ABB general purpose drives

User's manual
ACS580-01 drives

Power and productivity
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List of related manuals

Drive manuals and guides	Code (English)
ACS580-01 user's manual	3AUA0000076333
ACS580-01 quick installation and start-up guide for frames sizes R0 to R3	3AUA0000076332
ACS580-01 quick installation and start-up guide for frame size R5	3AXD50000007518
ACS580-01 quick installation and start-up guide for frame sizes R6 to R9	3AXD50000009286
ACS-AP-x assistant control panels user's manual	3AUA0000085685

Option manuals and guides	
CDPI-01 communication adapter module user's manual	3AXD50000009929
DPMP-01 mounting platform for ACS-AP control panel	3AUA0000100140
DPMP-02 mounting platform for ACS-AP control panel	3AUA0000136205
FCAN-01 CANopen adapter module user's manual	3AFE68615500
FDNA-01 DeviceNet™ adapter module user's manual	3AFE68573360
FECA-01 EtherCAT adapter module user's manual	3AUA0000068940
FENA-01/-11/-21 Ethernet adapter module user's manual	3AUA0000093568
FEPL-02 Ethernet POWERLINK adapter module user's manual	3AUA0000123527
FPBA-01 PROFIBUS DP adapter module user's manual	3AFE68573271
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	3AUA0000969391
NETA-21 remote monitoring tool installation and start-up guide	3AUA0000096881

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

The QR code below opens an online listing of the manuals applicable to this product.

ACS580-01 manuals

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1

Safety instructions

Contents of this chapter

This chapter contains the safety instructions which you must obey when you install and operate the drive and do maintenance on the drive. If you ignore the safety instructions, injury, death or damage can occur.

Use of warnings and notes in this manual

Warnings tell you about conditions which can cause injury or death, or damage to the equipment. They also tell you how to prevent the danger. Notes draw attention to a particular condition or fact, or give information on a subject.

The manual uses these warning symbols:

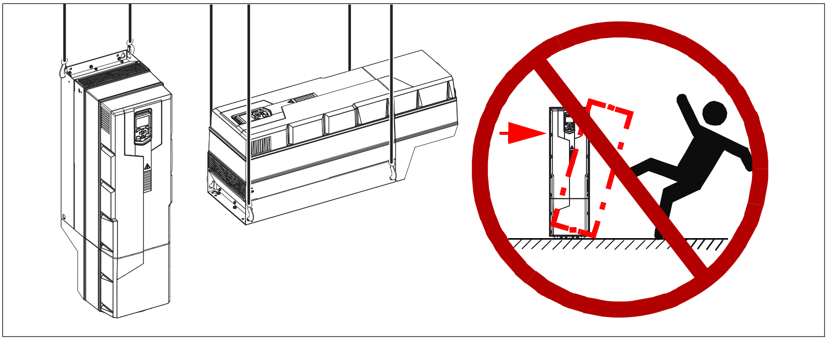
Electricity warning tells about hazards from electricity which can cause injury or death, or damage to the equipment.
General warning tells about conditions, other than those caused by electricity, which can cause injury or death, or damage to the equipment.
Electrostatic sensitive devices warning tells you about the risk of electrostatic discharge which can cause damage to the equipment.

General safety in installation, start-up and maintenance

These instructions are for all personnel that install the drive and do maintenance work on it.

WARNING! Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- Handle the drive carefully.
  - Use safety shoes with a metal toe cap to avoid foot injury.
  - Frames R6…R9: Lift the drive with a lifting device. Use the lifting eyes of the drive.
  - Frames R6…R9: Do not tilt the drive. The drive is heavy and its center of gravity is high. An overturning drive can cause physical injury.



- Beware of hot surfaces. Some parts, such as heatsinks of power semiconductors, remain hot for a while after disconnection of the electrical supply.
- Make sure that debris from borings and grindings does not enter the drive during the installation. Electrically conductive debris inside the drive may cause damage or malfunction.
- Make sure that there is sufficient cooling. See sections *Checking the installation site* on page *44* and *Losses, cooling data and noise* on page *505* for more information.
- Before you connect voltage to the drive, make sure that the drive covers are on. Keep the covers on during the operation.
- Before you adjust the drive operation limits, make sure that the motor and all driven equipment can operate throughout the set operation limits.
- Before you activate automatic fault reset functions of the drive control program, make sure that no dangerous situations can occur. These functions reset the drive automatically and continue operation after a fault.
- The maximum number of drive power-ups is five in ten minutes. Too frequent power-ups can damage the charging circuit of the DC capacitors.

- If you have connected safety circuits to the drive (for example, emergency stop and Safe torque off), validate them at the start up. For the validation of the Safe torque off, see chapter *Start-up, control with I/O and ID run* on page *119*. For the validation of other safety circuits, see the instructions provided with them.

Note:

- If you select an external source for start command and it is on, the drive will start immediately after fault reset. See parameters *20.02 Ext1 start trigger type* and *20.07 Ext2 start trigger type*.
- When the control location is not set to Local, the stop key on the control panel will not stop the drive.
- Frames R0…R5 are not field repairable. Do not attempt to repair a malfunctioning drive; contact your local ABB representative for replacement.

  Frames R6…R9 can be repaired by authorized persons.

Electrical safety in installation, start-up and maintenance

Precautions before electrical work

These warnings are for all personnel who do work on the drive, motor cable or motor.

WARNING! Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do electrical installation or maintenance work. Go through these steps before you begin any installation or maintenance work.

1. Clearly identify the work location.
2. Disconnect all possible voltage sources.
   - Open the main disconnector at the power supply of the drive.
   - Make sure that reconnection is not possible. Lock the disconnector to open position and attach a warning notice to it.
   - Disconnect any external power sources from the control circuits before you do work on the control cables.
   - After you disconnect the drive, always wait for 5 minutes to let the intermediate circuit capacitors discharge before you continue.
3. Protect any other energized parts in the work location against contact.
4. Take special precautions when close to bare conductors.
5. Measure that the installation is de-energized.
   - Use a multimeter with an impedance of at least 1 Mohm.
   - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding terminal (PE) is close to 0 V.
   - Make sure that the voltage between the drive DC terminals (UDC+ and UDC-) and the grounding terminal (PE) is close to 0 V.
6. Install temporary grounding as required by the local regulations.
7. Ask for a permit to work from the person in control of the electrical installation work.

Additional instructions and notes

WARNING! Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- If you install the drive on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), disconnect the internal EMC filter; otherwise the system will be connected to ground potential through the EMC

filter capacitors. This can cause danger or damage the drive. See page *78*.
Note: Disconnecting the internal EMC filter increases the conducted emission and reduces the drive EMC compatibility considerably. See section *EMC compatibility and motor cable length* on page *510*.

- If you install the drive on a corner-grounded TN system, disconnect the internal EMC filter; otherwise the system will be connected to ground potential through the EMC filter capacitors. This will damage the drive. See page *78*.
  Note: Disconnecting the internal EMC filter increases the conducted emission and reduces the drive EMC compatibility considerably. See section *EMC compatibility and motor cable length* on page *510*.
- Use all ELV (extra low voltage) circuits connected to the drive only within a zone of equipotential bonding, that is, within a zone where all simultaneously accessible conductive parts are electrically connected to prevent hazardous voltages appearing between them. You can accomplish this by a proper factory grounding, that is, make sure that all simultaneously accessible conductive parts are grounded to the protective earth (PE) bus of the building.
- Do not do insulation or voltage withstand tests on the drive or drive modules.

Note:

- The motor cable terminals of the drive are at a dangerous voltage when the input power is on, regardless of whether the motor is running or not.
- The DC and brake resistor terminals (UDC+, UDC-, R+ and R-) are at a dangerous voltage.
- External wiring can supply dangerous voltages to the terminals of relay outputs (RO1, RO2 and RO3).
- The Safe torque off function does not remove the voltage from the main and auxiliary circuits. The function is not effective against deliberate sabotage or misuse.

WARNING! Use a grounding wrist band when you handle the printed circuit boards. Do not touch the boards unnecessarily. The boards contain components sensitive to electrostatic discharge.

Grounding

These instructions are for all personnel who are responsible for the electrical installation, including the grounding of the drive.

WARNING! Obey these instructions. If you ignore them, injury or death, or equipment malfunction can occur, and electromagnetic interference can increase.

- If you are not a qualified electrician, do not do grounding work.
- Always ground the drive, the motor and adjoining equipment to the protective earth (PE) bus of the power supply. This is necessary for the personnel safety. Proper grounding also reduces electromagnetic emission and interference.
- In a multiple-drive installation, connect each drive separately to the protective earth (PE) bus of the power supply.
- Make sure that the conductivity of the protective earth (PE) conductors is sufficient. See section *Selecting the power cables* on page *60*. Obey the local regulations.
- Connect the power cable shields to the protective earth (PE) terminals of the drive.
- Make a 360° grounding of the power and control cable shields at the cable entries to suppress electromagnetic disturbances.

Note:

- You can use power cable shields as grounding conductors only when their conductivity is sufficient.
- Standard IEC/EN 61800-5-1 (section 4.3.5.5.2.) requires that as the normal touch current of the drive is higher than 3.5 mA AC or 10 mA DC, you must use a fixed protective earth (PE) connection. In addition,
  - install a second protective earth conductor of the same cross-sectional area as the original protective earthing conductor,

  or

  - install a protective earth conductor with a cross-section of at least 10 mm^2 Cu or 16 mm^2 Al,

  or

  - install a device which automatically disconnects the supply if the protective earth conductor breaks.

Additional instructions for permanent magnet motor drives

Safety in installation, start-up and maintenance

These are additional warnings concerning permanent magnet motor drives. The other safety instructions in this chapter are also valid.

WARNING! Obey these instructions. If you ignore them, injury or death and damage to the equipment can occur.

- Do not work on a drive when a rotating permanent magnet motor is connected to it. A rotating permanent magnet motor energizes the drive including its input power terminals.

Before installation, start-up and maintenance work on the drive:

- Stop the motor.
- Disconnect the motor from the drive with a safety switch or by other means.
- If you cannot disconnect the motor, make sure that the motor cannot rotate during work. Make sure that no other system, like hydraulic crawling drives, can rotate the motor directly or through any mechanical connection like felt, nip, rope, etc.
- Measure that the installation is de-energized.
  - Use a multimeter with an impedance of at least 1 Mohm.
  - Make sure that the voltage between the drive output terminals (T1/U, T2/V, T3/W) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive input power terminals (L1, L2, L3) and the grounding (PE) busbar is close to 0 V.
  - Make sure that the voltage between the drive DC terminals (UDC+, UDC-) and the grounding (PE) terminal is close to 0 V.
- Install temporary grounding to the drive output terminals (T1/U, T2/V, T3/W). Connect the output terminals together as well as to the PE.

Start-up and operation:

- Make sure that the operator cannot run the motor over the rated speed. Motor overspeed causes overvoltage that can damage or explode the capacitors in the intermediate circuit of the drive.

General safety in operation

These instructions are for all personnel that operate the drive.

WARNING! Obey these instructions. If you ignore them, injury or death, or damage to the equipment can occur.

- Do not control the motor with the disconnector at the drive power supply; instead, use the control panel start and stop keys or commands through the I/O terminals of the drive.
- Give a stop command to the drive before you reset a fault. If you have an external source for the start command and the start is on, the drive will start immediately after the fault reset.

Note: When the control location is not set to Local, the stop key on the control panel will not stop the drive.

2

Introduction to the manual

Contents of this chapter

The chapter describes applicability, target audience and purpose of this manual. It describes the contents of this manual and refers to a list of related manuals for more information. The chapter also contains a flowchart of steps for checking the delivery, installing and commissioning the drive. The flowchart refers to chapters/sections in this manual.

Applicability

The manual applies to the ACS580-01 standard control program (version 1.30). Check system information (select **Menu** - **System info**) or parameter *07.05 Firmware version* (see page *238*) on the control panel.

Target audience

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

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

Purpose of the manual

This manual provides information needed for planning the installation, installing, commissioning, using and servicing the drive.

Contents of this manual

The manual consists of the following chapters:

- *Safety instructions* (page *17*) gives safety instructions you must obey when installing, commissioning, operating and servicing the drive.
- *Introduction to the manual* (this chapter, page *25*) describes applicability, target audience, purpose and contents of this manual. It also contains a quick installation and commissioning flowchart. At the end, it lists terms and abbreviations.
- *Operation principle and hardware description* (page *31*) describes the operation principle, layout, power connections and control interfaces, type designation label and type designation information in short.
- *Mechanical installation* (page *43*) describes how to check the installation site, unpack, check the delivery and install the drive mechanically.
- *Planning the electrical installation* (page *59*) describes how to plan the electrical installation of the drive, for example, how to check the compatibility of the motor and the drive and select cables, protections and cable routing.
- *Electrical installation* (page *75*) describes how to check the insulation of the assembly and the compatibility with IT (ungrounded) and corner-grounded TN systems. It then shows how to connect the power and control cables, install optional modules and connect a PC.
- *Installation checklist* (page *117*) contains a checklist for checking the mechanical and electrical installation of the drive before start-up.
- *Start-up, control with I/O and ID run* (page *119*) tells how to start up the drive as well as how to start, stop, change the direction of the motor rotation and adjust the motor speed through the I/O interface.
- *Control panel* (page *137*) briefly describes the display, keys and key shortcuts of the assistant control panel.
- *Settings, I/O and diagnostics on the control panel* (page *143*) describes the simplified settings and diagnostic functions provided on the assistant control panel.
- *Control macros* (page *161*) contains a short description of each macro together with a connection diagram. Macros are pre-defined applications which will save the user time when configuring the drive.
- *Program features* (page *179*) describes program features with lists of related user settings, actual signals, and fault and warning messages.
- *Parameters* (page *225*) describes the parameters used to program the drive.
- *Additional parameter data* (page *393*) contains further information on the parameters.
- *Fieldbus control through the embedded fieldbus interface (EFB)* (page *441*) describes the communication to and from a fieldbus network using the embedded fieldbus interface of the drive.

- *Fieldbus control through a fieldbus adapter* (page *467*) describes the communication to and from a fieldbus network using an optional fieldbus adapter module
- *Fault tracing* (page *423*) lists the warning and fault messages with possible causes and remedies.
- *Maintenance and hardware diagnostics* (page *481*) contains preventive maintenance instructions and LED indicator descriptions.
- *Technical data* (page *495*) contains technical specifications of the drive, eg ratings, sizes and technical requirements as well as provisions for fulfilling the requirements for CE and other marks.
- *Dimension drawings* (page *523*) shows dimension drawings of the drive.
- *Control chain diagrams* (page *533*) shows the parameter structure within the drive.
- *Resistor braking* (page *547*) tells how to select the brake resistor.
- *The Safe torque off function* (page *555*) describes STO features, installation and technical data.
- *Optional I/O extension modules* (page *567*) describes CMOD-01 and CMOD-02 multifunction extension modules, their installation, start-up, diagnostics and technical data.
- *Further information* (inside of the back cover, page *585*) tells 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

See *List of related manuals* on page *2* (inside of the front cover).

Categorization by frame (size)

The ACS580-01 is manufactured in frames (frame sizes) R0…R3 and R5…R9. Some instructions and other information which only concern certain frames are marked with the symbol of the frame (R0…R3, R5…R9). The frame is marked on the type designation label attached to the drive, see section *Type designation label* on page *40*.

Quick installation and commissioning flowchart

Task	See
Identify the frame of your drive: R0…R3, R5…R9.	*Operation principle and hardware description*: *Type designation key* on page *41*
Plan the installation: select the cables, etc. Check the ambient conditions, ratings and required cooling air flow.	*Planning the electrical installation* on page *59* *Technical data* on page *495*
Unpack and check the drive.	*Mechanical installation*: *Unpacking and examining delivery, frames R0…R3* on page *46*, *Unpacking and examining delivery, frame R5* on page *47*, *Unpacking and examining delivery, frames R6…R9* on page *49*
If the drive will be connected to an IT (ungrounded) system or corner-grounded TN system, check that the internal EMC filter is not connected.	*Operation principle and hardware description*: *Type designation key* on page *41* *Electrical installation*: *Checking the compatibility with IT (ungrounded) and corner-grounded TN systems* on page *77*
Install the drive on a wall.	*Mechanical installation* on page *43*
Route the cables.	*Planning the electrical installation*: *Routing the cables* on page *66*
Check the insulation of the input cable and the motor and the motor cable.	*Electrical installation*: *Checking the insulation of the assembly* on page *76*
Connect the power cables.	*Electrical installation*: *Connecting the power cables* on page *80*
Connect the control cables.	*Electrical installation*: *Connecting the control cables* on page *97*
Check the installation.	*Installation checklist* on page *117*
Commission the drive.	*Start-up, control with I/O and ID run* on page *119*

Terms and abbreviations

Term/abbreviation	Explanation
ACS-AP-x	Assistant control panel, advanced operator keypad for communication with the drive. The ACS580 supports types ACS-AP-I and ACS-AP-S.
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 *Brake chopper*.
Control board	Circuit board in which the control program runs.
Capacitor bank	See *DC link capacitors*.
CDPI-01	Communication adapter module
CCA-01	Configuration adapter
CEIA-01	Embedded EIA-485 fieldbus adapter module
CHDI-01	Optional 115/230 V digital input extension module
CMOD-01	Optional multifunction extension module (external 24 V AC/DC and digital I/O extension)
CMOD-02	Optional multifunction extension module (external 24 V AC/DC and isolated PTC interface)
DC link	DC circuit between rectifier and inverter
DC link capacitors	Energy storage which stabilizes the intermediate circuit DC voltage
DPMP-01	Mounting platform for ACS-AP control panel (flange mounting)
DPMP-02	Mounting platform for ACS-AP control panel (surface mounting)
Drive	Frequency converter for controlling AC motors
EMC	Electromagnetic compatibility
EFB	Embedded fieldbus
FBA	Fieldbus adapter
FCAN-01	Optional CANopen adapter module
FCNA-01	ControlNet adapter module
FDNA-01	Optional DeviceNet adapter module
FECA-01	Optional EtherCAT adapter module
FENA-01/-11/-21	Optional Ethernet adapter module for EtherNet/IP, Modbus TCP and PROFINET IO protocols
FEPL-02	Ethernet POWERLINK adapter module
FPBA-01	Optional PROFIBUS DP adapter module
Frame (size)	Refers to drive physical size, for example R0 and R1. The type designation label attached to the drive shows the frame of the drive, see section *Type designation key* on page *41*.
FSCA-01	Optional RSA-485 adapter module
I/O	Input/Output

Term/abbreviation	Explanation
IGBT	Insulated gate bipolar transistor
Intermediate circuit	See *DC link*.
Inverter	Converts direct current and voltage to alternating current and voltage.
LRFI	Series of optional EMC filters
LSW	Least significant word
Macro	Pre-defined default values of parameters in drive control program. Each macro is intended for a specific application. See chapter *Control macros* on page *161*.
NETA-21	Remote monitoring tool
Network control	With fieldbus protocols based on the Common Industrial Protocol (CIP™), such as DeviceNet and Ethernet/IP, denotes the control of the drive using the Net Ctrl and Net Ref objects of the ODVA AC/DC Drive Profile. For more information, see www.odva.org, and the following manuals: • *FDNA-01 DeviceNet adapter module user's manual* (3AFE68573360 [English]), and • *FENA-01/-11/-21 Ethernet adapter module user's manual* (3AUA0000093568 [English]).
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PLC	Programmable logic controller
PROFIBUS, PROFIBUS DP, PROFINET IO	Registered trademarks of PI - PROFIBUS & PROFINET International
R0, R1, ...	*Frame (size)*
RCD	Residual current device
Rectifier	Converts alternating current and voltage to direct current and voltage.
RFI	Radio-frequency interference
SIL	Safety integrity level. See chapter *The Safe torque off function* on page *555*.
STO	Safe torque off. See chapter *The Safe torque off function* on page *555*.

3

Operation principle and hardware description

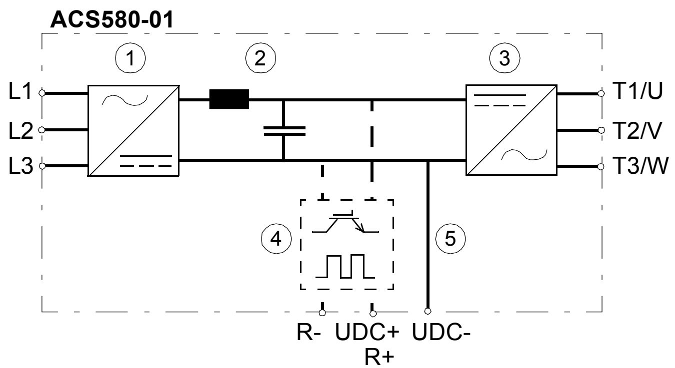
Contents of this chapter

This chapter briefly describes the operation principle, layout, type designation label and type designation information. It also shows a general diagram of power connections and control interfaces.

Operation principle

The ACS580-01 is a drive for controlling asynchronous AC induction motors and permanent magnet synchronous motors.

The figure below shows the simplified main circuit diagram of the drive.



