 22 | - | 1 = 1 |
| 35.12 | Temperature 1 fault limit | *Real* | -60…5000 °C or -76…9032 °F | °C, °F or ohm | 1 = 1 unit |
| 35.13 | Temperature 1 warning limit | *Real* | -60…5000 °C or -76…9032 °F | °C, °F or ohm | 1 = 1 unit |
| 35.14 | Temperature 1 AI source | *Analog src* | - | - | 1 = 1 |
| 35.21 | Temperature 2 source | *List* | 0…2, 5…8, 11…16, 19 | - | 1 = 1 |
| 35.22 | Temperature 2 fault limit | *Real* | -60…5000 °C or -76…9032 °F | °C, °F or ohm | 1 = 1 unit |
| 35.23 | Temperature 2 warning limit | *Real* | -60…5000 °C or -76…9032 °F | °C, °F or ohm | 1 = 1 unit |
| 35.24 | Temperature 2 AI source | *Analog src* | - | - | 1 = 1 |
| 35.50 | Motor ambient temperature | *Real* | -60…100 °C or -76 … 212 °F | °C | 1 = 1 ° |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 35.51 | Motor load curve | *Real* | 50…150 | % | 1 = 1% |
| 35.52 | Zero speed load | *Real* | 25…150 | % | 1 = 1% |
| 35.53 | Break point | *Real* | 1.00 … 500.00 | Hz | 100 = 1 Hz |
| 35.54 | Motor nominal temperature rise | *Real* | 0…300 °C or 32…572 °F | °C or °F | 1 = 1 ° |
| 35.55 | Motor thermal time constant | *Real* | 100…10000 | s | 1 = 1 s |
| 35.56 | Motor overload action | *List* | 0…2 | - | 1 = 1 |
| 35.57 | Motor overload class | *List* | 0…5 | - | 1 = 1 |
| **36 Load analyzer** | | | | | |
| 36.01 | PVL signal source | *Analog src* | - | - | 1 = 1 |
| 36.02 | PVL filter time | *Real* | 0.00…120.00 | s | 100 = 1 s |
| 36.06 | AL2 signal source | *Analog src* | - | - | 1 = 1 |
| 36.07 | AL2 signal scaling | *Real* | 0.00…32767.00 | - | 100 = 1 |
| 36.09 | Reset loggers | *List* | 0…3 | - | 1 = 1 |
| 36.10 | PVL peak value | *Real* | -32768.00…32767.00 | - | 100 = 1 |
| 36.11 | PVL peak date | *Data* | - | - | 1 = 1 |
| 36.12 | PVL peak time | *Data* | - | - | 1 = 1 |
| 36.13 | PVL current at peak | *Real* | -32768.00…32767.00 | A | 100 = 1 A |
| 36.14 | PVL DC voltage at peak | *Real* | 0.00…2000.00 | V | 100 = 1 V |
| 36.15 | PVL speed at peak | *Real* | -30000.00… 30000.00 | rpm | 100 = 1 rpm |
| 36.16 | PVL reset date | *Data* | - | - | 1 = 1 |
| 36.17 | PVL reset time | *Data* | - | - | 1 = 1 |
| 36.20 | AL1 0 to 10% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.21 | AL1 10 to 20% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.22 | AL1 20 to 30% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.23 | AL1 30 to 40% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.24 | AL1 40 to 50% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.25 | AL1 50 to 60% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.26 | AL1 60 to 70% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.27 | AL1 70 to 80% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.28 | AL1 80 to 90% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.29 | AL1 over 90% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.40 | AL2 0 to 10% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.41 | AL2 10 to 20% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.42 | AL2 20 to 30% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.43 | AL2 30 to 40% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.44 | AL2 40 to 50% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.45 | AL2 50 to 60% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.46 | AL2 60 to 70% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.47 | AL2 70 to 80% | *Real* | 0.00…100.00 | % | 100 = 1% |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 36.48 | AL2 80 to 90% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.49 | AL2 over 90% | *Real* | 0.00…100.00 | % | 100 = 1% |
| 36.50 | AL2 reset date | *Data* | - | - | 1 = 1 |
| 36.51 | AL2 reset time | *Data* | - | - | 1 = 1 |
| **37 User load curve** | | | | | |
| 37.01 | ULC output status word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 37.02 | ULC supervision signal | *Analog src* | - | - | 1 = 1 |
| 37.03 | ULC overload actions | *List* | 0…3 | - | 1 = 1 |
| 37.04 | ULC underload actions | *List* | 0…3 | - | 1 = 1 |
| 37.11 | ULC speed table point 1 | *Real* | -30000.0…30000.0 | rpm | 10 = 1 rpm |
| 37.12 | ULC speed table point 2 | *Real* | -30000.0…30000.0 | rpm | 10 = 1 rpm |
| 37.13 | ULC speed table point 3 | *Real* | -30000.0…30000.0 | rpm | 10 = 1 rpm |
| 37.14 | ULC speed table point 4 | *Real* | -30000.0…30000.0 | rpm | 10 = 1 rpm |
| 37.15 | ULC speed table point 5 | *Real* | -30000.0…30000.0 | rpm | 10 = 1 rpm |
| 37.16 | ULC frequency table point 1 | *Real* | -500.0…500.0 | Hz | 10 = 1 Hz |
| 37.17 | ULC frequency table point 2 | *Real* | -500.0…500.0 | Hz | 10 = 1 Hz |
| 37.18 | ULC frequency table point 3 | *Real* | -500.0…500.0 | Hz | 10 = 1 Hz |
| 37.19 | ULC frequency table point 4 | *Real* | -500.0…500.0 | Hz | 10 = 1 Hz |
| 37.20 | ULC frequency table point 5 | *Real* | -500.0…500.0 | Hz | 10 = 1 Hz |
| 37.21 | ULC underload point 1 | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 37.22 | ULC underload point 2 | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 37.23 | ULC underload point 3 | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 37.24 | ULC underload point 4 | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 37.25 | ULC underload point 5 | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 37.31 | ULC overload point 1 | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 37.32 | ULC overload point 2 | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 37.33 | ULC overload point 3 | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 37.34 | ULC overload point 4 | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 37.35 | ULC overload point 5 | *Real* | -1600.0…1600.0 | % | 10 = 1% |
| 37.41 | ULC overload timer | *Real* | 0.0…10000.0 | s | 10 = 1 s |
| 37.42 | ULC underload timer | *Real* | 0.0…10000.0 | s | 10 = 1 s |
| **40 Process PID set 1** | | | | | |
| 40.01 | Process PID output actual | *Real* | -200000.00…200000.00 | % | 100 = 1 % |
| 40.02 | Process PID feedback actual | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.03 | Process PID setpoint actual | *Real* | -200000…200000 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.04 | Process PID deviation actual | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.06 | Process PID status word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 40.07 | Process PID operation mode | *List* | 0…2 | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 40.08 | Set 1 feedback 1 source | *Analog src* | - | - | 1 = 1 |
| 40.09 | Set 1 feedback 2 source | *Analog src* | - | - | 1 = 1 |
| 40.10 | Set 1 feedback function | *List* | 0…13 | - | 1 = 1 |
| 40.11 | Set 1 feedback filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 40.14 | Set 1 setpoint scaling | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.15 | Set 1 output scaling | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.16 | Set 1 setpoint 1 source | *Analog src* | - | - | 1 = 1 |
| 40.17 | Set 1 setpoint 2 source | *Analog src* | - | - | 1 = 1 |
| 40.18 | Set 1 setpoint function | *List* | 0…13 | - | 1 = 1 |
| 40.19 | Set 1 internal setpoint sel1 | *Binary src* | - | - | 1 = 1 |
| 40.20 | Set 1 internal setpoint sel2 | *Binary src* | - | - | 1 = 1 |
| 40.21 | Set 1 internal setpoint 1 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.22 | Set 1 internal setpoint 2 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.23 | Set 1 internal setpoint 3 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.24 | Set 1 internal setpoint 0 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.26 | Set 1 setpoint min | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.27 | Set 1 setpoint max | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.28 | Set 1 setpoint increase time | *Real* | 0.0…1800.0 | s | 10 = 1 s |
| 40.29 | Set 1 setpoint decrease time | *Real* | 0.0…1800.0 | s | 10 = 1 s |
| 40.30 | Set 1 setpoint freeze enable | *Binary src* | - | - | 1 = 1 |
| 40.31 | Set 1 deviation inversion | *Binary src* | - | - | 1 = 1 |
| 40.32 | Set 1 gain | *Real* | 0.10…100.00 | - | 100 = 1 |
| 40.33 | Set 1 integration time | *Real* | 0.0…9999.0 | s | 10 = 1 s |
| 40.34 | Set 1 derivation time | *Real* | 0.000…10.000 | s | 1000 = 1 s |
| 40.35 | Set 1 derivation filter time | *Real* | 0.0…10.0 | s | 10 = 1 s |
| 40.36 | Set 1 output min | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.37 | Set 1 output max | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.38 | Set 1 output freeze enable | *Binary src* | - | - | 1 = 1 |
| 40.39 | Set 1 deadband range | *Real* | 0……200000.0 | - | 10 = 1 |
| 40.40 | Set 1 deadband delay | *Real* | 0.0 … 3600.0 | s | 10 = 1 s |
| 40.43 | Set 1 sleep level | *Real* | 0.0…200000.0 | - | 10 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 40.44 | Set 1 sleep delay | *Real* | 0.0…3600.0 | s | 10 = 1 s |
| 40.45 | Set 1 sleep boost time | *Real* | 0.0…3600.0 | s | 10 = 1 s |
| 40.46 | Set 1 sleep boost step | *Real* | 0.0…200000.0 | PID unit 1 | 10 = 1 PID unit 1 |
| 40.47 | Set 1 wake-up deviation | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.48 | Set 1 wake-up delay | *Real* | 0.00…60.00 | s | 100 = 1 s |
| 40.49 | Set 1 tracking mode | *Binary src* | - | - | 1 = 1 |
| 40.50 | Set 1 tracking ref selection | *Analog src* | - | - | 1 = 1 |
| 40.57 | PID set1/set2 selection | *Binary src* | - | - | 1 = 1 |
| 40.58 | Set 1 increase prevention | *Binary src* | - | - | 1 = 1 |
| 40.59 | Set 1 decrease prevention | *Binary src* | - | - | 1 = 1 |
| 40.60 | Set 1 PID activation source | *Binary src* | - | - | 1 = 1 |
| 40.61 | Setpoint scaling actual | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.62 | PID internal setpoint actual | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.70 | Compensated setpoint | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 40.71 | Set 1 compensation input source | *List* | 0, 2…4, 8, 10…12, 15…16, 19…20, 24 | - | 1 = 1 |