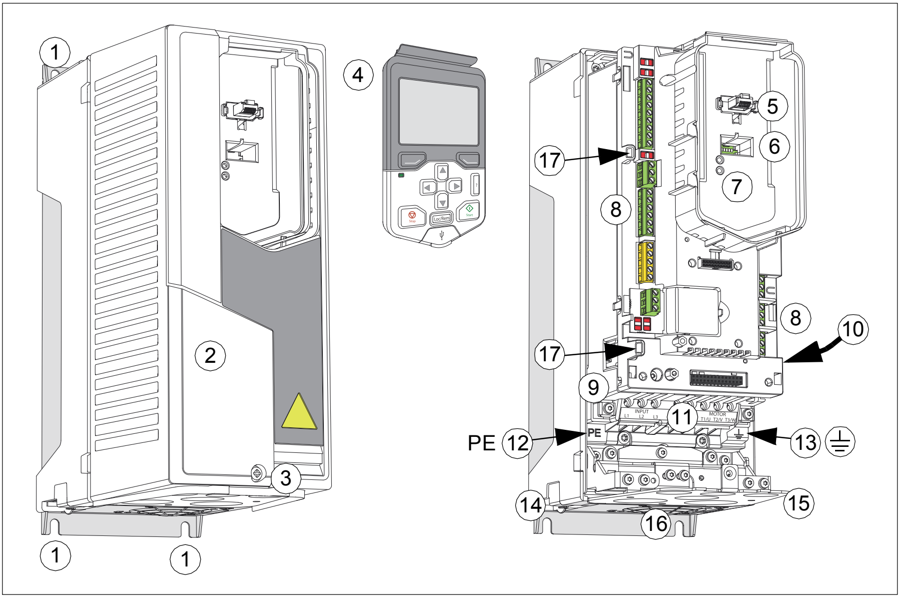
1	Rectifier. Converts alternating current and voltage to direct current and voltage.
2	DC link. DC circuit between rectifier and inverter.
3	Inverter. Converts direct current and voltage to alternating current and voltage.
4	Brake chopper (R-, R+). Conducts the surplus energy from the intermediate DC 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. The user obtains and installs the brake resistor when needed. Brake chopper is as standard in frames R0…R3.
5	DC connection (UDC+, UDC-), as standard for R5…R9.

Layout

Frames R0…R3

The layout of a frame R0 drive is presented below. The construction of frames R1…R3 differs to some extent.

R0



1	Mounting points (4 pieces)
2	Cover
3	Cover screw
4	Assistant control panel. See chapter *Control panel* on page *137*.
5	Control panel connection
6	Cold configuration connection
7	Power OK and Fault LEDs. See section *LEDs* on page *492*.
8	I/O connections. See section *External control connection terminals, frames R0…R3* on page *37*.
9	Varistor grounding switch (VAR)

10	EMC filter grounding switch (EMC). R0…R2: On the right side of the drive. R3: On the front, near the I/O connections. See *Checking the compatibility with IT (ungrounded) and corner-grounded TN systems* on page *77*.
11	Input power connection (L1, L2, L3), motor connection (T1/U, T2/V, T3/W) and brake connection (R-, R+/UDC+).
12	PE connection (power line)
13	Grounding connection (motor)
14	Additional grounding connection
15	Lead-through plate
16	Fan
17	Cable tie mounts for I/O cables

Frame R5

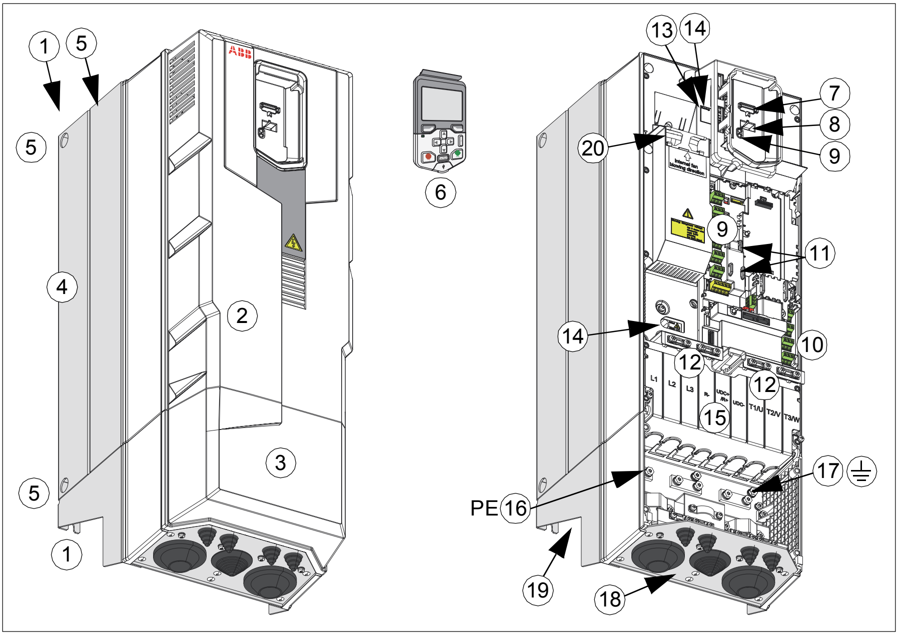
The layout of a frame R5 drive is presented below.

To be added.

Frames R6…R9

The layout of a frame R6 drive is presented below. The constructions of frames R7…R9 differ to some extent.

R6…R9

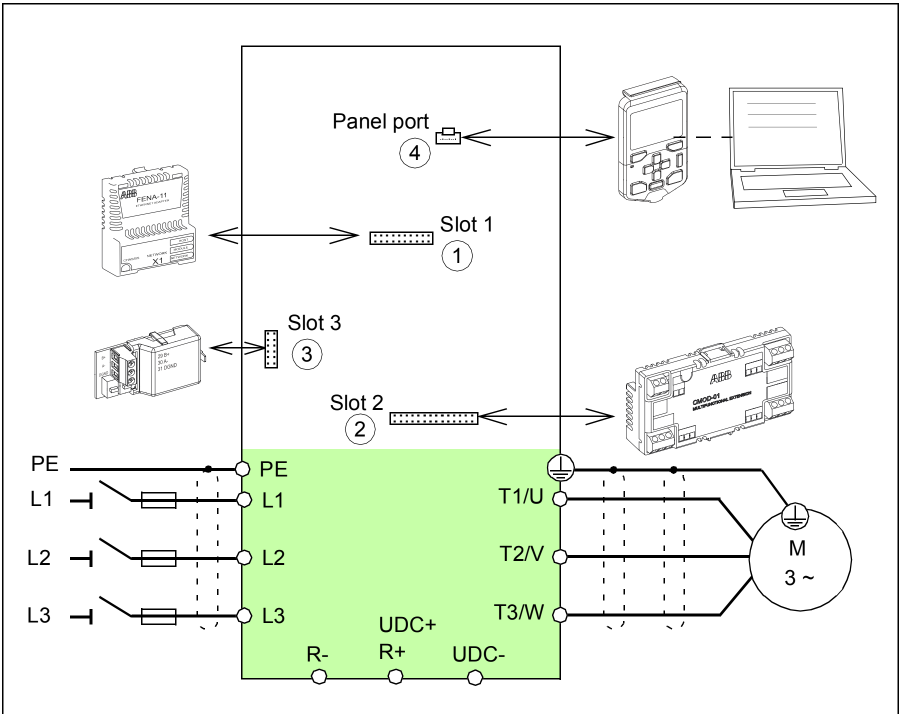


1	Mounting points (2 at the top, 2 at the bottom of the main part of the frame, 2 at the top of the cable entry box)
2	Cover
3	Cable entry box
4	Heatsink
5	Lifting holes (6 pieces)
6	Assistant control panel. See chapter *Control panel* on page *137*.
7	Control panel connection
8	Cold configuration connection
9	Power OK and Fault LEDs. See section *LEDs* on page *492*.
10	I/O connections. See section *External control connection terminals, frame R5…R9* on page *38*.
11	Cable tie mounts for I/O cables
12	Clamps for I/O cable mechanical support

13	Varistor grounding screw (VAR), under the control panel platform
14	Two EMC filter grounding screws (EMC), one under the control panel platform and one at the left, above the shroud. See *Checking the compatibility with IT (ungrounded) and corner-grounded TN systems* on page *77*.
15	Shroud. Under the shroud: Input power connection (L1, L2, L3), motor connection (T1/U, T2/V, T3/W) and brake connection (R-, R+/UDC+) as well as DC connection (UDC+, UDC-).
16	PE connection (power line)
17	Grounding connection (motor)
18	Lead-through plate
19	One main fan (R6…R8), two main fans (R9) at the bottom
20	Auxiliary fan

Overview of power and control connections

The logical diagram below shows the power connections and control interfaces of the drive.

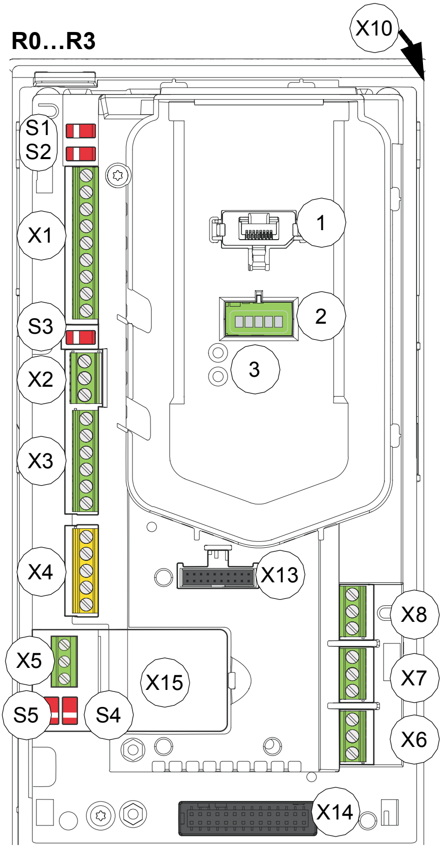


1	Option slot 1 for optional fieldbus adapter modules
2	Option slot 2 for optional I/O extension modules
3	Option slot 3 for optional embedded fieldbus adapter modules
4	Panel port.

External control connection terminals, frames R0…R3

The layout of the external control connection terminals of the R0 frame is shown below. Layout of the external control connection terminals is identical in frames R0…R3 but the location of the control unit with the terminals is different in frame R3.

R0…R3

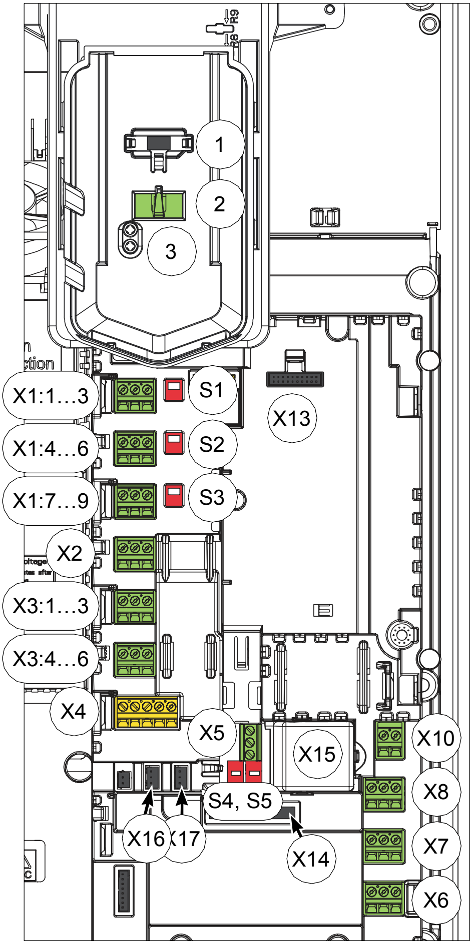


	Description
X1	Analog inputs and outputs
X2	Aux. voltage output
X3	Programmable digital inputs
X4	Safe torque off connection
X5	Connection to embedded EIA-485 fieldbus adapter module (installed in option slot 3)
X6	Relay output 1
X7	Relay output 2
X8	Relay output 3
X10	Internal fan connection (IP55)
X13	Option slot 1 (fieldbus adapter modules)
X14	Option slot 2 (I/O extension modules)
X15	Option slot 3 (embedded EIA-485 fieldbus adapter module)
S1, S2	Voltage/Current selection switches for analog input 1 (S1) and analog input 2 (S2), see section *Switches* on page *100*.
S3	Voltage/Current selection switch for analog output 1, see section *Switches* on page *100*.
S4, S5	Termination switch (S4), bias resistor switch (S5), see section *Switches* on page *100*
1	Panel port (control panel connection)
2	Cold configuration connection
3	Power OK and Fault LEDs. See section *LEDs* on page *492*.

External control connection terminals, frame R5…R9

The layout of the external control connection terminals of frames R5…R9 is shown below.

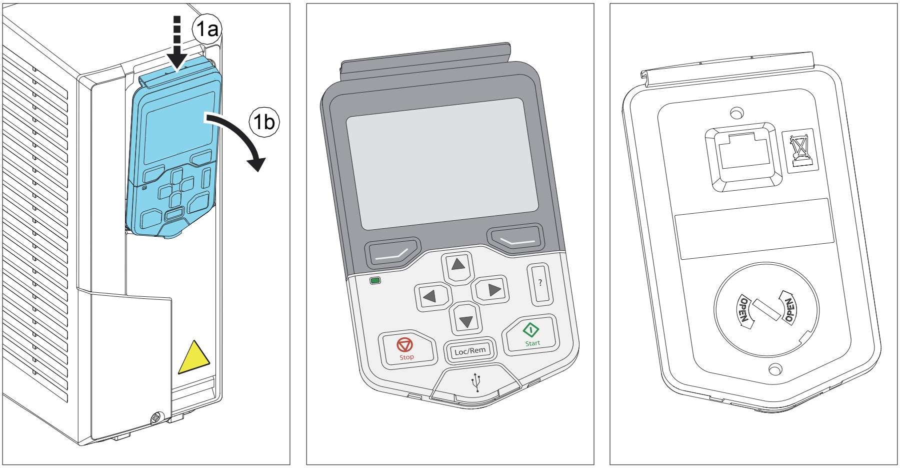
R5…R9



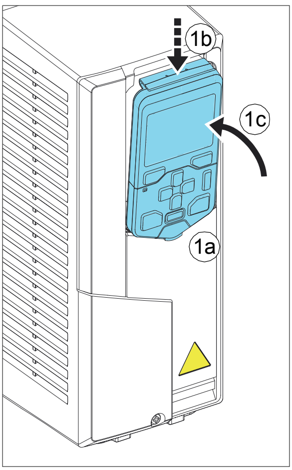
	Description
X1	Analog inputs and outputs
X2	Aux. voltage output
X3	Digital inputs
X4	Safe torque off connection
X5	Connection to embedded EIA-485 fieldbus adapter module (installed in option slot 3)
X6	Relay output 1
X7	Relay output 2
X8	Relay output 3
X10	External +24 V AC/DC connection
X13	Option slot 1 (fieldbus adapter modules)
X14	Option slot 2 (I/O extension modules)
X15	Option slot 3 (embedded EIA-485 fieldbus adapter module)
X16	Internal fan 1 connection
X17	Internal fan 2 connection
S1, S2	Voltage/Current selection switches for analog input 1 (S1) and analog input 2 (S2), see section *Switches* on page *100*.
S3	Voltage/Current selection switch for analog output 1, see section *Switches* on page *100*.
S4, S5	Termination switch (S4), bias resistor switch (S5), see section *Switches* on page *100*
1	Panel port (control panel connection)
2	Cold configuration connection
3	Power OK and Fault LEDs. See section *LEDs* on page *492*.

Control panel

To remove the control panel, press the retaining clip at the top (1a) and pull it forward from the top edge (1b).



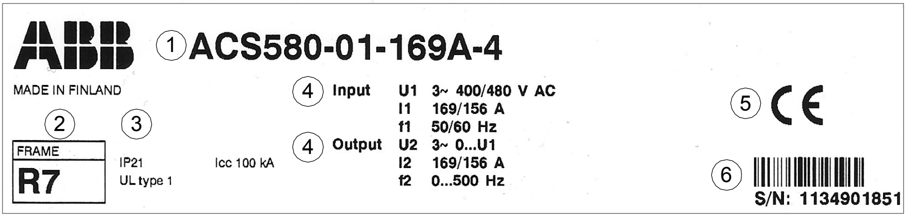
To reinstall the control panel, put the bottom of the container in position (1a), press the retaining clip at the top (1a) and push the control panel in at the top edge (1c).



For the use of the control panel, see chapter *Control panel* on page *137* and *ACS-AP-X assistant control panels user's manual* (3AUA0000085685 [English]).

Type designation label

The type designation label includes IEC and NEMA ratings, appropriate markings and the type designation and serial number, which allow identification of each drive. The type designation label is located on the left side of the drive. An example label is shown below.



No.	Description
1	Type designation, see section *Type designation key* on page *41*.
2	Frame (size)
3	Degree of protection
4	Nominal ratings in the supply voltage range, see section *Ratings* on page *496*.
5	Valid markings
6	S/N: Serial number of format MYYWWXXXX, where M: Manufacturer YY: 13, 14, 15, … for 2013, 2014, 2015, … WW: 01, 02, 03, … for week 1, week 2, week 3, … XXXXX: Integer starting every week from 0001

Type designation key

The type designation contains information on the specifications and configuration of the drive. You find the type designation on the type designation label attached to the drive. The first digits from the left express the basic configuration, for example, ACS580-01-12A6-5. The optional selections are given after that, separated by plus signs, for example, +L501. The main selections are described below. Not all selections are available for all types.

For more information, see *ACS580 Ordering information* (3AXD10000081909), available on the Internet, see section *Document library on the Internet* on the inside of the back cover.

ACS580-01-12A6-4+L501+K457+...

1 2 3 4

	CODE	DESCRIPTION
	Basic codes	
1	ACS580	Product series
	01	When no options are selected: Wall mounted, IP21 (UL type 1), assistant control panel with USB port, choke, EMC C2 filter (internal EMC filter), Safe torque off, braking chopper in frames R0, R1, R2, R3, coated boards, cable lead through entry from bottom, cable entry box or conduit plate with cable entries, Quick guides with default set of languages as well as web links to basic PC tool and latest manual versions.
2	**Size**	
	xxxx	Refer to the rating table, page *496*
3	**Voltage rating**	
	4	380…480 V
4	**Option codes (plus codes)**	
	Control panel and panel options	
	J400	ACS-AP-S Assistant control panel (as standard)
	J425	ACS-AP-I Assistant control panel
	J424	CDUM-01 Blank control panel cover (no control panel)
	K450	CDPI-01 panel bus adapter
	I/O (one slot available for I/O options)	
	L501	CMOD-01 External 24 V AC/DC and digital I/O extension (2×RO and 1×DO)
	L523	CMOD-02 External 24 V AC/DC and isolated PTC interface
	L512	CHDI-01 115/230 V Digital input extension (6×DI and 2×RO)

	CODE	DESCRIPTION
	Fieldbus adapters	
	K454	FPBA-01 PROFIBUS DP
	K457	FCAN-01 CANopen
	K451	FDNA-01 DeviceNet™
	K474	FENA-11 Ethernet (EtherNet/IP™, Modbus/TCP, PROFINET)
	K469	FECA-01 EtherCAT
	K458	FSCA-01 Modbus/RTU
	K470	FEPL-02 Ethernet POWERLINK
	K462	FCNA-01 ControlNet™
	K475	FENA-21 2-port Ethernet (EtherNet/IP™, Modbus/TCP, PROFINET)
	Embedded fieldbus	
		CEIA-01 Embedded Modbus RTU adapter, EIA-485 (as standard)
	Construction	
	B056	IP55 (UL type 12). Factory option, retro-fit not possible.
	H358	Cable conduit plate, blank. Up to frame R3.
	Full set of printed manuals in selected language. Note: The delivered manual set may include manuals in English if the translation is not available.	
	R700	English
	R701	German
	R702	Italian
	R703	Dutch
	R704	Danish
	R705	Swedish
	R706	Finnish
	R707	French
	R708	Spanish
	R709	Portuguese (Portugal)
	R711	Russian
	R712	Chinese
	R714	Turkish

4

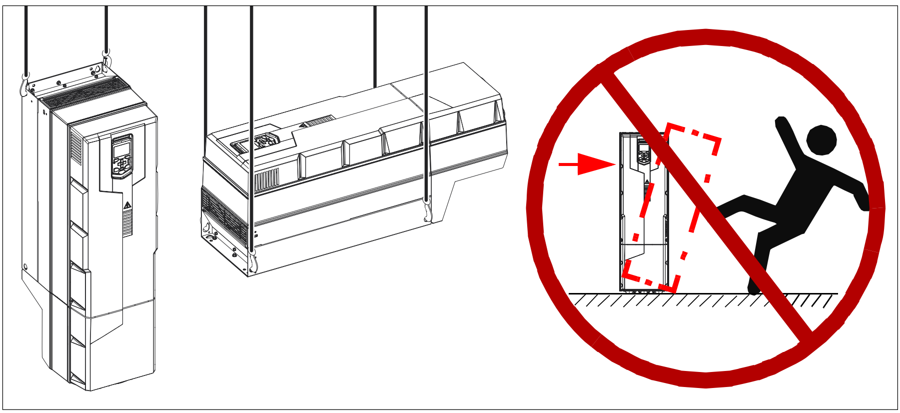
Mechanical installation

Contents of this chapter

The chapter tells how to check the installation site, unpack, check the delivery and install the drive mechanically.

Safety

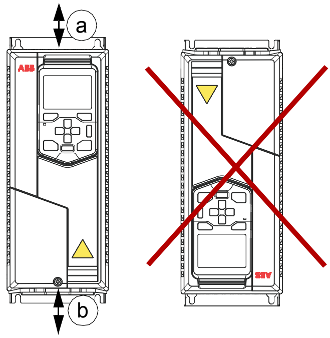
WARNING! Frames R6…R9: Lift the drive with a lifting device. Use the lifting eyes of the drive. Do not tilt the drive. **The drive is heavy and its center of gravity is high. An overturning drive can cause physical injury.**



Checking the installation site

The drive must be installed on the wall. There are three alternative ways to mount it:

- vertically alone. Do not install the drive upside down.

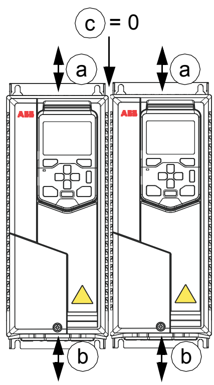


Frame size	Vertical mounting - Free space			
	Above (a)		Below (b)[1]	
	mm	in	mm	in
R0	200	7.9	200	7.9
R1	200	7.9	200	7.9
R2	200	7.9	200	7.9
R3	200	7.9	200	7.9
R5	200	7.9	300	11.8
R6	200	7.9	300	11.8
R7	200	7.9	300	11.8
R8	200	7.9	300	11.8
R9	200	7.9	300	11.8

3AXD00000586715.xls E

[1] Free space below is measured from the fan, not from the cable entry box used in frames R5…R9.

- vertically side by side

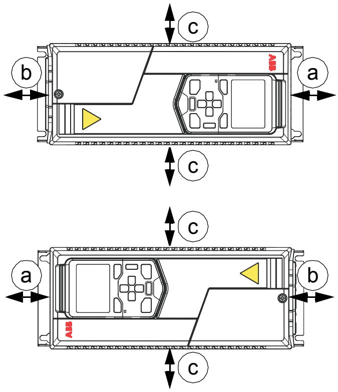


Frame size	Vertical mounting side by side - Free space					
	Above (a)		Below (b)[1]		Between (c)	
	mm	in	mm	in	mm	in
R0	200	7.9	200	7.9	0	0
R1	200	7.9	200	7.9	0	0
R2	200	7.9	200	7.9	0	0
R3	200	7.9	200	7.9	0	0
R5	200	7.9	300	11.8	0	0
R6	200	7.9	300	11.8	0	0
R7	200	7.9	300	11.8	0	0
R8	200	7.9	300	11.8	0	0
R9	200	7.9	300	11.8	0	0

3AXD00000586715.xls E

[1] Free space below is measured from the fan, not from the cable entry box used in frames R5…R9.

- horizontally alone.



Frame size	Horizontal mounting - Free space					
	Above (a)		Below (b)[1)]		Side (c)	
	mm	in	mm	in	mm	in
R0	TBA	TBA	TBA	TBA	TBA	TBA
R1	TBA	TBA	TBA	TBA	TBA	TBA
R2	TBA	TBA	TBA	TBA	TBA	TBA
R3	TBA	TBA	TBA	TBA	TBA	TBA
R5	TBA	TBA	TBA	TBA	TBA	TBA
R6	TBA	TBA	TBA	TBA	TBA	TBA
R7	TBA	TBA	TBA	TBA	TBA	TBA
R8	TBA	TBA	TBA	TBA	TBA	TBA
R9	TBA	TBA	TBA	TBA	TBA	TBA

3AXD00000586715.xls E

1) Free space below is measured from the fan, not from the cable entry box used in frames R5…R9.

Check the installation site according to the requirements below:

- The installation site is sufficiently ventilated or cooled to transfer away the drive losses. See section *Losses, cooling data and noise* on page *505*.
- The operation conditions of the drive meet the specifications given in section *Ambient conditions* on page *515*.
- The wall is as close to vertical as possible, of non-flammable material and strong enough to carry the weight of the drive, see section *Dimensions, weights and free space requirements* on page *503*.
- The floor/material below the installation is non-flammable.
- There is enough free space above and below the drive to enable cooling air flow, service and maintenance, See the required free space tables for each of the different mounting alignments on page *44* (or page *503*).

Required tools

To install the drive mechanically, you need the following tools:

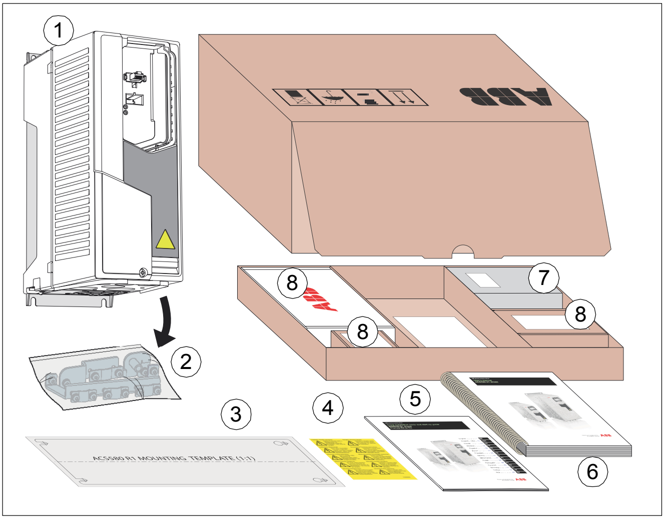
- drill with suitable bits
- screwdriver and/or wrench with a set of suitable bits (as appropriate for the mounting hardware used)
- tape measure, if you will not be using the provided mounting template.

Moving the drive

Frames R5…R9: Move the transport package by pallet truck to the installation site.

Unpacking and examining delivery, frames R0…R3

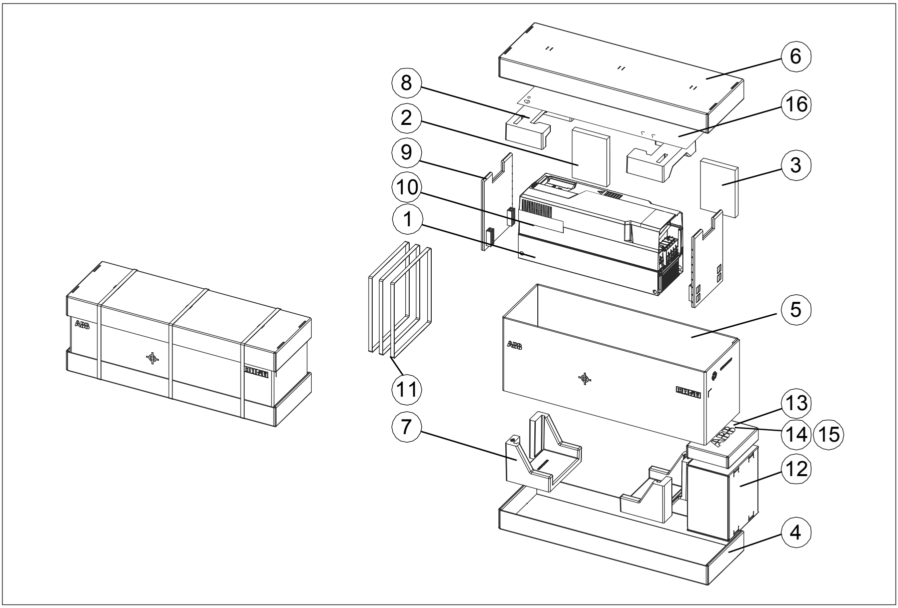
The figure below shows the drive package with its contents. Examine that all items are present and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type. See section *Type designation label* on page *40*.



1	Drive (frame R1 shown)
2	Mounting accessories in plastic bag(s), under the drive cover
3	Mounting template
4	Multilingual residual voltage warning stickers
5	Multilingual quick installation and start-up guide
6	User’s manual (if ordered with a plus code)
7	Control panel selected in the order (in a separate package)
8	Possible options in separate packages, if they have been ordered with a plus code, such as for example +K457 (FCAN-01 CANopen adapter module)

Unpacking and examining delivery, frame R5

The figure below shows the layout of the transport package. Examine that all items are present and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type. See section *Type designation label* on page *40*.



1	Drive with factory installed options.
2	Multilingual quick installation and start-up guide, multilingual residual voltage warning stickers
3	User’s manual (if ordered with a plus code)
4	Cardboard tray
5	Cardboard sleeve
6	Top cardboard cover
7, 8	Cushions
9	Cardboard support

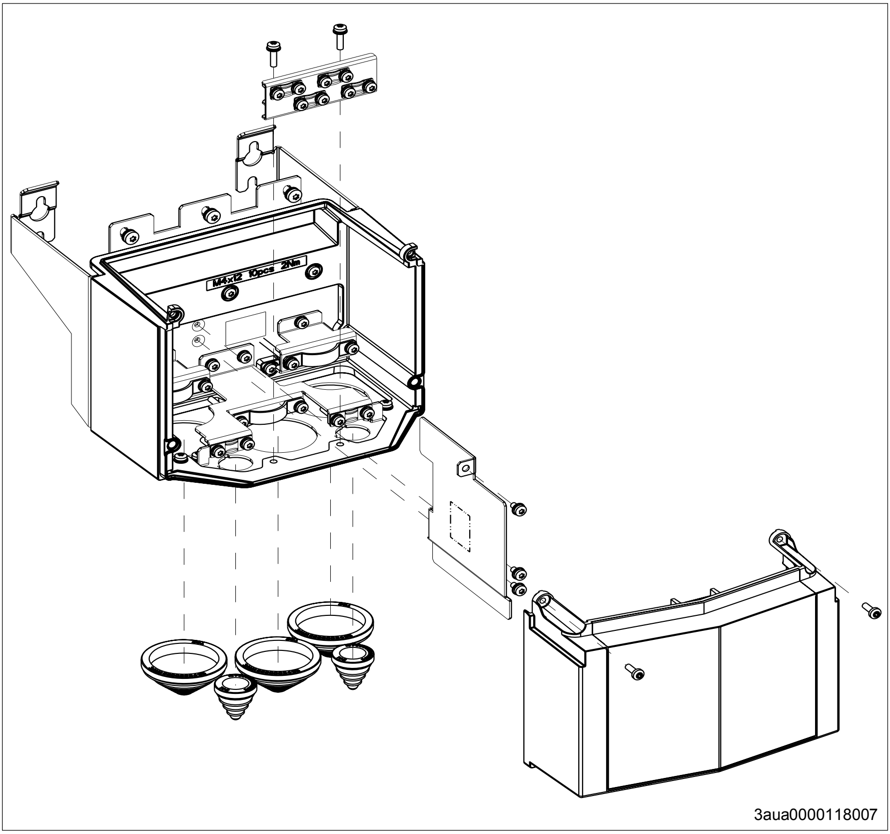
10	Support tape
11	PET straps
12	Cable entry box package
13	Option tray
14	Control panel selected in the order (in a separate package) in the option tray
15	Possible options in separate packages, if they have been ordered with a plus code, such as for example +K457 (FCAN-01 CANopen adapter module) in the option tray
16	Mounting template

To unpack:

- Cut the straps (11).
- Remove the top cardboard cover (6) and cushions (7, 8).
- Lift the cardboard sleeve (5).
- Lift the drive.

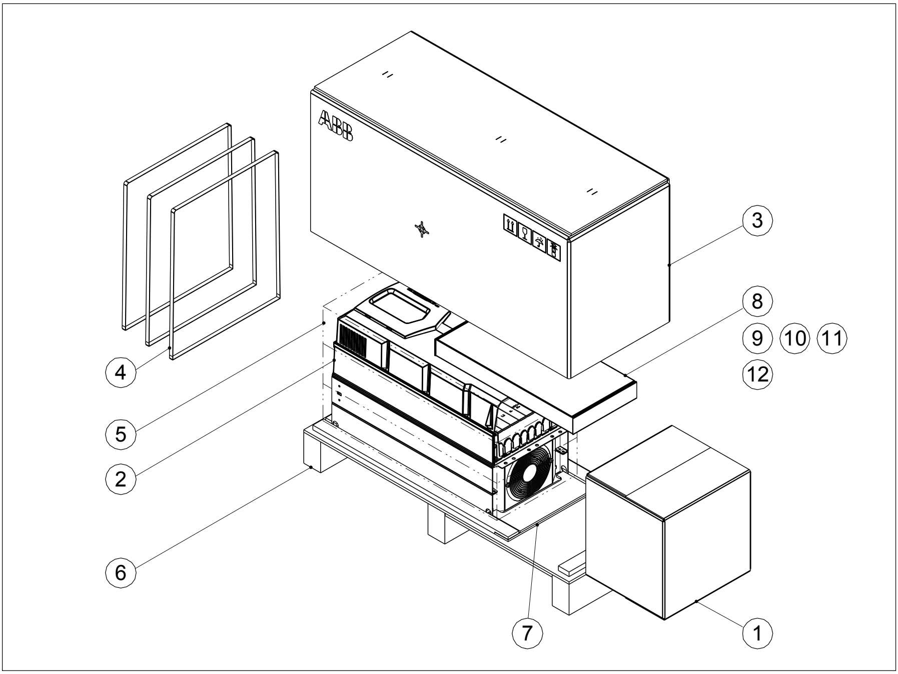
Frame R5 cable entry box

This illustration shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive module frame.



Unpacking and examining delivery, frames R6…R9

The figure below shows the layout of the transport package. Examine that all items are present and there are no signs of damage. Read the data on the type designation label of the drive to make sure that the drive is of the correct type. See section *Type designation label* on page *40*.



1	Cable entry box. Power and control cable grounding shelves in a plastic bag, assembly drawing.
2	Drive with factory installed options.
3	Cardboard box
4	Straps
5	VCI bag for protecting against corrosion
6	Pallet
7	Stopper
8	Option tray

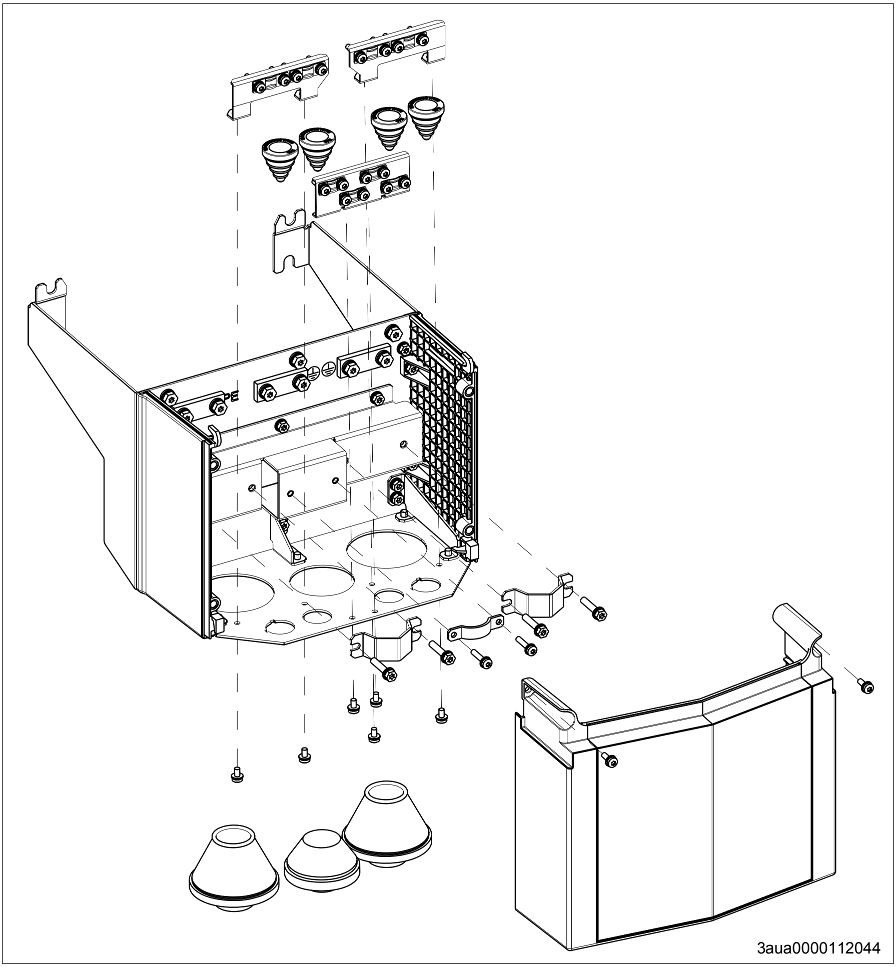
9	In the option tray • Multilingual quick installation and start-up guide • User's manual (if ordered with a plus code) • Multilingual residual voltage warning stickers
10	Control panel selected in the order (in a separate package) in the option tray
11	Possible options in separate packages, if they have been ordered with a plus code, such as for example +K457 (FCAN-01 CANopen adapter module) in the option tray
12	Mounting template on top of the option tray

To unpack:

- Cut the straps (4).
- Remove the cardboard box (3) and option tray (8).
- Remove the VCI bag (5).
- Attach lifting hooks to the lifting eyes of the drive (see the figure on page 43). Lift the drive with a hoist.

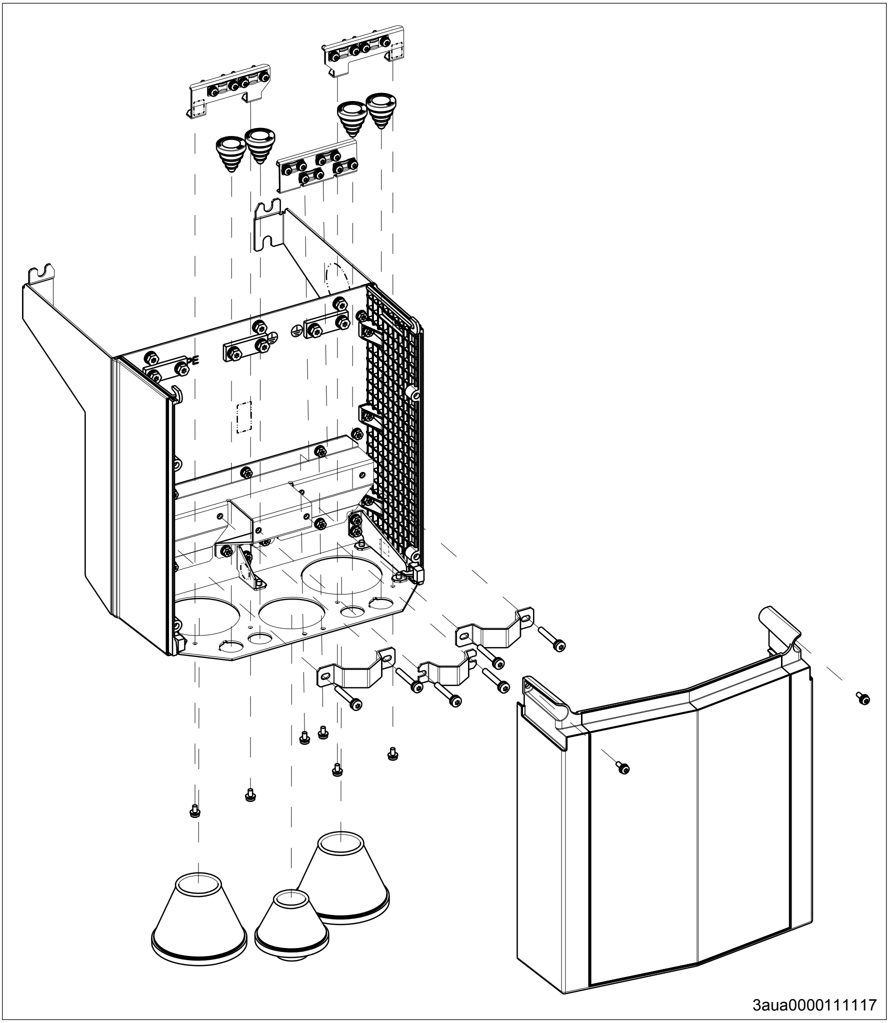
Frame R6 cable entry box

The figure below shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive frame.



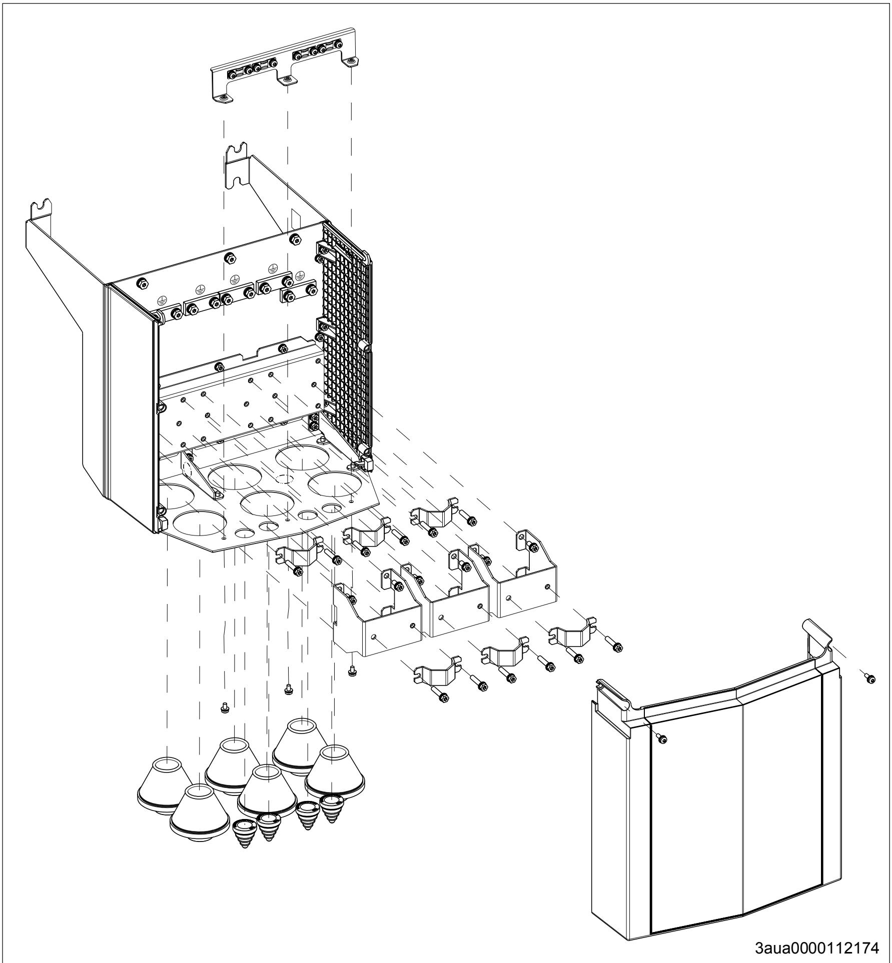
Frame R7 cable entry box

The figure below shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive frame.