| 40.72 | Set 1 compensation input 1 | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.73 | Set 1 compensated output 1 | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.74 | Set 1 compensation input 2 | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.75 | Set 1 compensated output 2 | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.76 | Set 1 compensation non-linearity | *Real* | 0…100 | % | 1= 1% |
| 40.79 | Set 1 units | *List* | | - | 1 = 1 |
| 40.80 | Set 1 PID output min source | *List* | 0…1 | - | 1 = 1 |
| 40.81 | Set 1 PID output max source | *List* | 0…1 | - | 1 = 1 |
| 40.89 | Set 1 setpoint multiplier | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.90 | Set 1 feedback multiplier | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 40.91 | Feedback data storage | *Real* | -327.68…327.67 | - | 100 = 1 |
| 40.92 | Setpoint data storage | *Real* | -327.68…327.67 | - | 100 = 1 |
| 40.96 | Process PID output % | *Real* | -100.00…100.00 | % | 100 = 1% |
| 40.97 | Process PID feedback % | *Real* | -100.00…100.00 | % | 100 = 1% |
| 40.98 | Process PID setpoint % | *Real* | -100.00…100.00 | % | 100 = 1% |
| 40.99 | Process PID deviation % | *Real* | -100.00…100.00 | % | 100 = 1% |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| **41 Process PID set 2** | | | | | |
| 41.08 | Set 2 feedback 1 source | *Analog src* | - | - | 1 = 1 |
| 41.09 | Set 2 feedback 2 source | *Analog src* | - | - | 1 = 1 |
| 41.10 | Set 2 feedback function | *List* | 0…13 | - | 1 = 1 |
| 41.11 | Set 2 feedback filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 41.14 | Set 2 setpoint scaling | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 41.15 | Set 2 output scaling | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 41.16 | Set 2 setpoint 1 source | *Analog src* | - | - | 1 = 1 |
| 41.17 | Set 2 setpoint 2 source | *Analog src* | - | - | 1 = 1 |
| 41.18 | Set 2 setpoint function | *List* | 0…13 | - | 1 = 1 |
| 41.19 | Set 2 internal setpoint sel1 | *Binary src* | - | - | 1 = 1 |
| 41.20 | Set 2 internal setpoint sel2 | *Binary src* | - | - | 1 = 1 |
| 41.21 | Set 2 internal setpoint 1 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 41.22 | Set 2 internal setpoint 2 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 41.23 | Set 2 internal setpoint 3 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 41.24 | Set 2 internal setpoint 0 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 41.26 | Set 2 setpoint min | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 41.27 | Set 2 setpoint max | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 41.28 | Set 2 setpoint increase time | *Real* | 0.0…1800.0 | s | 10 = 1 s |
| 41.29 | Set 2 setpoint decrease time | *Real* | 0.0…1800.0 | s | 10 = 1 s |
| 41.30 | Set 2 setpoint freeze enable | *Binary src* | - | - | 1 = 1 |
| 41.31 | Set 2 deviation inversion | *Binary src* | - | - | 1 = 1 |
| 41.32 | Set 2 gain | *Real* | 0.10…100.00 | - | 100 = 1 |
| 41.33 | Set 2 integration time | *Real* | 0.0…9999.0 | s | 10 = 1 s |
| 41.34 | Set 2 derivation time | *Real* | 0.000…10.000 | s | 1000 = 1 s |
| 41.35 | Set 2 derivation filter time | *Real* | 0.0…10.0 | s | 10 = 1 s |
| 41.36 | Set 2 output min | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 41.37 | Set 2 output max | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 41.38 | Set 2 output freeze enable | *Binary src* | - | - | 1 = 1 |
| 41.39 | Set 2 deadband range | *Real* | 0……200000.0 | - | 10 = 1 |
| 41.40 | Set 2 deadband delay | *Real* | 0.0 … 3600.0 | s | 10 = 1 s |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 41.43 | Set 2 sleep level | *Real* | 0.0…200000.0 | - | 10 = 1 |
| 41.44 | Set 2 sleep delay | *Real* | 0.0…3600.0 | s | 10 = 1 s |
| 41.45 | Set 2 sleep boost time | *Real* | 0.0…3600.0 | s | 10 = 1 s |
| 41.46 | Set 2 sleep boost step | *Real* | 0.0…200000.0 | PID unit 1 | 10 = 1 PID unit 1 |
| 41.47 | Set 2 wake-up deviation | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 41.48 | Set 2 wake-up delay | *Real* | 0.00…60.00 | s | 100 = 1 s |
| 41.49 | Set 2 tracking mode | *Binary src* | - | - | 1 = 1 |
| 41.50 | Set 2 tracking ref selection | *Analog src* | - | - | 1 = 1 |
| 41.58 | Set 2 increase prevention | *Binary src* | - | - | 1 = 1 |
| 41.59 | Set 2 decrease prevention | *Binary src* | - | - | 1 = 1 |
| 41.60 | Set 2 PID activation source | *Binary src* | - | - | 1 = 1 |
| 41.71 | Set 2 compensation input source | *List* | 0, 2…4, 8, 10…12, 15…16, 19…20, 24 | - | 1 = 1 |
| 41.72 | Set 2 compensation input 1 | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 41.73 | Set 2 compensated output 1 | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 41.74 | Set 2 compensation input 2 | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 41.75 | Set 2 compensated output 2 | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 41.76 | Set 2 compensation non-linearity | *Real* | 0…100 | % | 1= 1% |
| 41.79 | Set 2 units | *List* | | - | 1 = 1 |
| 41.80 | Set 2 PID output min source | *List* | 0…1 | - | 1 = 1 |
| 41.81 | Set 2 PID output max source | *List* | 0…1 | - | 1 = 1 |
| 41.89 | Set 2 setpoint multiplier | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 41.90 | Set 2 feedback multiplier | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| **43 Brake chopper** | | | | | |
| 43.01 | Braking resistor temperature | *Real* | 0.0…120.0 | % | 10 = 1% |
| 43.06 | Brake chopper function | *List* | 0…3 | - | 1 = 1 |
| 43.07 | Brake chopper run enable | *Binary src* | - | - | 1 = 1 |
| 43.08 | Brake resistor thermal t | *Real* | 0…10000 | s | 1 = 1 s |
| 43.09 | Brake resistor Pmax cont | *Real* | 0.00…10000.00 | kW | 100 = 1 kW |
| 43.10 | Brake resistance | *Real* | 0.0…1000.0 | ohm | 10 = 1 ohm |
| 43.11 | Brake resistor fault limit | *Real* | 0…150 | % | 1 = 1% |
| 43.12 | Brake resistor warning limit | *Real* | 0…150 | % | 1 = 1% |
| **45 Energy efficiency** | | | | | |
| 45.01 | Saved GW hours | *Real* | 0…65535 | GWh | 1 = 1 GWh |
| 45.02 | Saved MW hours | *Real* | 0…999 | MWh | 1 = 1 MWh |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 45.03 | Saved kW hours | *Real* | 0.0…999.9 | kWh | 10 = 1 kWh |
| 45.04 | Saved energy | *Real* | 0.0…214748364.0 | kWh | 10 = 1 kWh |
| 45.05 | Saved money x1000 | *Real* | 0…4294967295 thousands | (defina-ble) | 1 = 1 currency unit |
| 45.06 | Saved money | *Real* | 0.00…999.99 | (defina-ble) | 100 = 1 currency unit |
| 45.07 | Saved amount | *Real* | 0.00…21474830.08 | (defina-ble) | 100 = 1 currency unit |
| 45.08 | CO2 reduction in kilotons | *Real* | 0…65535 | metric kiloton | 1 = 1 metric kiloton |
| 45.09 | CO2 reduction in tons | *Real* | 0.0…999.9 | metric ton | 10 = 1 metric ton |
| 45.10 | Total saved CO2 | *Real* | 0.0…214748300.8 | metric ton | 10 = 1 metric ton |
| 45.11 | Energy optimizer | *List* | 0…1 | - | 1 = 1 |
| 45.12 | Energy tariff 1 | *Real* | 0.000…4294966.296 | (defina-ble) | 1000 = 1 currency unit |
| 45.13 | Energy tariff 2 | *Real* | 0.000…4294966.296 | (defina-ble) | 1000 = 1 currency unit |
| 45.14 | Tariff selection | *Binary src* | - | - | 1 = 1 |
| 45.18 | CO2 conversion factor | *Real* | 0.000…65.535 | tn/ MWh | 1000 = 1 tn/MWh |
| 45.19 | Comparison power | *Real* | 0.00…10000000.00 | kW | 10 = 1 kW |
| 45.21 | Energy calculations reset | *List* | 0…1 | - | 1 = 1 |
| 45.24 | Hourly peak power value | *Real* | -3000.00 … 3000.00 | kW | 1 = 1 kW |
| 45.25 | Hourly peak power time | *Real* | | | N/A |
| 45.26 | Hourly total energy (resettable) | *Real* | -3000.00 … 3000.00 | kWh | 1 = 1 kWh |
| 45.27 | Daily peak power value (resettable) | *Real* | -3000.00 … 3000.00 | kW | 1 = 1 kW |
| 45.28 | Daily peak power time | *Real* | | | N/A |
| 45.29 | Daily total energy (resettable) | *Real* | -30000.00 … 30000.00 | kWh | 1 = 1 kWh |
| 45.30 | Last day total energy | *Real* | -30000.00 … 30000.00 | kWh | 1 = 1 kWh |
| 45.31 | Monthly peak power value (resettable) | *Real* | -3000.00 … 3000.00 | kW | 1 = 1 kW |
| 45.32 | Monthly peak power date | *Real* | | | N/A |
| 45.33 | Monthly peak power time | *Real* | | | N/A |
| 45.34 | Monthly total energy (resettable) | *Real* | -1000000.00 … 1000000.00 | kWh | 1 = 1 kWh |
| 45.35 | Last month total energy | *Real* | -1000000.00 … 1000000.00 | kWh | 1 = 1 kWh |
| 45.36 | Lifetime peak power value | *Real* | -3000.00 … 3000.00 | kW | 1 = 1 kW |
| 45.37 | Lifetime peak power date | *Real* | | | N/A |
| 45.38 | Lifetime peak power time | *Real* | | | N/A |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| **46 Monitoring/scaling settings** | | | | | |
| 46.01 | Speed scaling | *Real* | 0.00…30000.00 | rpm | 100 = 1 rpm |
| 46.02 | Frequency scaling | *Real* | 0.10…1000.00 | Hz | 100 = 1 Hz |
| 46.03 | Torque scaling | *Real* | 0.1…1000.0 | % | 10 = 1% |
| 46.04 | Power scaling | *Real* | 0.10…30000.00 | - | 10 = 1 |
| 46.05 | Current scaling | *Real* | 0…30000 | A | 1 = 1 A |
| 46.06 | Speed ref zero scaling | *Real* | 0.00 … 30000.00 | rpm | 100 = 1 rpm |
| 46.07 | Frequency ref zero scaling | *Real* | 0.00…1000.00 | Hz | 100 = 1 Hz |
| 46.11 | Filter time motor speed | *Real* | 2…20000 | ms | 1 = 1 ms |
| 46.12 | Filter time output frequency | *Real* | 2…20000 | ms | 1 = 1 ms |
| 46.13 | Filter time motor torque | *Real* | 2…20000 | ms | 1 = 1 ms |
| 46.14 | Filter time power | *Real* | 2…20000 | ms | 1 = 1 ms |
| 46.21 | At speed hysteresis | *Real* | 0.00…30000.00 | rpm | 100 = 1 rpm |
| 46.22 | At frequency hysteresis | *Real* | 0.00…1000.00 | Hz | 100 = 1 Hz |
| 46.31 | Above speed limit | *Real* | 0.00…30000.00 | rpm | 100 = 1 rpm |
| 46.32 | Above frequency limit | *Real* | 0.00…1000.00 | Hz | 100 = 1 Hz |
| 46.41 | kWh pulse scaling | *Real* | 0.001…1000.000 | kWh | 1000 = 1 kWh |
| 46.43 | Power decimals | *Real* | 0…3 | - | 1 = 1 |
| 46.44 | Current decimals | *Real* | 0…3 | - | 1 = 1 |
| **47 Data storage** | | | | | |
| 47.01 | Data storage 1 real32 | *Real* | -2147483.000… 2147483.000 | - | 1000 = 1 |
| 47.02 | Data storage 2 real32 | *Real* | -2147483.000… 2147483.000 | - | 1000 = 1 |
| 47.03 | Data storage 3 real32 | *Real* | -2147483.000… 2147483.000 | - | 1000 = 1 |