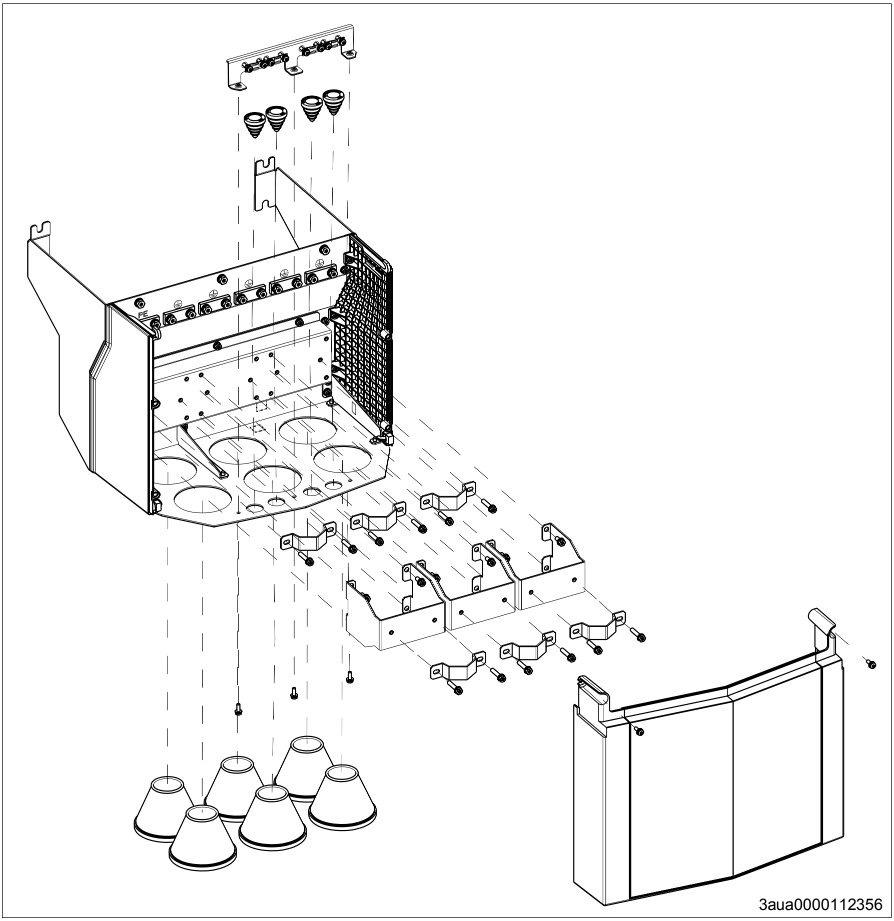
Frame R8 cable entry box

The figure below shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive frame.



Frame R9 cable entry box

The figure below shows the contents of the cable entry box package. The package also includes an assembly drawing which shows how to install the cable entry box to the drive frame.

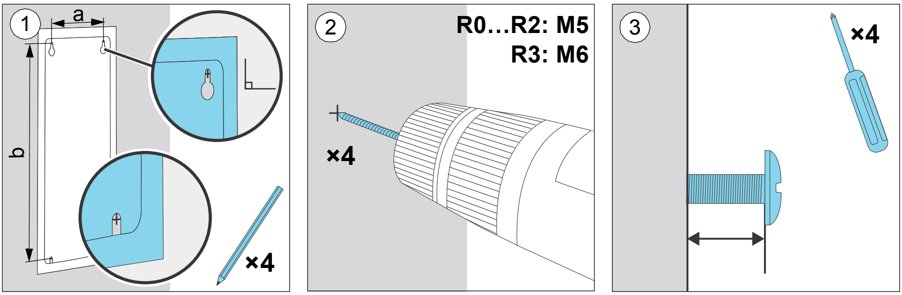


Installing the drive

Installing the drive vertically, frames R0…R3

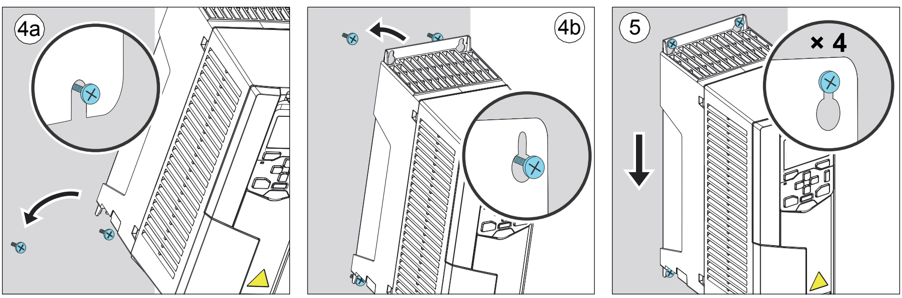
The figures show frame R0 as an example.

1. Mark the hole locations using the mounting template included in the package. Do not leave the mounting template under the drive. The drive dimensions and hole locations are also shown in the drawings in chapter *Dimension drawings* on page *523*.
2. Drill the mounting holes.
3. Start the screws or bolts into the mounting holes.



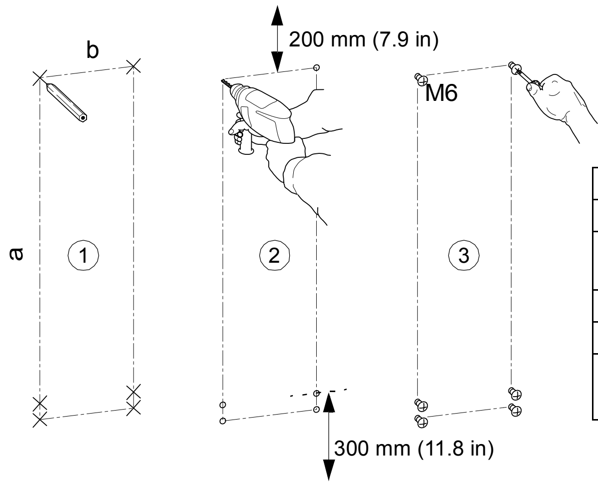
	R0		R1		R2		R3	
	mm	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**
a	98	3.86	98	3.86	98	3.86	160	6.30
b	317	12.48	317	12.48	417	16.42	473	18.62
Weight	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
	4.47	9.86	4.57	10.08	7.54	16.63	14.86	32.77

4. Position the drive onto the screws on the wall.
5. Tighten the screws in the wall securely.



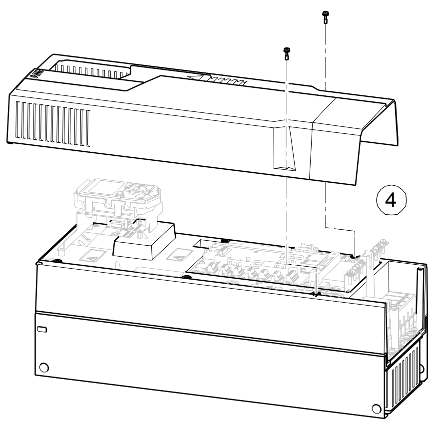
Installing the drive vertically, frame R5

1. Mark the hole locations using the mounting template included in the package. Do not leave the mounting template under the drive. The drive dimensions and hole locations are also shown in the drawings in chapter *Dimension drawings* on page *523*.
2. Drill the mounting holes.
3. Start the screws or bolts into the mounting holes.

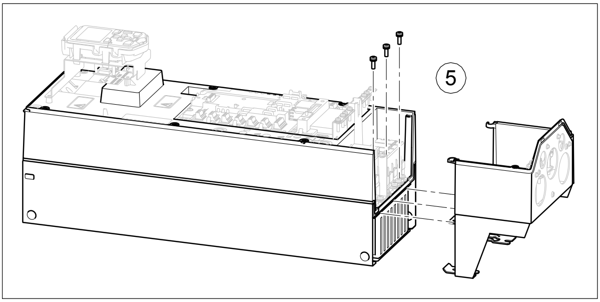


	R5	
	mm	**in**
a	581/ 611.5	22.87/ 24.07
b	160	6.30
	kg	**lb**
⚠	23.0	50.72

4. Remove the front cover: Remove the fastening screws, move the cover to the top side and then up.

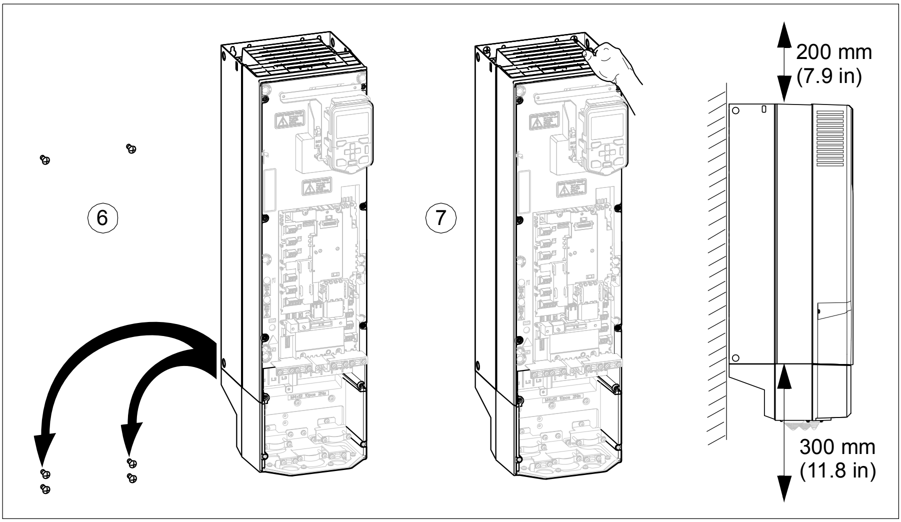


5. Attach the cable entry box to the drive frame. Push the box up to the drive frame and tighten the box screws.



6. Position the drive (without the cover) onto the screws on the wall. Lift the drive with another person or with a lifting device as it is heavy.

7. Tighten the screws in the wall securely.

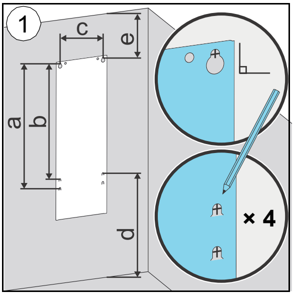


Installing the drive vertically, frames R6…R9

1. Mark the hole locations for the six mounting holes using the mounting template included in the package. Do not leave the mounting template under the drive.

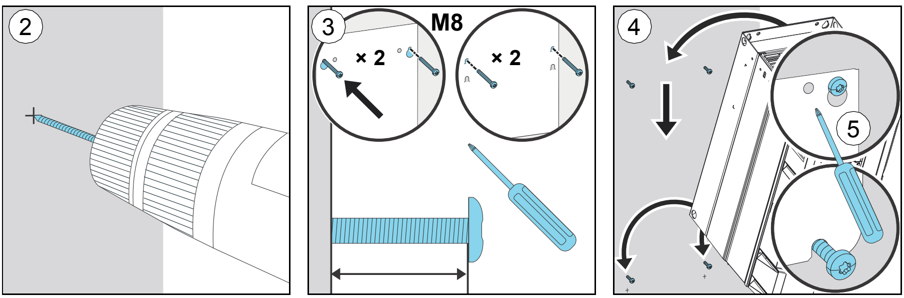
   The drive dimensions and hole locations are also shown in the drawings in chapter *Dimension drawings* on page *523*.

Note: You can use only two screws instead of four to attach the lower part of the drive.

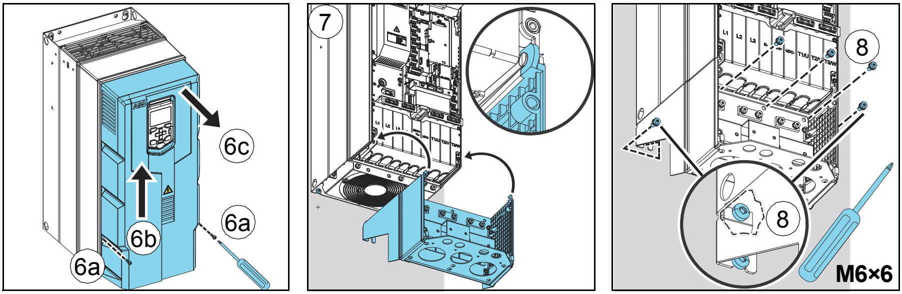


	R6		R7		R8		R9	
	mm	**in**	**mm**	**in**	**mm**	**in**	**mm**	**in**
a	571	22.5	623	24.5	701	27.6	718	28.3
b	531	20.9	583	22.9	658	25.9	658	25.9
c	213	8.4	245	9.7	263	10.4	345	13.6
d	300	11.8	300	11.8	300	11.8	300	11.8
e	200	7.9	200	7.9	200	7.9	200	7.9
	kg	**lb**	**kg**	**lb**	**kg**	**lb**	**kg**	**lb**
⚠	45	99	55	121	70	154	98	216

2. Drill the mounting holes.
3. Start the screws or bolts into the mounting holes.
4. Position the drive onto the screws on the wall. Lift the drive with another person as it is heavy.
5. Tighten the screws in the wall securely.



6. Remove the front cover: Remove the fastening screws (a), move the cover to the top side (b) and then up (c).
7. Attach the cable entry box to the drive frame.
8. Tighten the box screws: two at the top and four at the bottom.



Installing the drive vertically side by side

Install the drive following the steps in the appropriate section *Installing the drive vertically, frames R0…R3* (page *54*), *Installing the drive vertically, frame R5* (page *55*) or *Installing the drive vertically, frames R6…R9* (page *57*).

Installing the drive horizontally

Install the drive following the steps in the appropriate section *Installing the drive vertically, frames R0…R3* (page *54*), *Installing the drive vertically, frame R5* (page *55*) or *Installing the drive vertically, frames R6…R9* (page *57*). The drive can be mounted either the left or right side up.

Note: It is not allowed to mount drives immediately on top of it each other.

5

Planning the electrical installation

Contents of this chapter

This chapter contains instructions for planning the electrical installation of the drive, for example, for checking the compatibility of the motor and drive, selecting cables, protections and cable routing.

Note: The installation must always be designed and made according to applicable local laws and regulations. ABB does not assume any liability whatsoever for any installation which breaches the local laws and/or other regulations. Furthermore, if the recommendations given by ABB are not followed, the drive may experience problems that the warranty does not cover.

Selecting the supply disconnecting device

Install a hand-operated input disconnecting device between the AC power source and the drive. The disconnecting device must be of a type that can be locked to the open position for installation and maintenance work.

European Union

To meet the European Union Directives, according to standard EN 60204-1, *Safety of Machinery*, the disconnecting device must be one of the following types:

- switch-disconnector of utilization category AC-23B (EN 60947-3)
- disconnector that has an auxiliary contact that in all cases causes switching devices to break the load circuit before the opening of the main contacts of the disconnector (EN 60947-3)
- circuit breaker suitable for isolation in accordance with EN 60947-2.

Other regions

The disconnecting device must conform to the applicable local safety regulations.

Checking the compatibility of the motor and drive

Use an asynchronous AC induction motor or a permanent magnet motor with the drive. Several induction motors can be connected to the drive at a time but only one permanent magnet motor can be connected to the drive at a time.

Check that the motor and the drive are compatible according to the rating table in section *Ratings* on page *496*. The table lists the typical motor power for each drive type.

Selecting the power cables

General rules

Select the input power and motor cables **according to local regulations**:

- The input power and the motor cables must be able to carry the corresponding load currents. See section *Ratings* (page *496*) for the rated currents.
- The cable must be rated for at least 70 °C maximum permissible temperature of conductor in continuous use. For US, see *Additional US requirements,* page *63.*
- The conductivity of the PE conductor must be sufficient, see the table on page 60.
- 600 V AC cable is accepted for up to 500 V AC.

To comply with the EMC requirements of the CE mark, use one of the approved cable types in section *Recommended power cable types* on page *62*.

Symmetrical shielded cable reduces electromagnetic emission of the whole drive system as well as the stress on motor insulation, bearing currents and wear.

The protective conductor must always have an adequate conductivity. The table below shows the minimum cross-sectional area related to the phase conductor size according to IEC 61439-1 when the phase conductor and the protective conductor are made of the same metal.

Cross-sectional area of the phase conductors S (mm^2)	**Minimum cross-sectional area of the corresponding protective conductor S_p (mm^2)**
$S \leq 16$	S
$16 < S \leq 35$	16
$35 < S$	S/2

Note: See the IEC/EN 61800-5-1 requirement on grounding in the Note on page 22.

Typical power cable sizes

The table below gives copper cable types with concentric copper shield for the drives with nominal current. The value separated by the plus sign means the diameter of the PE conductor. Aluminum cables are not allowed.

Drive type	IEC[1)]	US	Frame size
	Cu cable type	Cu cable type	
	mm²	AWG/kcmil	
3-phase U_N = 400 V (380…480 V)			
ACS580-01-02A6-4	3×1.5 + 1.5	16	R0
ACS580-01-03A3-4	3×1.5 + 1.5	16	R0
ACS580-01-04A0-4	3×1.5 + 1.5	16	R0
ACS580-01-05A6-4	3×1.5 + 1.5	16	R0
ACS580-01-07A2-4	3×1.5 + 1.5	16	R1
ACS580-01-09A4-4	3×2.5 + 2.5	14	R1
ACS580-01-12A6-4	3×2.5 + 2.5	14	R1
ACS580-01-017A-4	3×2.5 + 2.5	14	R2
ACS580-01-025A-4	3×6 + 6	10	R2
ACS580-01-032A-4	3×10 + 10	8	R3
ACS580-01-038A-4	3×10 + 10	8	R3
ACS580-01-045A-4	3×16 +16	6	R3
ACS580-01-061A-4	3×25 + 16	4	R5
ACS580-01-072A-4	3×35 + 16	2	R5
ACS580-01-087A-4	3×35 + 16	2	R5
ACS580-01-105A-4	3×50 + 25	1/0	R6
ACS580-01-145A-4	3×95 + 50	3/0	R6
ACS580-01-169A-4	3×120 + 70	250 MCM	R7
ACS580-01-206A-4	3×150 + 70	300 MCM	R7
ACS580-01-246A-4	2×(3×70+35)	2×2/0	R8
ACS580-01-293A-4	2×(3×95+50)	2×3/0	R8
ACS580-01-363A-4	2×(3×120+70)	2×250 MCM	R9
ACS580-01-430A-4	2×(3×150+70)	2×300 MCM	R9

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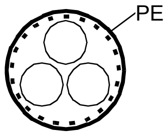
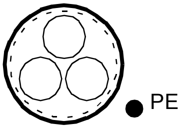
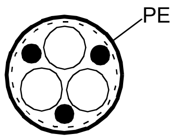
1) The cable sizing is based on max. 6 cables laid on a cable ladder side by side, ambient temperature 30 °C, PVC insulation, surface temperature 70 °C (EN 60204-1 and IEC 60364-5-52/2001). For other conditions, size the cables according to local safety regulations, appropriate input voltage and the load current of the drive. See also page 506 for the accepted cable sizes of the drive.

See also section *Terminal and lead-through data for the power cables* on page 506.

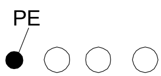
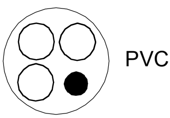
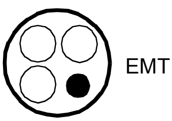
Alternative power cable types

The recommended and the not allowed power cable types to be used with the drive are presented below.

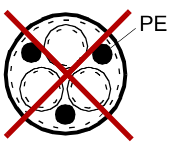
Recommended power cable types

	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as the shield. The shield must meet the requirements of IEC 61439-1, see page *60*. Check with local/state/country electrical codes for allowance.
	Symmetrical shielded cable with three phase conductors and a concentric PE conductor as the shield. A separate PE conductor is required if the shield does not meet the requirements of IEC 61439-1, see page *60*.
	Symmetrical shielded cable with three phase conductors and symmetrically constructed PE conductor, and a shield. The PE conductor must meet the requirements of IEC 61439-1, see page *60*.

Power cable types for limited use

	A four-conductor system (three phase conductors and a protective conductor on a cable tray) is **not allowed for motor cabling** (it is allowed for input cabling).
	A four-conductor system (three phase conductors and a PE conductor in a PVC conduit) is **allowed for input cabling with phase conductor cross-section less than 10 mm^2 (8 AWG) or motors ≤ 30 kW (40 hp)**. Not allowed in the USA.
	Corrugated or EMT cable with three phase conductors and a protective conductor is allowed for motor cabling with phase conductor cross section less than 10 mm^2 (8 AWG) or motors ≤ 30 kW (40 hp).

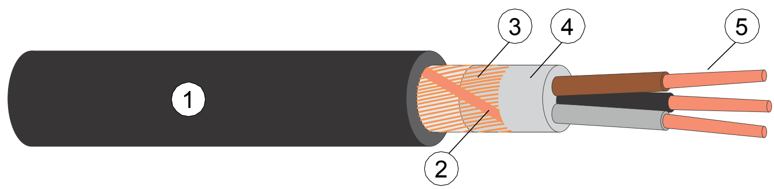
Not allowed power cable types

	Symmetrical shielded cable with individual shields for each phase conductor is not allowed on any cable size for input or motor cabling.

Motor cable shield

If the motor cable shield is used as the sole protective earth conductor of the motor, make sure that the conductivity of the shield is sufficient. See section *General rules* above, or IEC 61439-1.

To effectively suppress radiated and conducted radio-frequency emissions, the cable shield conductivity must be at least 1/10 of the phase conductor conductivity. The requirements are easily met with a copper or aluminum shield. The minimum requirement of the motor cable shield of the drive is shown below. It consists of a concentric layer of copper wires with an open helix of copper tape or copper wire. The better and tighter the shield, the lower the emission level and bearing currents.



1	Sheath
2	Copper wire shield
3	Helix of copper tape or copper wire
4	Filling
5	Cable conductors

Additional US requirements

Use type MC continuous corrugated aluminum armor cable with symmetrical grounds or shielded power cable for the motor cables if metallic conduit is not used. For the North American market, 600 V AC cable is accepted for up to 500 V AC. 1000 V AC cable is required above 500 V AC (below 600 V AC). For drives rated over 100 amperes, the power cables must be rated for 75 °C (167 °F).