| 47.04 | Data storage 4 real32 | *Real* | -2147483.000… 2147483.000 | - | 1000 = 1 |
| 47.11 | Data storage 1 int32 | *Real* | -2147483648… 2147483647 | - | 1 = 1 |
| 47.12 | Data storage 2 int32 | *Real* | -2147483648… 2147483647 | - | 1 = 1 |
| 47.13 | Data storage 3 int32 | *Real* | -2147483648… 2147483647 | - | 1 = 1 |
| 47.14 | Data storage 4 int32 | *Real* | -2147483648… 2147483647 | - | 1 = 1 |
| 47.21 | Data storage 1 int16 | *Real* | -32768…32767 | - | 1 = 1 |
| 47.22 | Data storage 2 int16 | *Real* | -32768…32767 | - | 1 = 1 |
| 47.23 | Data storage 3 int16 | *Real* | -32768…32767 | - | 1 = 1 |
| 47.24 | Data storage 4 int16 | *Real* | -32768…32767 | - | 1 = 1 |
| **49 Panel port communication** | | | | | |
| 49.01 | Node ID number | *Real* | 1…32 | - | 1 = 1 |
| 49.03 | Baud rate | *List* | 1…5 | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|------|-------------------------------|------------|-------------------------------|------|-----------|
| 49.04 | Communication loss time | *Real* | 0.3…3000.0 | s | 10 = 1 s |
| 49.05 | Communication loss action | *List* | 0…3 | - | 1 = 1 |
| 49.06 | Refresh settings | *List* | 0…1 | - | 1 = 1 |
| **50 Fieldbus adapter (FBA)** | | | | | |
| 50.01 | FBA A enable | *List* | 0…1 | - | 1 = 1 |
| 50.02 | FBA A comm loss func | *List* | 0…5 | - | 1 = 1 |
| 50.03 | FBA A comm loss t out | *Real* | 0.3…6553.5 | s | 10 = 1 s |
| 50.04 | FBA A ref1 type | *List* | 0…5 | - | 1 = 1 |
| 50.05 | FBA A ref2 type | *List* | 0…5 | - | 1 = 1 |
| 50.06 | FBA A SW sel | *List* | 0…1 | - | 1 = 1 |
| 50.07 | FBA A actual 1 type | *List* | 0…5 | - | 1 = 1 |
| 50.08 | FBA A actual 2 type | *List* | 0…5 | - | 1 = 1 |
| 50.09 | FBA A SW transparent source | *Analog src* | - | - | 1 = 1 |
| 50.10 | FBA A act1 transparent source | *Analog src* | - | - | 1 = 1 |
| 50.11 | FBA A act2 transparent source | *Analog src* | - | - | 1 = 1 |
| 50.12 | FBA A debug mode | *List* | 0…1 | - | 1 = 1 |
| 50.13 | FBA A control word | *Data* | 00000000h…FFFFFFFFh | - | 1 = 1 |
| 50.14 | FBA A reference 1 | *Real* | -2147483648… 2147483647 | - | 1 = 1 |
| 50.15 | FBA A reference 2 | *Real* | -2147483648… 2147483647 | - | 1 = 1 |
| 50.16 | FBA A status word | *Data* | 00000000h…FFFFFFFFh | - | 1 = 1 |
| 50.17 | FBA A actual value 1 | *Real* | -2147483648… 2147483647 | - | 1 = 1 |
| 50.18 | FBA A actual value 2 | *Real* | -2147483648… 2147483647 | - | 1 = 1 |
| **51 FBA A settings** | | | | | |
| 51.01 | FBA A type | *List* | - | - | 1 = 1 |
| 51.02 | FBA A Par2 | *Real* | 0…65535 | - | 1 = 1 |
| … | … | … | … | … | |
| 51.26 | FBA A Par26 | *Real* | 0…65535 | - | 1 = 1 |
| 51.27 | FBA A par refresh | *List* | 0…1 | - | 1 = 1 |
| 51.28 | FBA A par table ver | *Data* | - | - | 1 = 1 |
| 51.29 | FBA A drive type code | *Real* | 0…65535 | - | 1 = 1 |
| 51.30 | FBA A mapping file ver | *Real* | 0…65535 | - | 1 = 1 |
| 51.31 | D2FBA A comm status | *List* | 0…6 | - | 1 = 1 |
| 51.32 | FBA A comm SW ver | *Data* | - | - | 1 = 1 |
| 51.33 | FBA A appl SW ver | *Data* | - | - | 1 = 1 |
| **52 FBA A data in** | | | | | |
| 52.01 | FBA A data in1 | *List* | - | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| … | … | … | … | … | |
| 52.12 | FBA A data in12 | *List* | - | - | 1 = 1 |
| **53 FBA A data out** | | | | | |
| 53.01 | FBA A data out1 | *List* | - | - | 1 = 1 |
| … | … | … | … | … | |
| 53.12 | FBA A data out12 | *List* | - | - | 1 = 1 |
| **58 Embedded fieldbus** | | | | | |
| 58.01 | Protocol enable | *List* | 0…25 | - | 1 = 1 |
| 58.02 | Protocol ID | *Real* | 0000h…FFFFh | - | 1 = 1 |
| 58.03 | Node address | *Real* | 0…255 | - | 1 = 1 |
| 58.04 | Baud rate | *List* | 0…7 | - | 1 = 1 |
| 58.05 | Parity | *List* | 0…3 | - | 1 = 1 |
| 58.06 | Communication control | *List* | 0…2 | - | 1 = 1 |
| 58.07 | Communication diagnostics | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 58.08 | Received packets | *Real* | 0…4294967295 | - | 1 = 1 |
| 58.09 | Transmitted packets | *Real* | 0…4294967295 | - | 1 = 1 |
| 58.10 | All packets | *Real* | 0…4294967295 | - | 1 = 1 |
| 58.11 | UART errors | *Real* | 0…4294967295 | - | 1 = 1 |
| 58.12 | CRC errors | *Real* | 0…4294967295 | - | 1 = 1 |
| 58.13 | Token counter | *Real* | 0…4294967295 | - | 1 = 1 |
| 58.14 | Communication loss action | *List* | 0…5 | - | 1 = 1 |
| 58.15 | Communication loss mode | *List* | 1…2 | - | 1 = 1 |
| 58.16 | Communication loss time | *Real* | 0.0…6000.0 | s | 10 = 1 s |
| 58.17 | Transmit delay | *Real* | 0…65535 | ms | 1 = 1 ms |
| 58.18 | EFB control word | *PB* | 00000000h…FFFFFFFFh | - | 1 = 1 |
| 58.19 | EFB status word | *PB* | 00000000h…FFFFFFFFh | - | 1 = 1 |
| 58.25 | Control profile | *List* | 0, 5 | - | 1 = 1 |
| 58.26 | EFB ref1 type | *List* | 0…5 | - | 1 = 1 |
| 58.27 | EFB ref2 type | *List* | 0…5 | - | 1 = 1 |
| 58.28 | EFB act1 type | *List* | 0…5 | - | 1 = 1 |
| 58.29 | EFB act2 type | *List* | 0…5 | - | 1 = 1 |
| 58.30 | EFB status word transparent source | *List* | 0 | - | 1 = 1 |
| 58.31 | EFB act1 transparent source | *Analog src* | - | - | 1 = 1 |
| 58.32 | EFB act2 transparent source | *Analog src* | - | - | 1 = 1 |
| 58.33 | Addressing mode | *List* | 0…2 | - | 1 = 1 |
| 58.34 | Word order | *List* | 0…1 | - | 1 = 1 |
| 58.40 | Device object ID | *Real* | 0…4194303 | - | 1 = 1 |
| 58.41 | Max master | *Real* | 0…127 | - | 1 = 1 |
| 58.42 | Max info frames | *Real* | 0…10 | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|-----|------|------|-------|------|--------|
| 58.43 | Max APDU retries | *Real* | 0…10 | - | 1 = 1 |
| 58.44 | APDU timeout | *Real* | 0…60 | s | 1 = 1 |
| 58.101 | Data I/O 1 | *Analog src* | - | - | 1 = 1 |
| 58.102 | Data I/O 2 | *Analog src* | - | - | 1 = 1 |
| 58.103 | Data I/O 3 | *Analog src* | - | - | 1 = 1 |
| 58.104 | Data I/O 4 | *Analog src* | - | - | 1 = 1 |
| 58.105 | Data I/O 5 | *Analog src* | - | - | 1 = 1 |
| 58.106 | Data I/O 6 | *Analog src* | - | - | 1 = 1 |
| 58.107 | Data I/O 7 | *Analog src* | - | - | 1 = 1 |
| … | … | … | … | … | |
| 58.114 | Data I/O 14 | *Analog src* | - | - | 1 = 1 |
| **70 Override** | | | | | |
| 70.01 | Override status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 70.02 | Override enable | *List* | 0…1 | - | 1 = 1 |
| 70.03 | Override activation source | *Binary src* | - | - | 1 = 1 |
| 70.04 | Override reference source | *List* | 0…6 | - | 1 = 1 |
| 70.05 | Override direction | *Binary src* | - | - | 1 = 1 |
| 70.06 | Override frequency | *Real* | -500.0…500.0 | Hz | 100 = 1 Hz |
| 70.07 | Override speed | *Real* | -30000.0…30000.0 | rpm | 100 = 1 rpm |
| 70.10 | Override enables selection | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 70.20 | Override fault handling | *List* | 0…1 | - | 1 = 1 |
| 70.21 | Override auto reset trials | *Real* | 0…5 | - | 1 = 1 |
| 70.22 | Override auto reset time | *Real* | 5.0…120.0 | s | 10 = 1 |
| 70.40 | Override log 1 start date | *Real* | | - | |
| 70.41 | Override log 1 start time | *Real* | | - | |
| 70.42 | Override log 1 end date | *Real* | | - | |
| 70.43 | Override log 1 end time | *Real* | | - | |
| 70.44 | Override log 1 fault 1 | *Real* | | - | |
| 70.45 | Override log 1 fault 2 | *Real* | | - | |
| 70.46 | Override log 1 fault 3 | *Real* | | - | |
| 70.47 | Override log 1 warning 1 | *Real* | | - | |
| 70.48 | Override log 1 warning 2 | *Real* | | - | |
| 70.49 | Override log 1 warning 3 | *Real* | | - | |
| 70.50 | Override log 2 start date | *Real* | | - | |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 70.51 | Override log 2 start time | *Real* | | - | |
| 70.52 | Override log 2 end date | *Real* | | - | |
| 70.53 | Override log 2 end time | *Real* | | - | |
| 70.54 | Override log 2 fault 1 | *Real* | | - | |
| 70.55 | Override log 2 fault 2 | *Real* | | - | |
| 70.56 | Override log 2 fault 3 | *Real* | | - | |
| 70.57 | Override log 2 warning 1 | *Real* | | - | |
| 70.58 | Override log 2 warning 2 | *Real* | | - | |
| 70.59 | Override log 2 warning 3 | *Real* | | - | |
| 70.60 | Override log 3 start date | *Real* | | - | |
| 70.61 | Override log 3 start time | *Real* | | - | |
| 70.62 | Override log 3 end date | *Real* | | - | |
| 70.63 | Override log 3 end time | *Real* | | - | |
| 70.64 | Override log 3 fault 1 | *Real* | | - | |
| 70.65 | Override log 3 fault 2 | *Real* | | - | |
| 70.66 | Override log 3 fault 3 | *Real* | | - | |
| 70.67 | Override log 3 warning 1 | *Real* | | - | |
| 70.68 | Override log 3 warning 2 | *Real* | | - | |
| 70.69 | Override log 3 warning 3 | *Real* | | - | |
| **71 External PID1** | | | | | |
| 71.01 | External PID act value | *Real* | -200000.00…200000.00 | % | 100 = 1% |
| 71.02 | Feedback act value | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 71.03 | Setpoint act value | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 71.04 | Deviation act value | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 71.06 | PID status word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 71.07 | PID operation mode | *List* | 0…2 | - | 1 = 1 |
| 71.08 | Feedback 1 source | *Analog src* | - | - | 1 = 1 |
| 71.11 | Feedback filter time | *Real* | 0.000…30.000 | s | 1000 = 1 s |
| 71.14 | Setpoint scaling | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 71.15 | Output scaling | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 71.16 | Setpoint 1 source | *Analog src* | - | - | 1 = 1 |
| 71.19 | Internal setpoint sel1 | *Binary src* | - | - | 1 = 1 |
| 71.20 | Internal setpoint sel2 | *Binary src* | - | - | 1 = 1 |
| 71.21 | Internal setpoint 1 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 71.22 | Internal setpoint 2 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 71.23 | Internal setpoint 3 | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 71.26 | Setpoint min | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 71.27 | Setpoint max | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 71.31 | Deviation inversion | *Binary src* | - | - | 1 = 1 |
| 71.32 | Gain | *Real* | 0.10…100.00 | - | 100 = 1 |