Conduit

Couple separate parts of a conduit together: bridge the joints with a ground conductor bonded to the conduit on each side of the joint. Also bond the conduits to the drive enclosure and motor frame. Use separate conduits for input power, motor, brake resistor, and control wiring. When conduit is employed, type MC continuous corrugated aluminum armor cable or shielded cable is not required. A dedicated ground cable is always required.

Note: Do not run motor wiring from more than one drive in the same conduit.

Armored cable / shielded power cable

Six-conductor (three phases and three ground) type MC continuous corrugated aluminum armor cable with symmetrical grounds is available from the following suppliers (trade names in parentheses):

- Anixter Wire & Cable (Philsheath)
- BICC General Corp (Philsheath)
- Rockbestos Co. (Gardex)
- Oaknite (CLX).

Shielded power cables are available from the following suppliers:

- Belden
- LAPPKABEL (ÖLFLEX)
- Pirelli.

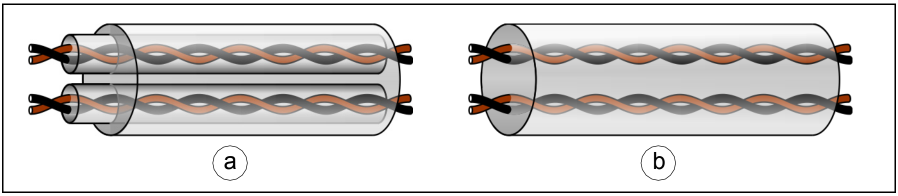
Selecting the control cables

Shielding

All control cables must be shielded.

Use a double-shielded twisted pair cable (figure a below) for analog signals. Employ one individually shielded pair for each signal. Do not use common return for different analog signals.

A double-shielded cable is the best alternative for low-voltage digital signals but single-shielded (b) twisted pair cable is also acceptable.



Signals in separate cables

Run analog and digital signals in separate, shielded cables.

Do not mix 24 V AC/DC and 115/230 V AC signals in the same cable.

Signals allowed to be run in the same cable

Relay-controlled signals, providing their voltage does not exceed 48 V, can be run in the same cables as digital input signals. The relay-controlled signals should be run as twisted pairs.

Relay cable

The cable type with braided metallic screen (for example ÖLFLEX by LAPPKABEL, Germany) has been tested and approved by ABB.

Control panel cable

In remote use, the cable connecting the control panel to the drive must not exceed 100 m (330 ft). If multiple panels or drives are connected, the total length of the panel bus must not exceed 100 m (330 ft).

The cable type tested and approved by ABB is used in control panel option kits. Suitable cables are CAT 5e unshielded or shielded twisted pair cables.

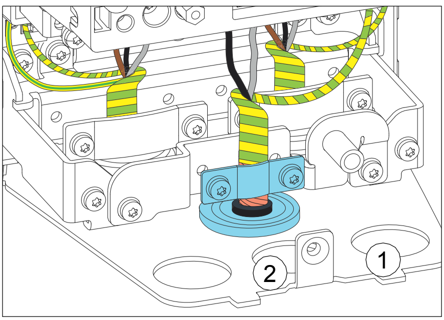
Drive composer PC tool cable

Connect the Drive composer PC tool to the drive through the USB port of the control panel. Use a USB type A (PC) - type B (control panel) cable. The maximum length of the cable is 3 m (9.8 ft).

FPBA-01 PROFIBUS DP adapter module connectors

<u>Frames R0…R3</u>: The following connector types have been tested to fit in the tight space for option slot 1.

- Phoenix Contact SUBCON-PLUS-PROFIB/PG/SC2, part number 2708245. Lead the cable through the control cable hole on the right in the lead-through plate (1).
- Siemens, part number 6GK1 500 0EA02. Lead the cable through the middle control cable hole in the lead-through plate (2).



Routing the cables

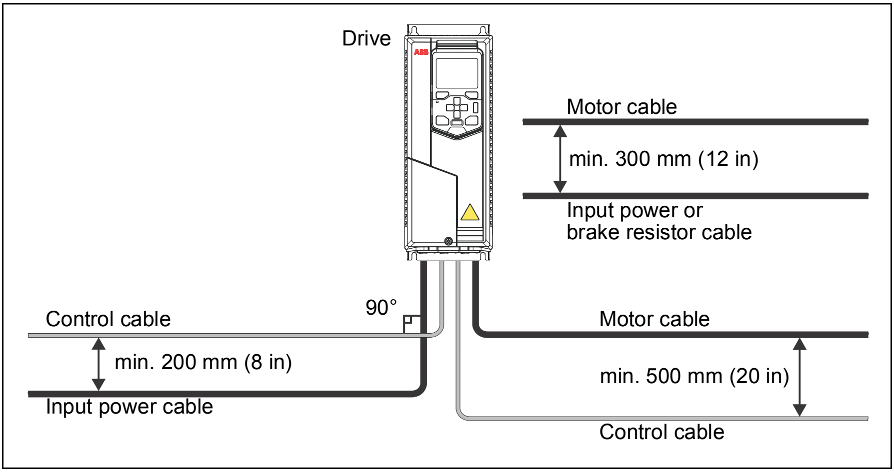
General rules

Route the motor cable away from other cable routes. Motor cables of several drives can be run in parallel installed next to each other. The motor cable, input power cable and control cables should be installed on separate trays. Avoid long parallel runs of motor cables with other cables in order to decrease electromagnetic interference caused by the rapid changes in the drive output voltage.

Where control cables must cross power cables, make sure they are arranged at an angle as near to 90 degrees as possible. Do not run extra cables through the drive.

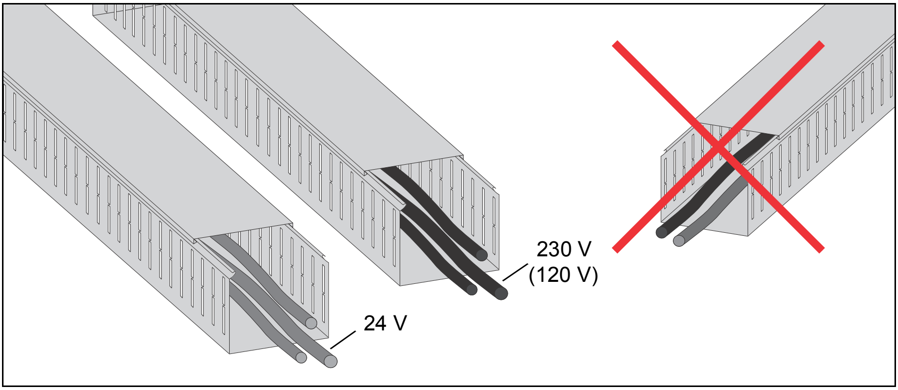
The cable trays must have good electrical bonding to each other and to the grounding electrodes. Aluminum tray systems can be used to improve local equalizing of potential.

A diagram of the cable routing is shown below.



Separate control cable ducts

Lead 24 V and 230 V (120 V) control cables in separate ducts unless the 24 V cable is insulated for 230 V (120 V) or insulated with an insulation sleeving for 230 V (120 V).



Continuous motor cable shield or enclosure for equipment on the motor cable

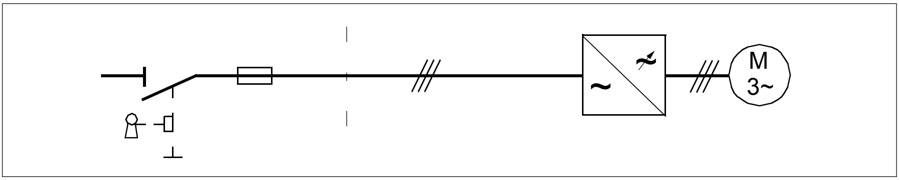
To minimize the emission level when safety switches, contactors, connection boxes or similar equipment are installed on the motor cable between the drive and the motor:

- European Union: Install the equipment in a metal enclosure with 360 degree grounding for the shields of both the incoming and outgoing cable, or connect the shields of the cables otherwise together.
- US: Install the equipment in a metal enclosure in a way that the conduit or motor cable shielding runs consistently without breaks from the drive to the motor.

Implementing thermal overload and short-circuit protection

Protecting the drive and input power cable in short-circuits

Protect the drive and input cable with fuses as follows:



Size the fuses at the distribution board according to instructions given in chapter *Technical data* on page *495*. The fuses will protect the input cable in short-circuit situations, restrict drive damage and prevent damage to adjoining equipment in case of a short-circuit inside the drive.

Note: Circuit breakers must not be used without fuses.

Protecting the motor and motor cable in short-circuits

The drive protects the motor cable and motor in a short-circuit situation when the motor cable is sized according to the nominal current of the drive. No additional protection devices are needed.

Protecting the drive and the input power and motor cables against thermal overload

The drive protects itself and the input and motor cables against thermal overload when the cables are sized according to the nominal current of the drive. No additional thermal protection devices are needed.

WARNING! If the drive is connected to multiple motors, use a separate circuit breaker or fuses for protecting each motor cable and motor against overload. The drive overload protection is tuned for the total motor load. It may not trip due to an overload in one motor circuit only

Protecting the motor against thermal overload

According to regulations, the motor must be protected against thermal overload and the current must be switched off when overload is detected. The drive includes a motor thermal protection function that protects the motor and switches off the current when necessary. Depending on a drive parameter value, the function either monitors a calculated temperature value (based on a motor thermal model) or an actual temperature indication given by motor temperature sensors. The user can tune the thermal model further by feeding in additional motor and load data.

The most common temperature sensors are:

- motor sizes IEC180…225: thermal switch, eg, Klixon
- motor sizes IEC200…250 and larger: PTC or Pt100.

For more information, see section *Motor thermal protection* on page *214*.

Protecting the drive against ground faults

The drive is equipped with an internal ground fault protective function to protect the unit against ground faults in the motor and motor cable. This is not a personnel safety or a fire protection feature. The ground fault protective function can be reduced with a parameter *31.20 Earth fault*.

Residual current device compatibility

The drive is suitable to be used with residual current devices of Type B.

Note: The EMC filter of the drive includes capacitors connected between the main circuit and the frame. These capacitors and long motor cables increase the ground leakage current and may cause fault current circuit breakers to function.

Implementing the Emergency stop function

For safety reasons, install the emergency stop devices at each operator control station and at other operating stations where emergency stop may be needed. Design the emergency stop according to relevant standards.

Note: Pressing the stop key on the control panel of the drive does not generate an emergency stop of the motor or separate the drive from dangerous potential.

Implementing the Safe torque off function

See chapter *The Safe torque off function* on page *555*.

Implementing the Power-loss ride-through function

Implement the power-loss ride-through function as follows:

- Check that the power-loss ride-through function of the drive is enabled with parameter *30.31 Undervoltage control*.
- Parameter *21.01 Vector 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 Power-loss ride-through function.

Using a safety switch between the drive and the motor

It is recommended to install a safety switch between the permanent magnet motor and the drive output. This is needed to isolate the motor from the drive during maintenance work on the drive.

Using a contactor between the drive and the motor

Implementing the control of the output contactor depends on how you select the drive to operate. See also section *Implementing a bypass connection* on page *70*.

When you have selected to use

- Vector control mode and motor ramp stop,

open the contactor as follows:

1. Give a stop command to the drive.
2. Wait until the drive decelerates the motor to zero speed.
3. Open the contactor.

When you have selected to use

- Vector control mode and motor coast stop; or scalar control mode,

open the contactor as follows:

1. Give a stop command to the drive.
2. Open the contactor.

WARNING! When the Vector control mode is in use, never open the output contactor while the drive controls the motor. The vector control operate extremely fast, much faster than it takes for the contactor to open its contacts. When the contactor starts opening while the drive controls the motor, the vector control will try to maintain the load current by immediately increasing the drive output voltage to the maximum. This will damage, or even burn the contactor completely.

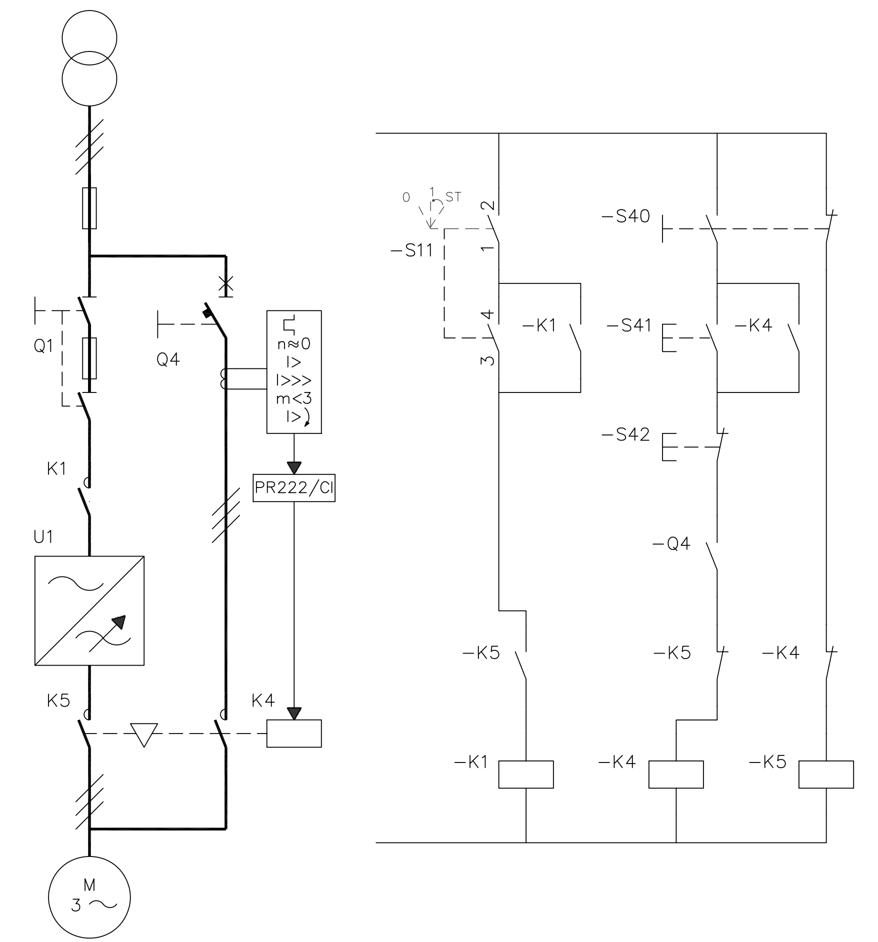
Implementing a bypass connection

If frequent bypassing is required, employ mechanically or electrically interlocked contactors between the motor and the drive and between the motor and the power line. Make sure with interlocking that the contactors cannot be closed simultaneously.

WARNING! Never connect the drive output to the electrical power network. The connection may damage the drive.

Example bypass connection

An example bypass connection is shown below.



Q1	Drive main switch	S11	Drive main contactor on/off control
Q4	Bypass circuit breaker	S40	Motor power supply selection (drive or direct-on-line)
K1	Drive main contactor	S41	Start when motor is connected direct-on-line

K4	Bypass contactor	S42	Stop when motor is connected direct-on-line
K5	Drive output contactor		

Switching the motor power supply from drive to direct-on-line

1. Stop the drive and the motor with the drive control panel (drive in local control mode) or with the external stop signal (drive in remote control mode).
2. Open the main contactor of the drive with S11.
3. Switch the motor power supply from the drive to direct-on-line with S40.
4. Wait for 10 seconds to allow the motor magnetization to die away.
5. Start the motor with S41.

Switching the motor power supply from direct-on-line to drive

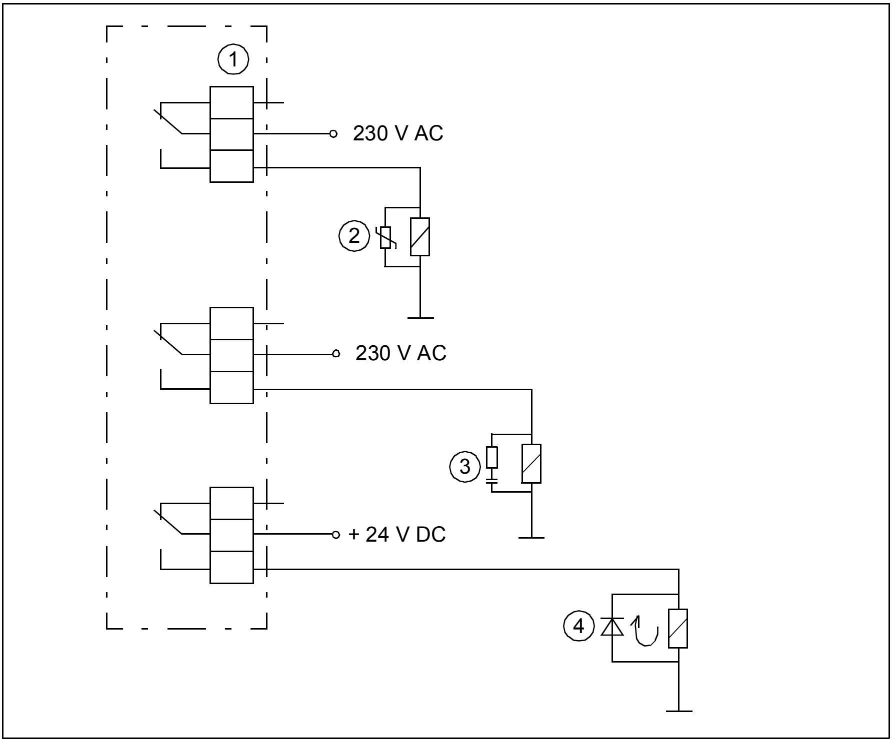
1. Stop the motor with S42.
2. Switch the motor power supply from direct-on-line to the drive with S40.
3. Close the main contactor of the drive with switch S11 (-> turn to position ST for two seconds and leave at position 1).
4. Start the drive and the motor with the drive control panel (drive in local control mode) or with the external start signal (drive in remote control mode).

Protecting the contacts of relay outputs

Inductive loads (relays, contactors, motors) cause voltage transients when switched off.

It is highly recommended that inductive loads are equipped with noise attenuating circuits (varistors, RC filters [AC] or diodes [DC]) in order to minimize the EMC emission at switch-off. If not suppressed, the disturbances may connect capacitively or inductively to other conductors in the control cable and form a risk of malfunction in other parts of the system.

Install the protective component as close to the inductive load as possible. Do not install protective components at the relay outputs.



1) Relay outputs; 2) varistor; 3) RC filter; 4) diode

Limiting relay output maximum voltages at high installation altitudes

See sections *Isolation areas, R0…R3:* on page *513* and *Isolation areas, R5…R9:* on page *514*.

6

Electrical installation

Contents of this chapter

The chapter describes how to check the insulation of the assembly and the compatibility with IT (ungrounded) and corner-grounded TN systems. It then shows how to connect the power and control cables, install optional modules and connect a PC.

Warnings

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. If you ignore them, injury or death, or damage to the equipment can occur.

Make sure that the drive is disconnected from the input power during installation. If the drive is already connected to the input power, wait for 5 minutes after disconnecting the input power.

Required tools

To perform the electrical installation, you need the following tools:

- wire stripper
- screwdriver and/or wrench with a set of suitable bits.

Checking the insulation of the assembly

Drive

Do not make any voltage tolerance or insulation resistance tests on any part of the drive as testing can damage the drive. Every drive has been tested for insulation between the main circuit and the chassis at the factory. Also, there are voltage-limiting circuits inside the drive which cut down the testing voltage automatically.

Input power cable

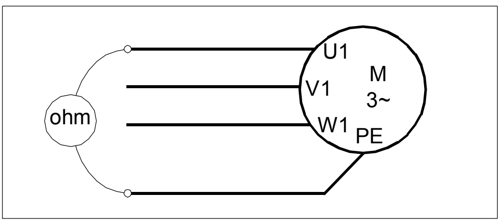
Check the insulation of the input cable according to local regulations before connecting it to the drive.

Motor and motor cable

Check the insulation of the motor and motor cable as follows:

1. Check that the motor cable is disconnected from the drive output terminals T1/U, T2/V and T3/W.
2. Measure the insulation resistance between each phase conductor and the Protective Earth conductor using a measuring voltage of 1000 V DC. The insulation resistance of an ABB motor must exceed 100 Mohm (reference value at 25 °C or 77 °F). For the insulation resistance of other motors, please consult the manufacturer's instructions.

   Note: Moisture inside the motor casing will reduce the insulation resistance. If moisture is suspected, dry the motor and repeat the measurement.

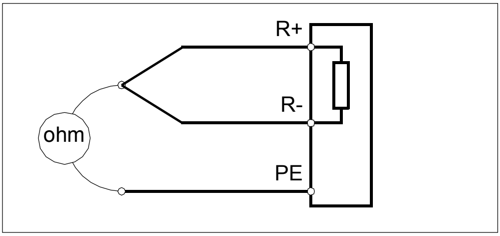


Brake resistor assembly

Check the insulation of the brake resistor assembly (if present) as follows:

1. Check that the resistor cable is connected to the resistor, and disconnected from the drive output terminals R+ and R-.
2. At the drive end, connect the R+ and R- conductors of the resistor cable together. Measure the insulation resistance between the combined conductors and the PE

conductor by using a measuring voltage of 1 kV DC. The insulation resistance must be higher than 1 Mohm.



Checking the compatibility with IT (ungrounded) and corner-grounded TN systems

The internal EMC filter is not suitable for use on an IT (ungrounded) system or on a corner-grounded TN system. Disconnect the EMC filter before connecting the drive to the supply network. For instructions on how to do this, see page *78*.

WARNING! Do not install the drive with the internal EMC filter connected on an IT system (an ungrounded power system or a high-resistance-grounded [over 30 ohms] power system), otherwise the system will be connected to ground potential through the EMC filter capacitors of the drive. This can cause danger, or damage the drive.