| 71.33 | Integration time | *Real* | 0.0…9999.0 | s | 10 = 1 s |
| 71.34 | Derivation time | *Real* | 0.000…10.000 | s | 1000 = 1 s |
| 71.35 | Derivation filter time | *Real* | 0.0…10.0 | s | 10 = 1 s |
| 71.36 | Output min | *Real* | -200000.00…200000.00 | - | 10 = 1 |
| 71.37 | Output max | *Real* | -200000.00…200000.00 | - | 10 = 1 |
| 71.38 | Output freeze enable | *Binary src* | - | - | 1 = 1 |
| 71.39 | Deadband range | *Real* | 0.0…200000.0 | - | 10 = 1 |
| 71.40 | Deadband delay | *Real* | 0.0…3600.0 | s | 10 = 1 s |
| 71.58 | Increase prevention | *Binary src* | - | - | 1 = 1 |
| 71.59 | Decrease prevention | *Binary src* | - | - | 1 = 1 |
| 71.62 | Internal setpoint actual | *Real* | -200000.00…200000.00 | PID unit 1 | 100 = 1 PID unit 1 |
| 71.79 | External PID units | *List* | | - | 1 = 1 |
| **76 PFC configuration** | | | | | |
| 76.01 | PFC status | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 76.02 | PFC system status | *List* | 0…3, 100…103, 200…202, 300…302, 400, 500, 600, 700, 800…801, 4…9 | - | 1 = 1 |
| 76.11 | Pump/fan status 1 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 76.12 | Pump/fan status 2 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 76.13 | Pump/fan status 3 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 76.14 | Pump/fan status 4 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 76.21 | PFC configuration | *List* | 0, 2…3 | - | 1 = 1 |
| 76.25 | Number of motors | *Real* | 1…4 | - | 1 = 1 |
| 76.26 | Min number of motors allowed | *Real* | 0…4 | - | 1 = 1 |
| 76.27 | Max number of motors allowed | *Real* | 1…4 | - | 1 = 1 |
| 76.30 | Start point 1 | *Real* | 0.00…32767.00 | rpm/Hz | 1 = 1 unit |
| 76.31 | Start point 2 | *Real* | 0.00…32767.00 | rpm/Hz | 1 = 1 unit |
| 76.32 | Start point 3 | *Real* | 0.00…32767.00 | rpm/Hz | 1 = 1 unit |
| 76.41 | Stop point 1 | *Real* | 0.00…32767.00 | rpm/Hz | 1 = 1 unit |
| 76.42 | Stop point 2 | *Real* | 0.00…32767.00 | rpm/Hz | 1 = 1 unit |
| 76.43 | Stop point 3 | *Real* | 0.00…32767.00 | rpm/Hz | 1 = 1 unit |
| 76.55 | Start delay | *Real* | 0.00…12600.00 | s | 100 = 1 s |
| 76.56 | Stop delay | *Real* | 0.00…12600.00 | s | 100 = 1 s |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 76.57 | Speed hold on | *Real* | 0.00…1000.00 | s | 100 = 1 s |
| 76.58 | Speed hold off | *Real* | 0.00…1000.00 | s | 100 = 1 s |
| 76.59 | PFC contactor delay | *Real* | 0.20…600.00 | s | 100 = 1 s |
| 76.60 | PFC ramp acceleration time | *Real* | 0.00…1800.00 | s | 100 = 1 s |
| 76.61 | PFC ramp deceleration time | *Real* | 0.00…1800.00 | s | 100 = 1 s |
| 76.70 | Autochange | *List* | 0…13 | - | 1 = 1 |
| 76.71 | Autochange interval | *Real* | 0.00…42949672.95 | h | 100 = 1 h |
| 76.72 | Maximum wear imbalance | *Real* | 0.00…1000000.00 | h | 100 = 1 h |
| 76.73 | Autochange level | *Real* | 0.0…300.0 | % | 10 = 1% |
| 76.74 | Autochange auxiliary PFC | *List* | 0…1 | - | 1 = 1 |
| 76.81 | PFC 1 interlock | *List* | 0…10 | - | 1 = 1 |
| 76.82 | PFC 2 interlock | *List* | 0…10 | - | 1 = 1 |
| 76.83 | PFC 3 interlock | *List* | 0…10 | - | 1 = 1 |
| 76.84 | PFC 4 interlock | *List* | 0…10 | - | 1 = 1 |
| 76.95 | Regulator bypass control | *Binary src* | - | - | - |
| **77 PFC maintenance and monitoring** | | | | | |
| 77.10 | PFC runtime change | *List* | 0…5 | - | 1 = 1 |
| 77.11 | Pump/fan 1 running time | *Real* | 0.00…42949672.95 | h | 100 = 1 h |
| 77.12 | Pump/fan 2 running time | *Real* | 0.00…42949672.95 | h | 100 = 1 h |
| 77.13 | Pump/fan 3 running time | *Real* | 0.00…42949672.95 | h | 100 = 1 h |
| 77.14 | Pump/fan 4 running time | *Real* | 0.00…42949672.95 | h | 100 = 1 h |
| **80 Flow calculation and protection** | | | | | |
| 80.01 | Actual flow | *Real* | -10000.00…10000.00 | - | 100 = 1 |
| 80.02 | Actual flow percentage | *Real* | -100.00…100.00 | % | 100 = 1 |
| 80.11 | Flow feedback 1 source | *List* | 0…3, 8…10, | - | 1 = 1 |
| 80.12 | Flow feedback 2 source | *List* | 0…3, 8…10, | - | 1 = 1 |
| 80.13 | Flow feedback function | *List* | 0…1, 8…9, | - | 1 = 1 |
| 80.14 | Flow feedback multiplier | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| 80.15 | Maximum flow | *Real* | -200000.00…200000.00 | - | 100 = 1 |
| | | | | | |
| **95 HW configuration** | | | | | |
| 95.01 | Supply voltage | *List* | 0, 2, 3, 5 | - | 1 = 1 |
| 95.02 | Adaptive voltage limits | *List* | 0…1 | - | 1 = 1 |
| 95.03 | Estimated AC supply voltage | *Real* | 0…65535 | V | 1 = 1 V |
| 95.04 | Control board supply | *List* | 0…1 | - | 1 = 1 |
| 95.15 | Special HW settings | *PB* | 00000000h…FFFFFFFFh | - | 1 = 1 |
| 95.20 | HW options word 1 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 95.21 | HW options word 2 | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 95.200 | Cooling fan mode | *List* | 0…1 | - | 1 = 1 |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| **96 System** | | | | | |
| 96.01 | Language | *List* | - | - | 1 = 1 |
| 96.02 | Pass code | *Data* | 0…99999999 | - | 1 = 1 |
| 96.03 | Access level status | *PB* | 00000000h…FFFFFFFFh | - | 1 = 1 |