Do not install the drive with the internal EMC filter connected on a corner-grounded TN system, otherwise the drive will be damaged.

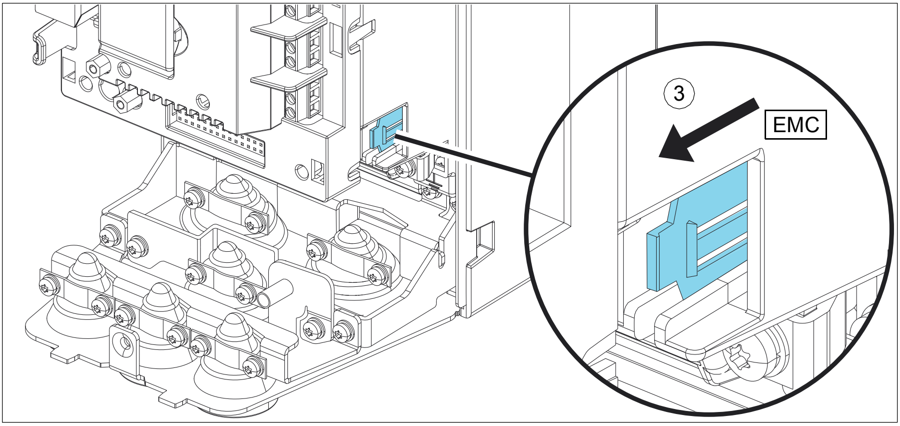
Note: When the internal EMC filter is disconnected, the drive EMC compatibility is considerably reduced. See section *EMC compatibility and motor cable length* on page *510*.

Frames R0…R3

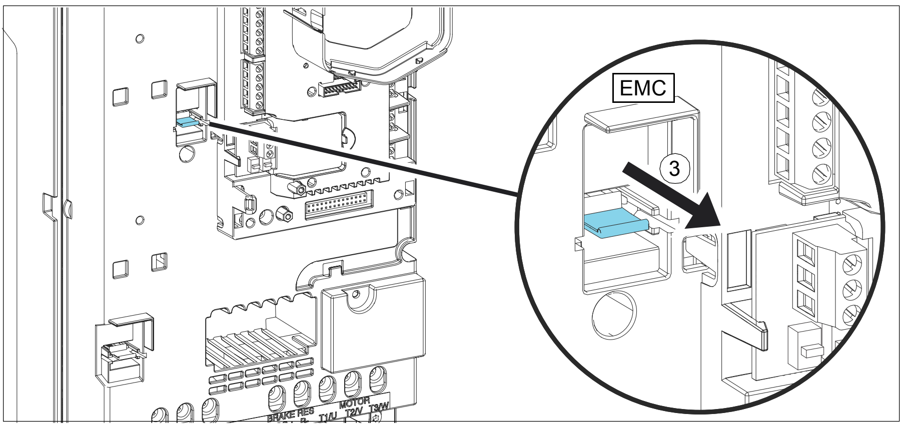
If you have an IT (ungrounded) or corner-grounded TN system, do as follows:

1. Switch off the power from the drive.
2. Open the front cover, if not already opened, see page *81*.
3. Disconnect the internal EMC filter by sliding the EMC switch in the direction shown by the arrow.

R0…R2



R3

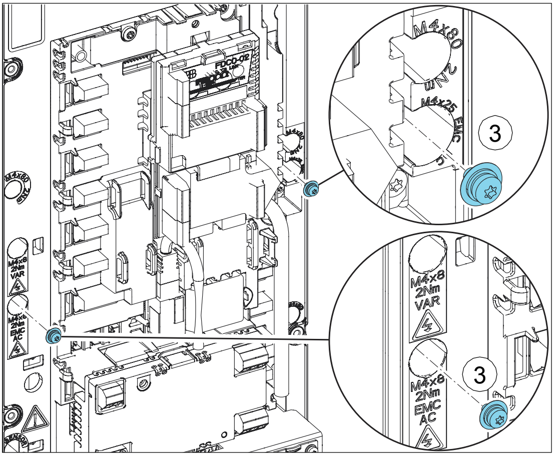


Frames R5…R9

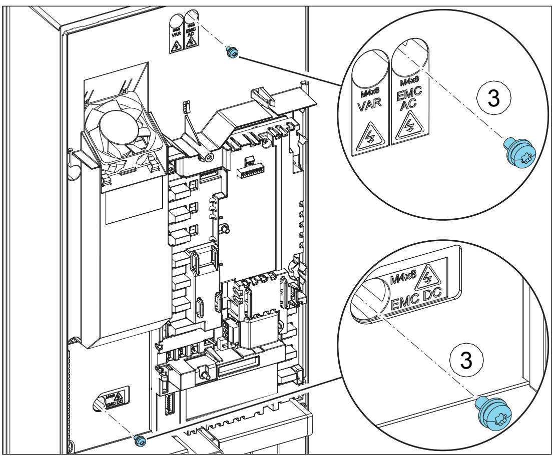
If you have an IT (ungrounded) or corner-grounded TN system, do as follows:

1. Switch off the power from the drive.
2. Open the cover, if not already opened. Frame R5: see page 55, frames R6…R9: see page 58.
3. Disconnect the internal EMC filter by removing the two EMC screws.

R5

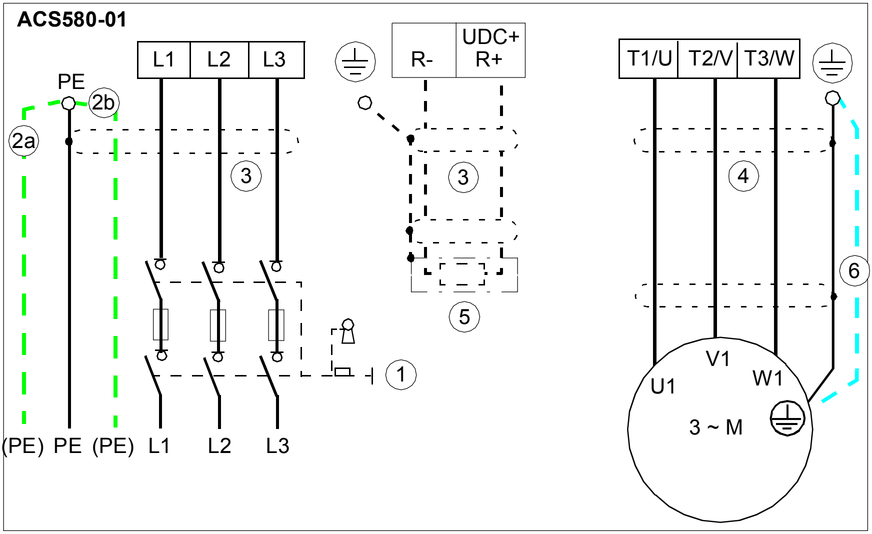


R6…R9



Connecting the power cables

Connection diagram



1	For alternatives, see section *Selecting the supply disconnecting device* on page *59.*
2	Use a separate grounding PE cable (2a) or a cable with a separate PE conductor (2b) if the conductivity of the shield does not meet the requirements for the PE conductor (see page *60*).
3	360-degree grounding is recommended if shielded cable is used. Ground the other end of the input cable shield or PE conductor at the distribution board.
4	360-degree grounding is required.
5	External brake resistor
6	Use a separate grounding cable if the shield does not meet the requirements of IEC 61439-1 (see page *60*) and there is no symmetrically constructed grounding conductor in the cable (see page *63*).

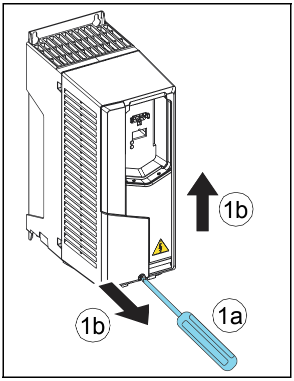
Note:

If there is a symmetrically constructed grounding conductor on the motor cable in addition to the conductive shield, connect the grounding conductor to the grounding terminal at the drive and motor ends.

Do not use an asymmetrically constructed motor cable for motors above 30 kW (see page *60*). Connecting its fourth conductor at the motor end increases bearing currents and causes extra wear.

Connection procedure, frames R0…R3

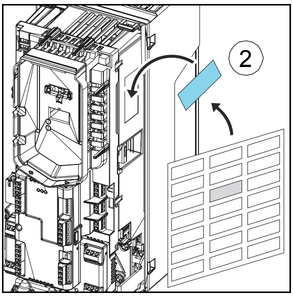
1. Remove the front cover: Loosen the retaining screw with a screwdriver (1a) and lift the cover from the bottom outwards (1b).



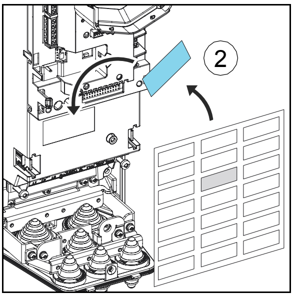
WARNING! If the drive will be connected on an IT (ungrounded) system or on a corner-grounded TN system, make sure you have disconnected the EMC filter. See page 77.

2. Attach the residual voltage warning sticker in the local language.

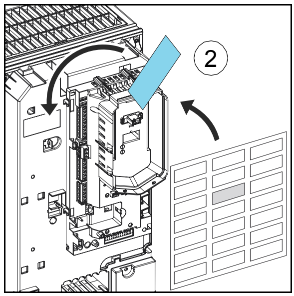
R0…R1



R2

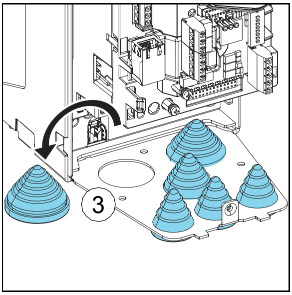


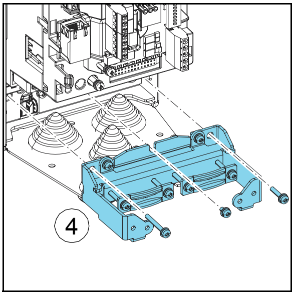
R3



3. Remove the rubber grommets from the lead-through plate.

4. <u>Frames R0…R2, optional</u>: It is possible to temporarily remove the power cable grounding shelf at this point to make it easier to connect the power cable conductors and twisted shields in a tight space. The grounding shelf must be reinstalled before grounding the stripped parts of the power cables 360 degrees.

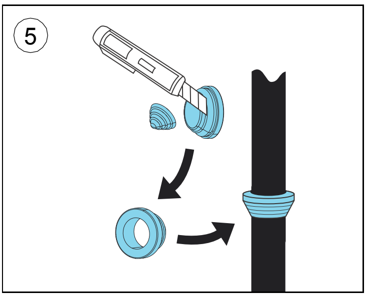


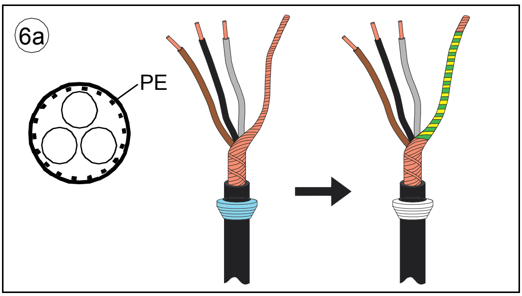


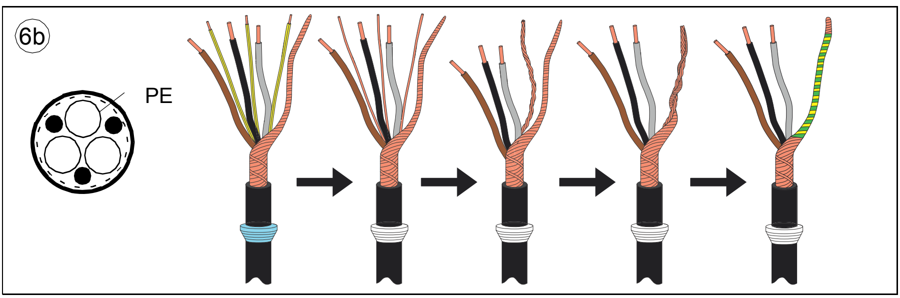
Motor cable

5. Cut an adequate hole into the rubber grommet. Slide the grommet onto the cable.

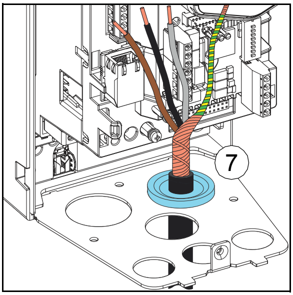
6. Prepare the ends of the cable as illustrated in the figure. Two different motor cable types are shown in the figures (6a, 6b). **Note:** The bare shield will be grounded 360 degrees.







7. Slide the cable through the hole of the lead-through plate and attach the grommet to the hole.

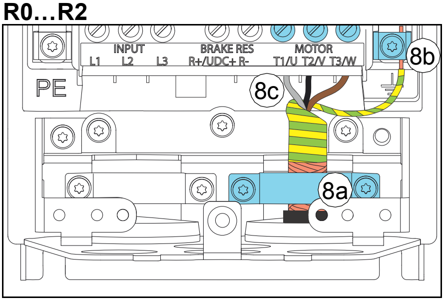


8. Connect the motor cable:

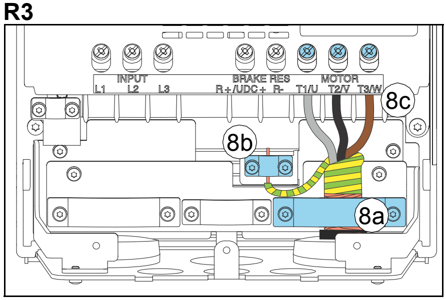
   If you temporarily removed the power cable grounding shelf in step *4*, connect the motor and input power cables except the 360 degree grounding, and then reinstall the grounding shelf. **Note:** The screws are of different length; find out where each of them is used in the figure at step *4*. After reinstalling the grounding shelf, you can make the 360 degree grounding for the cables.

   - Ground the shield 360 degrees by tightening the clamp of the power cable grounding shelf onto the stripped part of the cable. (8a)
   - Connect the twisted shield of the cable to the grounding terminal. (8b)
   - Connect the phase conductors of the cable to the T1/U, T2/V and T3/W terminals. Tighten the screws to the torque given below the figure. (8c).

R0…R2



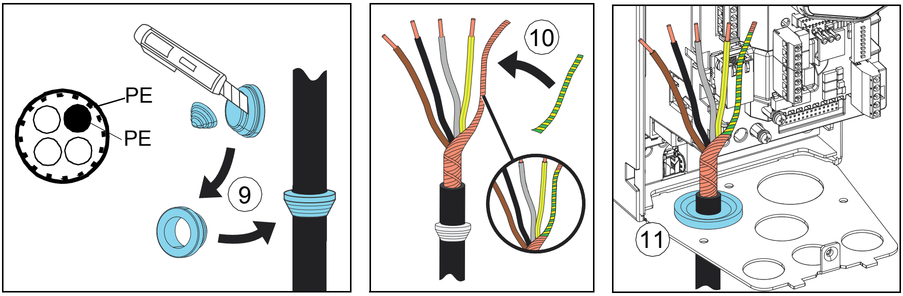
R3



Frame size	R0…R1		R2		R3	
	N·m	lbf·ft	N·m	lbf·ft	N·m	lbf·ft
L1, L2, L3, T1/U, T2/V, T3/W, R+, R-	0.5…0.6	0.4	1.2…1.5	0.9…1.1	2.5…4.5	1.8…3.3

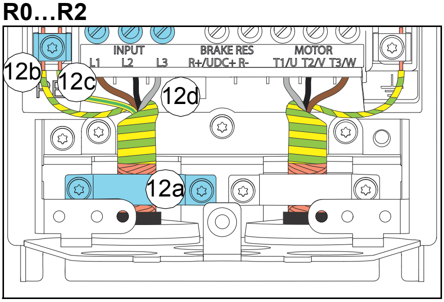
Input power cable

9. Cut an adequate hole into the rubber grommet. Slide the grommet onto the cable.
10. Prepare the ends of the cable as illustrated in the figure. **Note:** The bare shield will be grounded 360 degrees. Mark the pigtail made from the shield as a PE conductor with yellow-and-green color.
11. Slide the cable through the hole of the lead-through plate and attach the grommet to the hole.

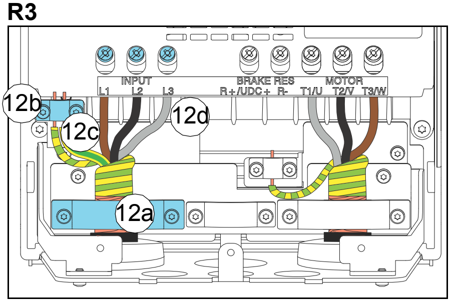


12. Connect the input power cable:
    - Ground the shield 360 degrees by tightening the clamp of the power cable grounding shelf onto the stripped part of the cable. (12a)
    - Connect the twisted shield of the cable to the grounding terminal. (12b)
    - Connect the additional PE conductor (see the note on page *21* in chapter *Safety instructions*) of the cable (12c).
    - Connect the phase conductors of the cable to the L1, L2 and L3 terminals. Tighten the screws to the torque given below the figure. (12d).

R0…R2



R3

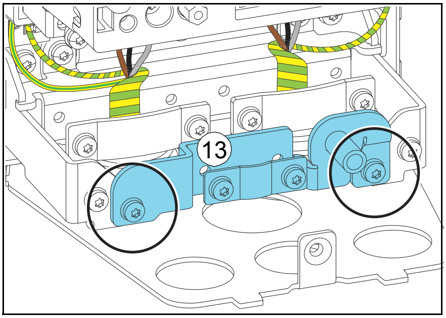


Frame size	R0…R1		R2		R3	
	N·m	lbf·ft	N·m	lbf·ft	N·m	lbf·ft
L1, L2, L3, T1/U, T2/V, T3/W, R+, R-	0.5…0.6	0.4	1.2…1.5	0.9…1.1	2.5…4.5	1.8…3.3

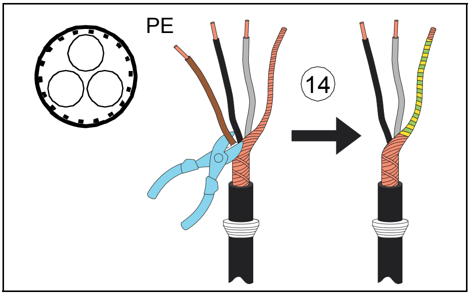
Brake resistor cable (if used)

13. Frames R0…R2: Install the grounding shelf for the brake resistor cable (included with the mounting screws in a plastic bag in the delivery) onto the grounding shelf for the power cables.

R0…R2

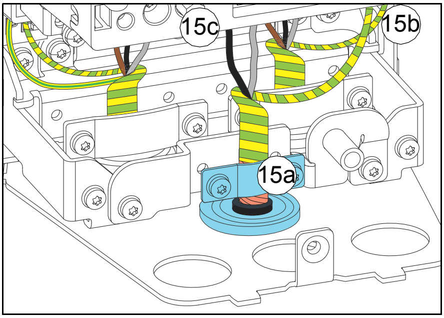


14. Repeat steps *5*…*7* for the brake resistor cable. Cut off one phase conductor.

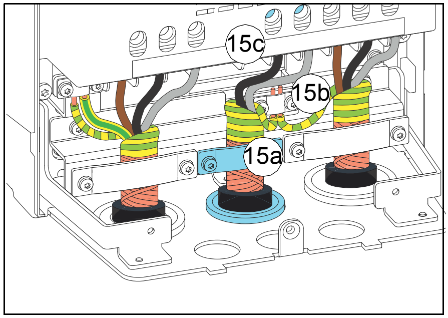


15. Connect the cable as the motor cable in step *8*. Ground the shield 360 degrees (15a). Connect the twisted shield to the grounding terminal (15b) and the conductors to the R+ and R- terminals (15c) and tighten to the torque given below the figure.

R0…R2



R3



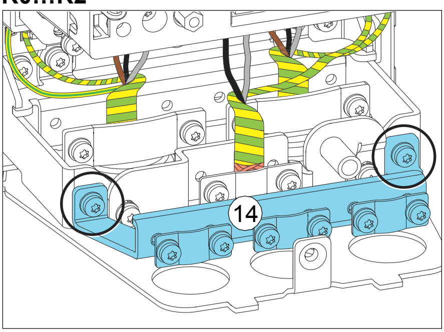
Frame size	R0…R1		R2		R3	
	N·m	lbf·ft	N·m	lbf·ft	N·m	lbf·ft
L1, L2, L3, T1/U, T2/V, T3/W, R+, R-	0.5…0.6	0.4	1.2…1.5	0.9…1.1	2.5…4.5	1.8…3.3

Finalization

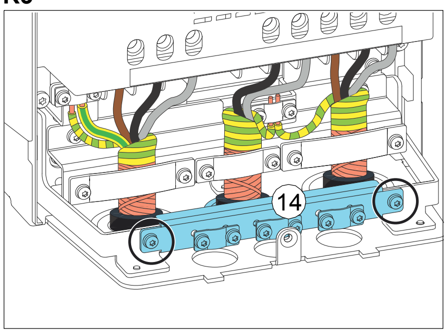
Note: Frames R0…R2: You have to install any optional I/O extension module, if used, in options slot 2 at this point. See section *Installing optional modules* on page *110*.

16. Install the grounding shelf for the control cables (included with the mounting screws in a plastic bag in the delivery) onto the grounding shelf for the power cables.

R0…R2

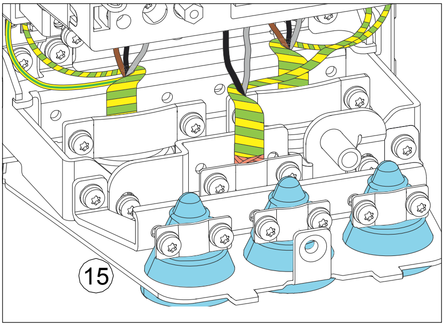


R3

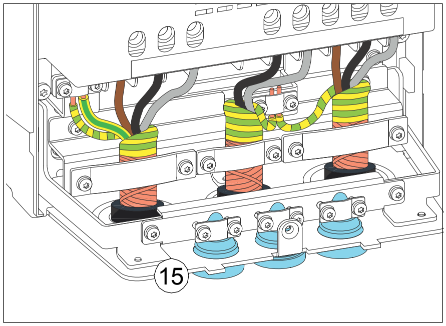


17. Put the (so far) unused rubber grommets to the holes in the lead-through plate, unless you will continue with installing the control cables.

R0…R2

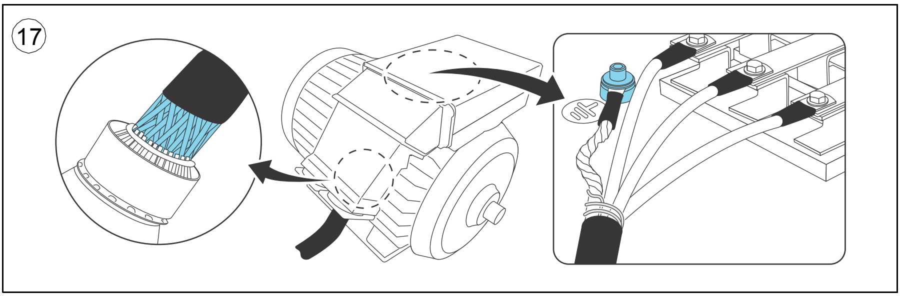


R3



18. Secure the cables outside the unit mechanically.

19. Ground the motor cable shield at the motor end. For minimum radio frequency interference, ground the motor cable shield 360 degrees at the lead-through of the motor terminal box.



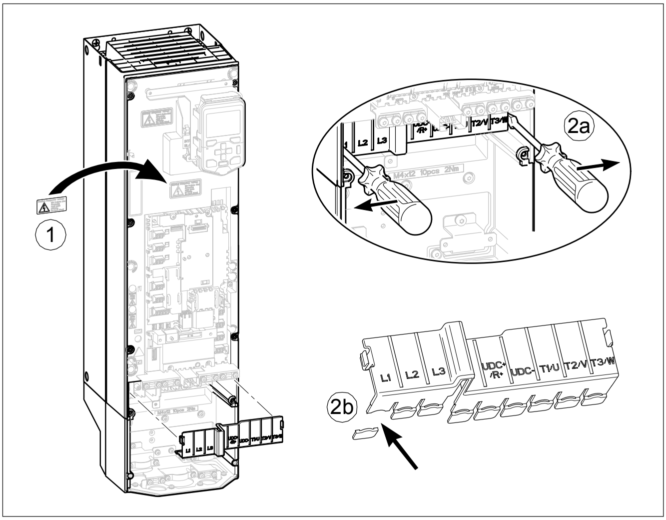
Connection procedure, frame R5

Prepare the drive and the cables

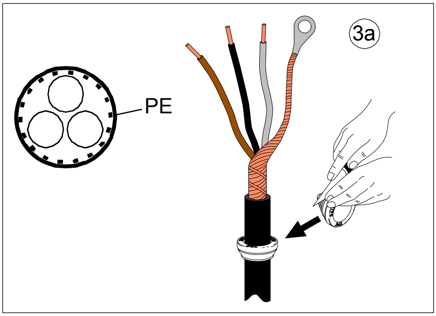
WARNING! If the drive will be connected on an IT (ungrounded) system or on a corner-grounded TN system, make sure you have disconnected the EMC filter. See page 77.

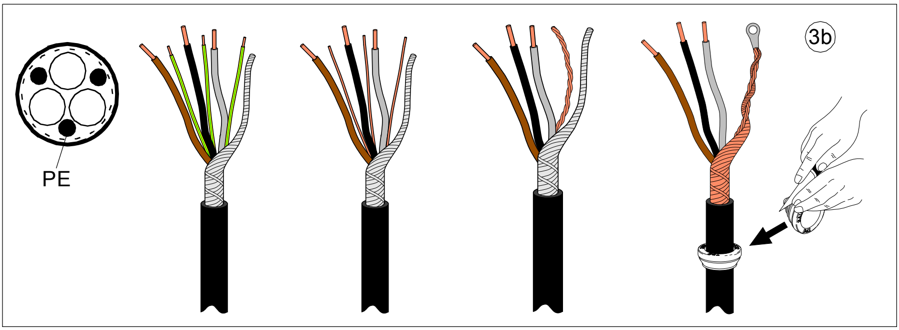
---

1. Attach the residual voltage warning sticker in the local language next to the control board.
2. Remove the shroud on the power cable terminals by releasing the clips and lifting the shroud up from the sides with a screwdriver (2a). Knock out holes in the shroud for the cables to be installed (2b).



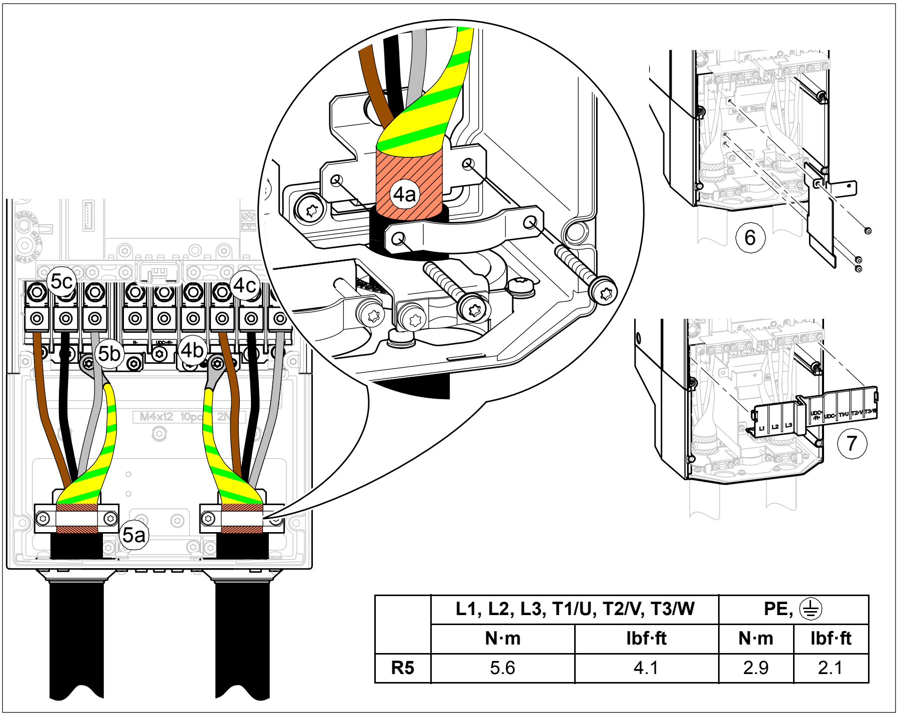
3. Cut adequate holes into the rubber grommets. Slide the grommets onto the cables. Prepare the ends of the cables as illustrated in the figure. **Note:** The bare shield will be grounded 360 degrees. Mark the pigtail made from the shield as a PE conductor with yellow-and-green color. Slide the cables through the holes of the lead-through plate and attach the grommets to the holes (the motor cable to the right and the input power cable to the left).





Connect the cables

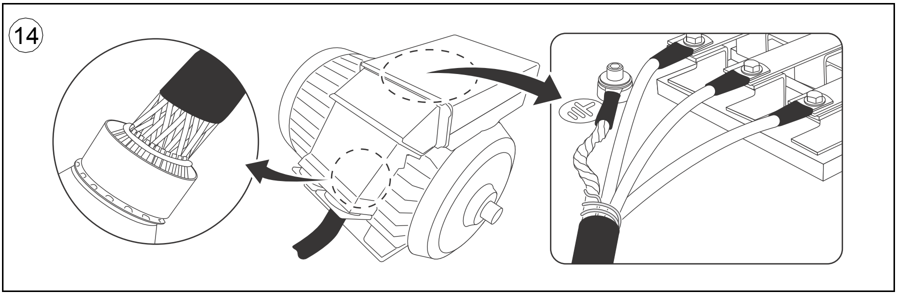
4. Connect the motor cable:
   - Ground the shield 360 degrees under the grounding clamps (4a).
   - Connect the twisted shield of the cable to the grounding terminal (4b).
   - Connect the phase conductors of the cable to the T1/U, T2/V and T3/W terminals (4c). Tighten the screws to the torque given in table.
5. Connect the input power cable as in step *4*. Ground the shield 360 degrees under the grounding clamps (5a). Connect the twisted shield to the grounding terminal (5b) and the phase conductors to the L1, L2 and L3 terminals (5c). Tighten the screws to the torque given in table.
6. Install the EMC shroud separating the input and output cabling.
7. Reinstall the shroud on the power terminals.



	L1, L2, L3, T1/U, T2/V, T3/W		PE, ⏚	
	N·m	**lbf·ft**	**N·m**	**lbf·ft**
R5	5.6	4.1	2.9	2.1

8. Put the unused rubber grommets to the holes in the lead-through plate.
9. Secure the cables outside the unit mechanically.

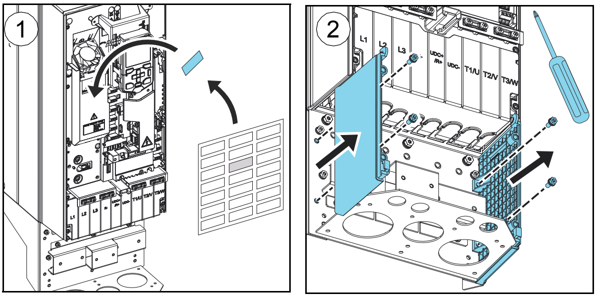
10. Ground the motor cable shield at the motor end. For minimum radio frequency interference, ground the motor cable shield 360 degrees at the lead-through of the motor terminal box.



Connection procedure, frames R6…R9

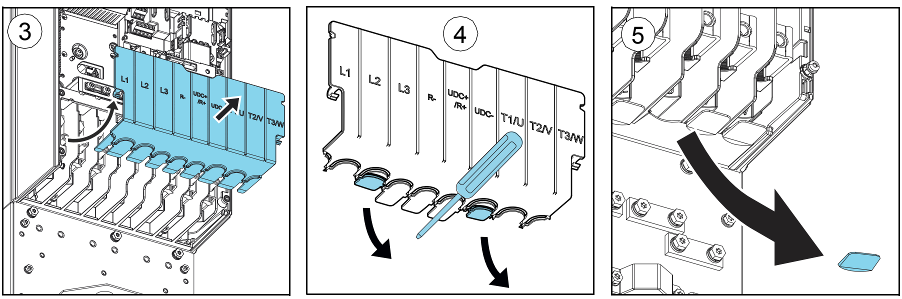
WARNING! If the drive will be connected on an IT (ungrounded) system or on a corner-grounded TN system, make sure you have disconnected the EMC filter. See page 77.

1. Attach the residual voltage warning sticker in the local language next to the control board.
2. Remove the side plates of the cable entry box: Remove the retaining screws and slide the walls out.



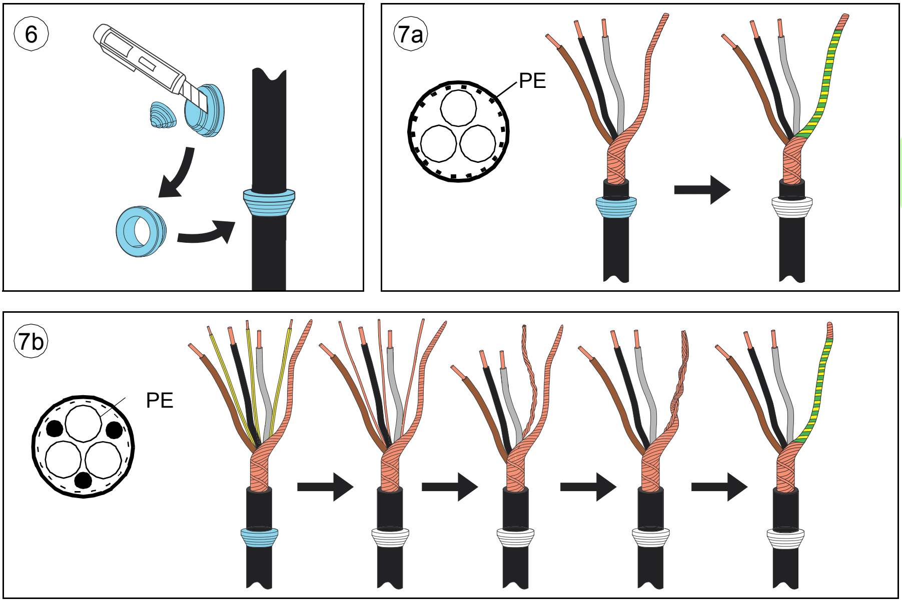
3. Remove the shroud on the power cable terminals by releasing the clips with a screwdriver and pulling the shroud out.
4. Knock out holes in the shroud for the cables to be installed.
5. <u>Frames R8…R9</u>: If you install parallel cables, also knock out holes in the lower shroud for the cables to be installed.

R8…R9



Motor cable

6. Cut an adequate hole into the rubber grommet. Slide the grommet onto the cable.
7. Prepare the ends of the input power cable and motor cable as illustrated in the figure. Two different motor cable types are shown in the figures (7a, 7b). **Note:** The bare shield will be grounded 360 degrees. Mark the pigtail made from the shield as a PE conductor with yellow-and-green color.



8. Slide the cables through the holes of the lead-through plate and attach the grommets to the holes (the motor cable to the right and the input power cable to the left).

9. Connect the motor cable:
   - Ground the shield 360 degrees under the grounding clamps.
   - Connect the twisted shield of the cable to the grounding terminal (9a).
   - Connect the phase conductors of the cable to terminals T1/U, T2/V and T3/W. Tighten the screws to the torque given in the figure (9b).

   Note 1 for frames R8…R9: If you connect only one conductor to the connector, we recommend that you put it under the upper pressure plate.

   Note 2 for frames R8…R9: The connectors are detachable but we do not recommend that you detach them. If you do, detach and reinstall the connectors as follows.

   Terminals L1, L2 and L3

   - Remove the combi screw that attaches the connector to its terminal post, and pull the connector off.
   - Put the conductor under the connector pressure plate and pretighten the conductor.
   - Put the connector back onto the terminal post. Start the combi screw, and turn it at least two rotations by hand.

WARNING! Before using tools, make sure that the nut/screw is not cross-threading. Cross-threading will damage the drive and cause danger.

   - Tighten the combi screw to a torque of 30 N·m (22 lbf·ft).
   - Tighten the conductor(s) to 40 N·m (30 lbf·ft) for frame R8 or to 70 N·m (52 lbf·ft) for frame R9.

   Terminals T1/U, T2/V and T3/W

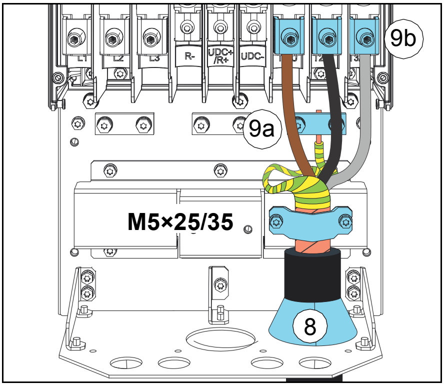
   - Remove the nut that attaches the connector to its busbar.
   - Put the conductor under the connector pressure plate and pretighten the conductor.
   - Put the connector back to its busbar. Start the nut, and turn it at least two rotations by hand.

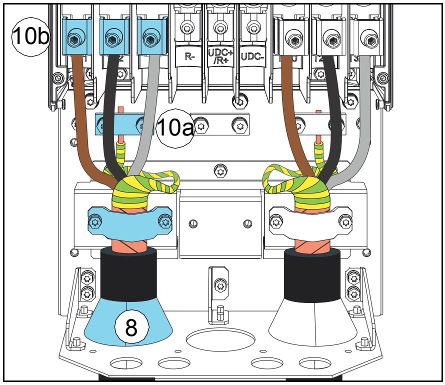
WARNING! Before using tools, make sure that the nut/screw is not cross-threading. Cross-threading will damage the drive and cause danger.

   - Tighten the nut to a torque of 30 N·m (22 lbf·ft).

- Tighten the conductor(s) to 40 N·m (30 lbf·ft) for frame R8 or to 70 N·m (52 lbf·ft) for frame R9.

10. Connect the input power cable as in step *9*. Use terminals L1, L2 and L3.

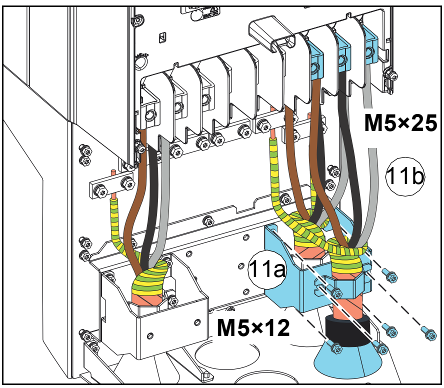




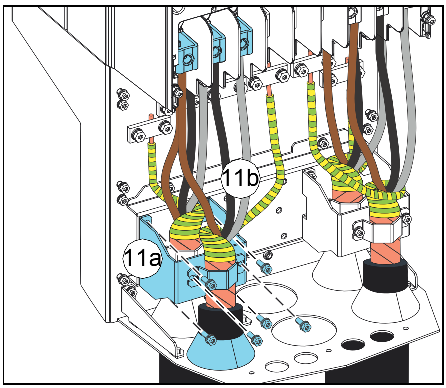
Frame size	**L1, L2, L3, T1/U, T2/V, T3/W**		**PE, ⏚**	
	N·m	**lbf·ft**	**N·m**	**lbf·ft**
R6	30	22.1	9.8	7.2
R7	40	29.5	9.8	7.2
R8	40	29.5	9.8	7.2
R9	70	51.6	9.8	7.2

11. Frames R8…R9: If you install parallel cables, install the second grounding shelf for the parallel power cables (11a). Repeat steps *6*...*10* (11b).

R8…R9

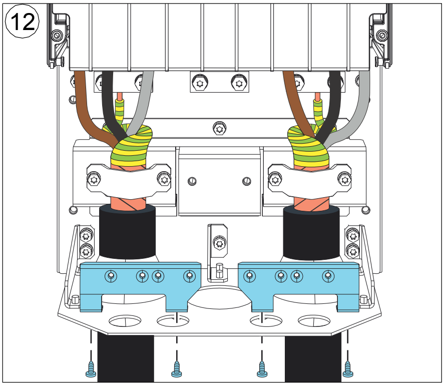


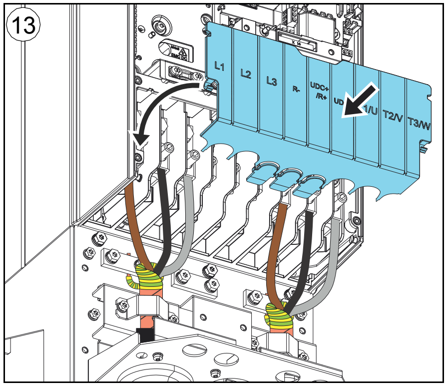
R8…R9



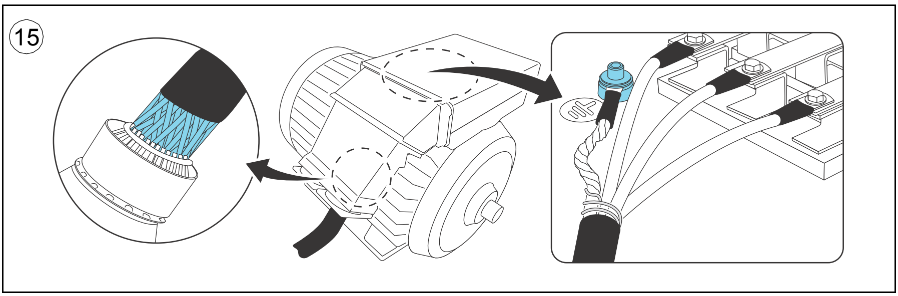
12. Install the grounding shelf of the control cables.

13. Reinstall the shroud on the power terminals.
14. Secure the cables outside the unit mechanically.





15. Ground the motor cable shield at the motor end. For minimum radio frequency interference, ground the motor cable shield 360 degrees at the lead-through of the motor terminal box.



DC connection

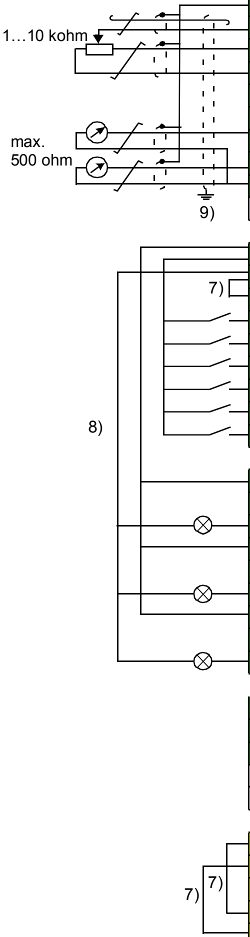
The UDC+ and UDC- terminals (as standard in frames R5…R9) are for using external brake chopper units.

Connecting the control cables

See section *Default I/O connection diagram (ABB standard macro)* on page *98* for the default I/O connections of the ABB standard macro. For other macros, see chapter *Control macros* on page *161*.

Connect the cables as described under *Control cable connection procedure R0…R9* on page *105*.