| 96.04 | Macro select | *List* | 0…1 | - | 1 = 1 |
| 96.05 | Macro active | *List* | 1 | - | 1 = 1 |
| 96.06 | Parameter restore | *List* | 0, 2, 8, 32, 62, 512, 1024, 34560 | - | 1 = 1 |
| 96.07 | Parameter save manually | *List* | 0…1 | - | 1 = 1 |
| 96.08 | Control board boot | *List* | 0…1 | - | 1 = 1 |
| 96.10 | User set status | *List* | 0…7, 20…23 | - | 1 = 1 |
| 96.11 | User set save/load | *List* | 0…5, 18…21 | - | 1 = 1 |
| 96.12 | User set I/O mode in1 | *Binary src* | - | - | - |
| 96.13 | User set I/O mode in2 | *Binary src* | - | - | - |
| 96.16 | Unit selection | *PB* | 0000h…FFFFh | | 1 = 1 |
| 96.20 | Time sync primary source | *List* | 0, 3, 6, 8, 9 | - | 1 = 1 |
| 96.51 | Clear fault and event logger | *Real* | 0…1 | - | 1 = 1 |
| 96.54 | Checksum action | *List* | 0…4 | - | 1 = 1 |
| 96.55 | Checksum control word | *PB* | 0000h…FFFFh | - | 1 = 1 |
| 96.68 | Actual checksum A | *PB* | 00000000h…FFFFFFFFh | - | 1 = 1 |
| 96.69 | Actual checksum B | *PB* | 00000000h…FFFFFFFFh | - | 1 = 1 |
| 96.70 | Disable adaptive program | *List* | 0…1 | - | 1 = 1 |
| 96.71 | Approved checksum A | *PB* | 00000000h…FFFFFFFFh | - | 1 = 1 |
| 96.72 | Approved checksum B | *PB* | 00000000h…FFFFFFFFh | - | 1 = 1 |
| 96.78 | 550 Compatibility mode | *List* | 0…1 | - | 1 = 1 |
| 96.100 | Change user pass code | *Data* | 10000000…99999999 | - | 1 = 1 |
| 96.101 | Confirm user pass code | *Data* | 10000000…99999999 | - | 1 = 1 |
| 96.102 | User lock functionality | *PB* | 0000h…FFFFh | - | 1 = 1 |
| **97 Motor control** | | | | | |
| 97.01 | Switching frequency reference | *List* | 2, 4, 8, 12 | kHz | 1 = 1 kHz |
| 97.02 | Minimum switching frequency | *List* | 1.5, 2, 4, 8, 12 | kHz | 1 = 1 kHz |
| 97.03 | Slip gain | *Real* | 0…200 | % | 1 = 1% |
| 97.04 | Voltage reserve | *Real* | -4…50 | % | 1 = 1% |
| 97.05 | Flux braking | *List* | 0…2 | - | 1 = 1 |
| 97.08 | Optimizer minimum torque | *Real* | 0.0 … 1600.0 | % | 10 = 1% |
| 97.11 | TR tuning | *Real* | 25…400 | % | 1 = 1% |
| 97.13 | IR compensation | *Real* | 0.00…50.00 | % | 100 = 1% |
| 97.15 | Motor model temperature adaptation | *List* | 0…1 | - | 1 = 1 |
| 97.16 | Stator temperature factor | *Real* | 0…200 | % | 1 = 1% |

| No. | Name | Type | Range | Unit | FbEq32 |
|---|---|---|---|---|---|
| 97.17 | Rotor temperature factor | *Real* | 0…200 | % | 1 = 1% |
| 97.20 | U/F ratio | *List* | 0…1 | - | 1 = 1 |
| 97.49 | Slip gain for scalar | *Real* | 0 …200 | % | 1 = 1% |
| 97.94 | IR comp max frequency | *Real* | 1.0 …200.0 | % | 1 = 1% |
| **98 User motor parameters** | | | | | |
| 98.01 | User motor model mode | *List* | 0…1 | - | 1 = 1 |
| 98.02 | Rs user | *Real* | 0.0000…0.50000 | p.u. | 100000 = 1 p.u. |
| 98.03 | Rr user | *Real* | 0.0000…0.50000 | p.u. | 100000 = 1 p.u. |
| 98.04 | Lm user | *Real* | 0.00000…10.00000 | p.u. | 100000 = 1 p.u. |
| 98.05 | SigmaL user | *Real* | 0.00000…1.00000 | p.u. | 100000 = 1 p.u. |
| 98.06 | Ld user | *Real* | 0.00000…10.00000 | p.u. | 100000 = 1 p.u. |
| 98.07 | Lq user | *Real* | 0.00000…10.00000 | p.u. | 100000 = 1 p.u. |
| 98.08 | PM flux user | *Real* | 0.00000…2.00000 | p.u. | 100000 = 1 p.u. |
| 98.09 | Rs user SI | *Real* | 0.00000…100.00000 | ohm | 100000 = 1 p.u. |
| 98.10 | Rr user SI | *Real* | 0.00000…100.00000 | ohm | 100000 = 1 p.u. |
| 98.11 | Lm user SI | *Real* | 0.00…100000.00 | mH | 100 = 1 mH |
| 98.12 | SigmaL user SI | *Real* | 0.00…100000.00 | mH | 100 = 1 mH |
| 98.13 | Ld user SI | *Real* | 0.00…100000.00 | mH | 100 = 1 mH |
| 98.14 | Lq user SI | *Real* | 0.00…100000.00 | mH | 100 = 1 mH |
| **99 Motor data** | | | | | |
| 99.03 | Motor type | *List* | 0…2 | - | 1 = 1 |
| 99.04 | Motor control mode | *List* | 0…1 | - | 1 = 1 |
| 99.06 | Motor nominal current | *Real* | 0.0…6400.0 | A | 10 = 1 A |
| 99.07 | Motor nominal voltage | *Real* | 0.0…960.0 | V | 10 = 1 V |
| 99.08 | Motor nominal frequency | *Real* | 0.00 … 500.00 | Hz | 100 = 1 Hz |
| 99.09 | Motor nominal speed | *Real* | 0 … 30000 | rpm | 1 = 1 rpm |
| 99.10 | Motor nominal power | *Real* | 0.00…10000.00 kW or 0.00 … 13404.83 hp | kW or hp | 100 = 1 unit |
| 99.11 | Motor nominal cos Φ | *Real* | 0.00 … 1.00 | - | 100 = 1 |
| 99.12 | Motor nominal torque | *Real* | 0.000…4000000.000 N·m or 0.000…2950248.597 lb·ft | N·m or lb·ft | 1000 = 1 unit |
| 99.13 | ID run requested | *List* | 0…3, 8 | - | 1 = 1 |
| 99.14 | Last ID run performed | *List* | 0…3, 8 | - | 1 = 1 |
| 99.15 | Motor polepairs calculated | *Real* | 0…1000 | - | 1 = 1 |
| 99.16 | Motor phase order | *List* | 0…1 | - | 1 = 1 |

# 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/searchchannels.

## Product training

For information on ABB product training, navigate to new.abb.com/service/training.

## Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

## Document library on the Internet

You can find manuals and other product documents in PDF format on the Internet at www.abb.com/drives/documents.

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