Default I/O connection diagram (ABB standard macro)



S1	AI1 U/I	Voltage/Current selection for AI1: U I [1)]
S2	AI2 U/I	Voltage/Current selection for AI2: U I [2)]
XI	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Output frequency/speed reference**: 0…10 V[4)]
3	AGND	Analog input circuit common
4	+10V	Reference voltage 10 V DC
5	AI2	Not configured
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0…20 mA
8	AO2	**Output current:** 0…20 mA
9	AGND	Analog output circuit common
S3	AO1 I/U	Voltage/Current selection for AO1: I U
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Aux. voltage output +24 V DC, max. 250 mA[3)]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1)**
14	DI2	**Forward (0) / Reverse (1)**
15	DI3	**Constant frequency/speed selection**[5)]
16	DI4	**Constant frequency/speed selection**[5)]
17	DI5	**Ramp set 1 (0) / Ramp set 2 (1)**[6)]
18	DI6	Not configured
X6, X7, X8	Relay outputs	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	EIA-485 Modbus RTU	
29	B+	Embedded Modbus RTU (EIA-485). See chapter *Fieldbus control through the embedded fieldbus interface (EFB)* on page *441*.
30	A-	
31	DGND	
S4	TERM	Serial data link termination switch
S5	BIAS	Serial data link bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter *The Safe torque off function* on page *555*.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	
40	24 V AC/DC- in	R5…R9 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.
41	24 V AC/DC+ in	

See the notes on the next page.

Terminal sizes:

R0…R3: 0.2…2.5 mm^2 (terminals +24V, DGND, DCOM, B+, A-, DGND, Ext. 24V)
0.14…1.5 mm^2 (terminals DI, AI, AO, AGND, RO, STO)

R5…R9: 0.14…2.5 mm^2 (all terminals)

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

Notes:

1) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected with jumper S1. Change of setting requires changing the corresponding parameter.

2) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input selected with jumper S2. Change of setting requires changing the corresponding parameter.

3) Total load capacity of the Auxiliary voltage output +24V (X2:10) is 6.0 W (250 mA / 24 V) minus the power taken by the option modules installed on the board.

4) AI1 is used as a speed reference if vector control is selected.

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

DI3	DI4	Operation/Parameter	
		Scalar control (default)	**Vector control**
0	0	Set frequency through AI1	Set speed through AI1
1	0	*28.26 Constant frequency 1*	*22.26 Constant speed 1*
0	1	*28.27 Constant frequency 2*	*22.27 Constant speed 2*
1	1	*28.28 Constant frequency 3*	*22.28 Constant speed 3*

6) In scalar control (default): See **Menu - Primary settings** - **Ramps** or parameter group *28 Frequency reference chain*.
In vector control: See **Menu - Primary settings** - **Ramps** or parameter group *23 Speed reference ramp*.

DI5	Ramp set	Parameters	
		Scalar control (default)	**Vector control**
0	1	*28.72 Freq acceleration time 1* *28.73 Freq deceleration time 1*	*23.12 Acceleration time 1* *23.13 Deceleration time 1*
1	2	*28.74 Freq acceleration time 2* *28.75 Freq deceleration time 2*	*23.14 Acceleration time 2* *23.15 Deceleration time 2*

7) Connected with jumpers at the factory.

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

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

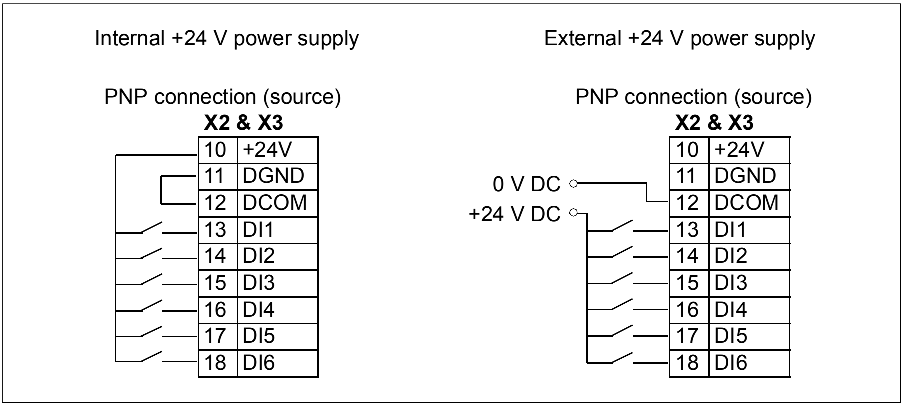
Further information on the usage of the connectors and switches is given in the sections below. See also section *Control connection data* on page *511*.

Switches

Switch	Description	Position	
S1 (AI1)	Determines whether analog input AI1 is used as a voltage or current input.	U I AI1	Voltage (U) (**default**)
		U I AI1	Current (I)
S2 (AI2)	Determines whether analog input AI2 is used as a voltage or current input.	U I AI2	Voltage (U)
		U I AI2	Current (I) (**default**)
S3 (AO1)	Determines whether analog output AO1 is used as a current or voltage output.	I U AO1	Current (I) (**default**)
		I U AO1	Voltage (U)
S4 (TERM)	Drive-to-drive link termination. Must be set to the terminated (ON) position when the drive (or another device) is the first or last unit on the link.	ON TERM	Bus not terminated (**default**)
		ON TERM	Bus terminated
S5 (BIAS)	Switches on the biasing voltages to the bus. One (and only one) device, preferably at the end of the bus must have the bias on.	ON BIAS	Bias off (**default**)
		ON BIAS	Bias on

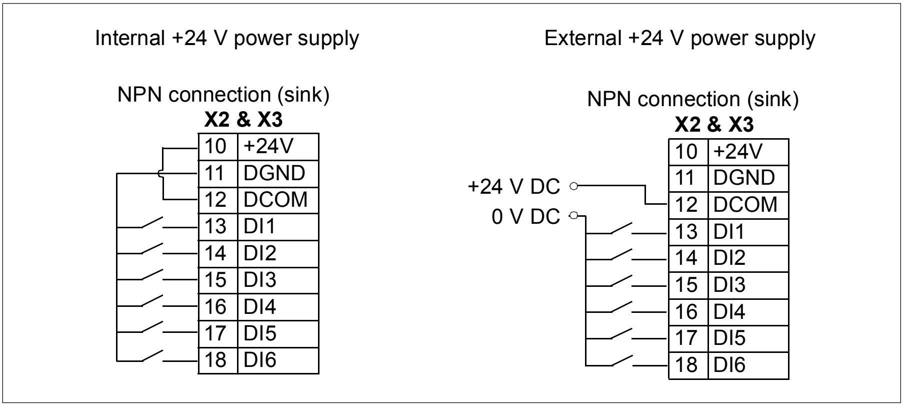
PNP configuration for digital inputs

Internal and external +24 V power supply connections for PNP configuration are shown in the figure below.



NPN configuration for digital inputs

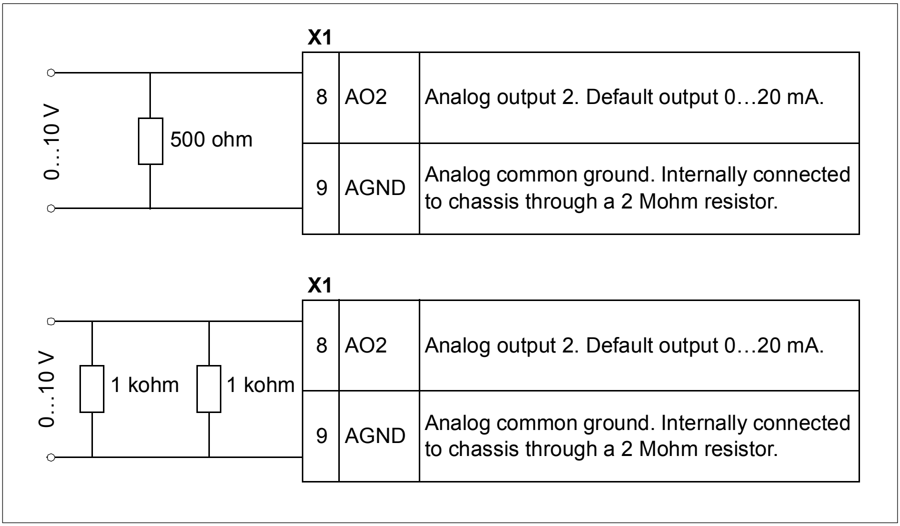
Internal and external +24 V power supply connections for NPN configuration are shown in the figure below.



Connection for obtaining 0…10 V from analog output 2 (AO2)

To obtain 0…10 V from analog output AO2, connect a 500 ohm resistor (or two 1 kohm resistors in parallel) between the analog output 2 AO2 and analog common ground AGND.

Examples are shown in the figure below.

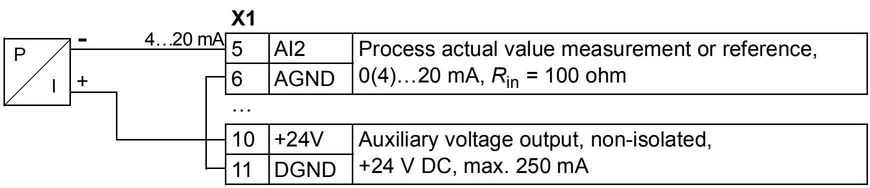


Connection examples of two-wire and three-wire sensors

Hand/Auto, Hand/PID, and PID macros (see chapter *Control macros*, pages *170*, *172* and *174*, respectively) use analog input 2 (AI2). The macro wiring diagrams on these pages use an externally powered sensor (connections not shown). The figures below give examples of connections using a two-wire or three-wire sensor/transmitter supplied by the drive auxiliary voltage output.

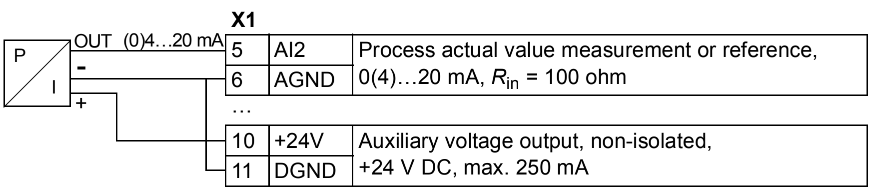
Note: Maximum capability of the auxiliary 24 V DC (250 mA) output must not be exceeded.

Two-wire sensor/transmitter



Note: The sensor is supplied through its current output and the drive feeds the supply voltage (+24 V DC). Thus the output signal must be 4…20 mA, not 0…20 mA.

Three-wire sensor/transmitter

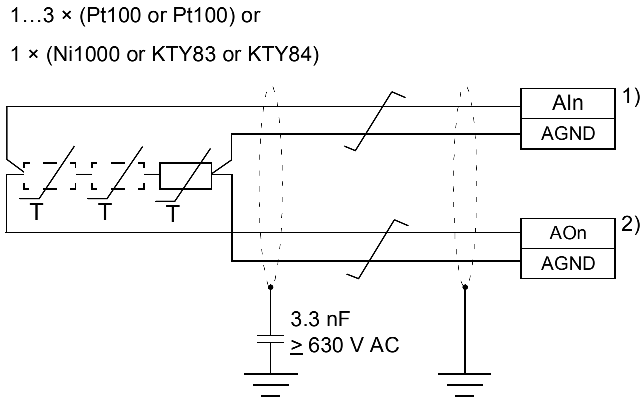


DI6 as frequency input

If DI6 is used as a frequency input, see section *Programmable frequency input and output* on page *186* for how to set parameters accordingly.

AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)

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) Set the input type to voltage with switch S1 for analog input AI1or with S2 for analog input AI2. Set the appropriate analog input unit to V (volt) in parameter group *12 Standard AI*.

2) 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.

Safe torque off (X4)

For the drive to start, both connections (+24 V DC to IN1 and +24 V DC to IN2) must be closed. By default, the terminal block has jumpers to close the circuit. Remove the jumpers before connecting an external Safe torque off circuitry to the drive. See chapter *The Safe torque off function* on page *555*.

Note: Only 24 V DC can be used for STO. Only PNP input configuration can be used.

Control cable connection procedure R0…R9

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. If you ignore them, injury or death, or damage to the equipment can occur.

1. Stop the drive and do the steps in section *Precautions before electrical work* on page *20* before you start the work.
2. Remove the front cover(s) if not already removed. See page *81* (R0…R3), page *55* (R5) or page *58* (R6…R9).

<u>Analog signals</u>
The figures for frames R0…R2 (page *107*), R3 (page *107*), R5 (page *108*) and R6…R7 (page *109*) show an example of connecting a cable. Make the connections according to the macro in use.

3. Cut an adequate hole into the rubber grommet and slide the grommet onto the cable. Slide the cable through a hole in the lead-through plate and attach the grommet to the hole.
4. Ground the outer shield of the cable 360 degrees under the grounding clamp. Keep the cable unstripped as close to the terminals of the control board as possible.
   <u>Frames R5…R9:</u> Secure the cables mechanically at the clamps below the control unit.
   Ground also the pair-cable shields and grounding wire at the SCR terminal.
5. Route the cable as shown in the figures on pages *107* (R0…R2), *107* (R3), *108* (R5) or *109* (R6…R9).
6. Connect the conductors to the appropriate terminals of the control board and tighten to 0.5…0.6 N·m (0.4 lbf·ft).

<u>Digital signals</u>
The figures for frames R0…R2 (page *107*), R3 (page *107*), R5 (page *108*) and R6…R7 (page *109*) show an example of connecting a cable. Make the connections according to the macro in use.

7. Cut an adequate hole into the rubber grommet and slide the grommet onto the cable. Slide the cable through the hole in the lead-through plate and attach the grommet to the hole.
8. Ground the outer shield of the cable 360 degrees under the grounding clamp. Keep the cable unstripped as close to the terminals of the control board as possible.
   <u>Frames R5…R9:</u> Secure the cables mechanically at the clamps below the control unit.
   If you use double-shielded cables, ground also the pair-cable shields and grounding wire at the SCR terminal.

9. Route the cable as shown in the figures on pages *107* (R0…R2), *107* (R3), *108* (R5) or *109* (R6…R9).

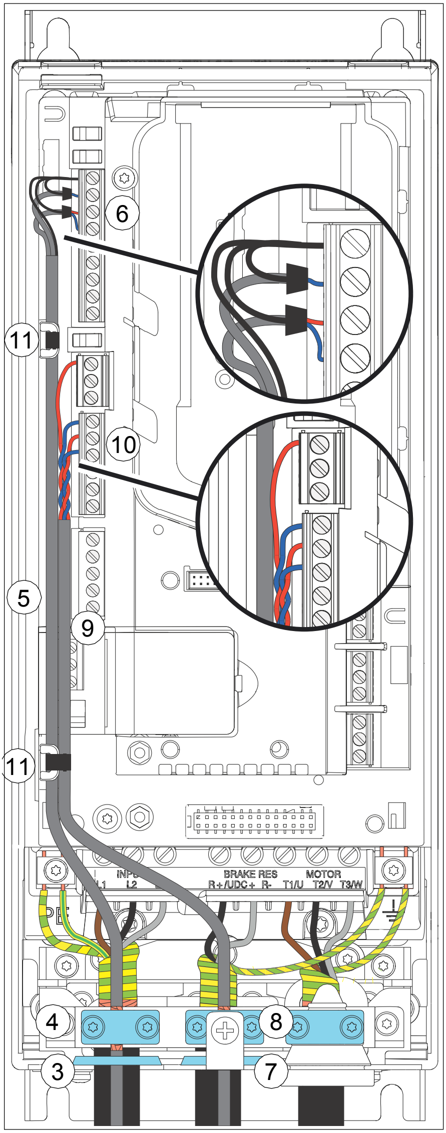
10. Connect the conductors to the appropriate terminals of the control board and tighten to 0.5…0.6 N·m (0.4 lbf·ft).

11. Tie all control cables to the provided cable tie mounts.

Note:

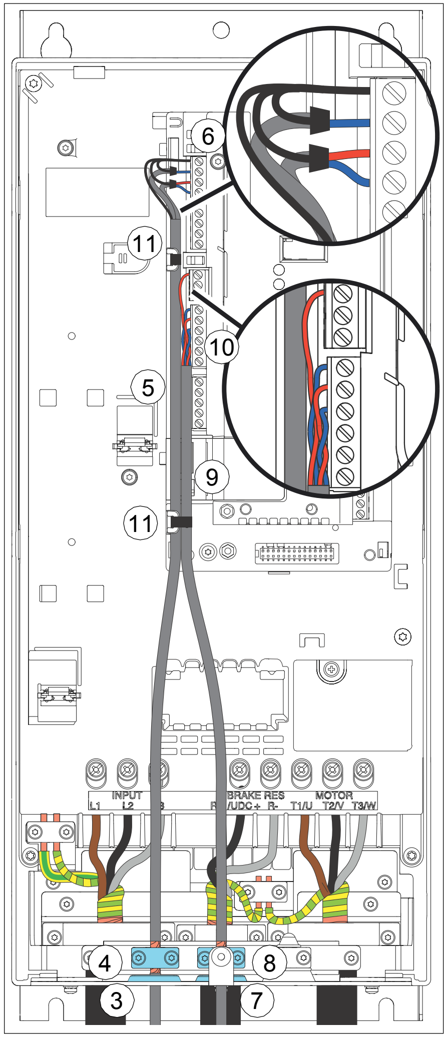
- Leave the other ends of the control cable shields unconnected or ground them indirectly via a high-frequency capacitor with a few nanofarads, eg, 3.3 nF / 630 V. The shield can also be grounded directly at both ends if they are *in the same ground line* with no significant voltage drop between the end points.
- Keep any signal wire pairs twisted as close to the terminals as possible. Twisting the wire with its return wire reduces disturbances caused by inductive coupling.

R0…R2



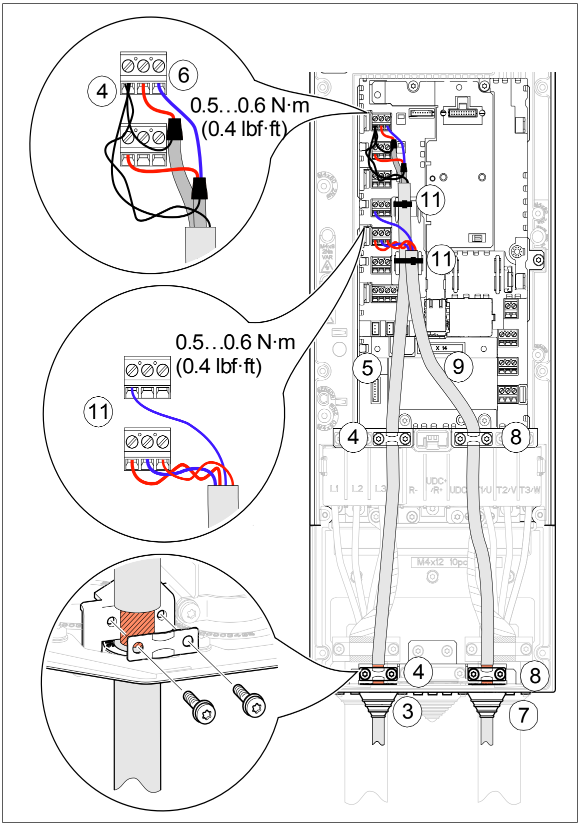
R0…R2: 0.5…0.6 N·m (0.4 lbf·ft)

R3

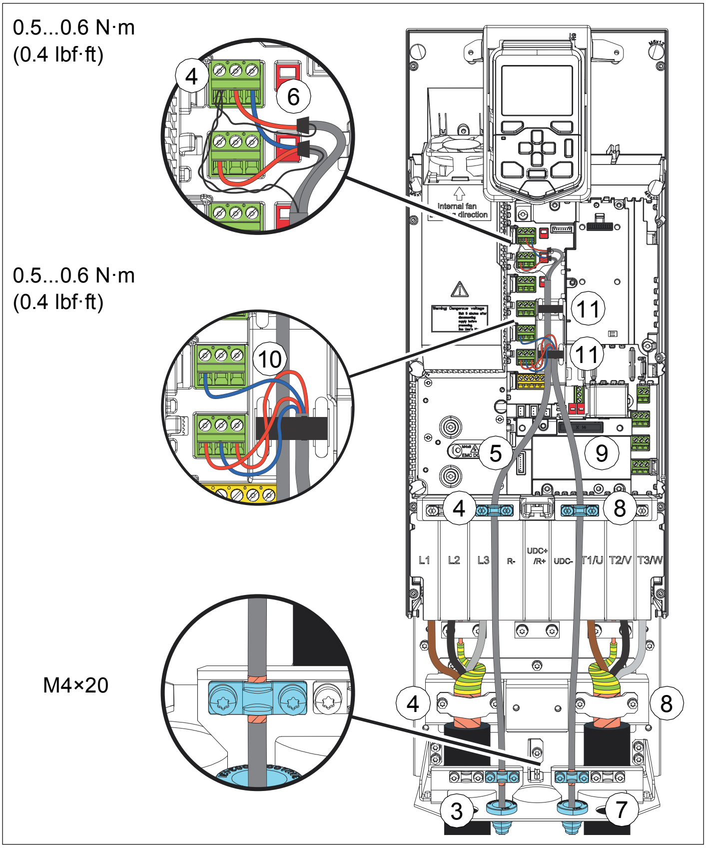


R3: 0.5…0.6 N·m (0.4 lbf·ft)

R5


4
6
0.5…0.6 N·m
(0.4 lbf·ft)
11
0.5…0.6 N·m
(0.4 lbf·ft)
11
11
5
9
4
8
L1
L2
L3
R-
UDC+
/R+
UDC-
T1/U
T2/V
T3/W
M4x12 10pcs
4
8
3
7

R6…R9


0.5...0.6 N·m
(0.4 lbf·ft)
0.5...0.6 N·m
(0.4 lbf·ft)
M4×20
4
6
10
11
11
5
9
4
8
L1
L2
L3
R-
UDC+
/R+
UDC-
T1/U
T2/V
T3/W
4
8
3
7
Internal fan
direction

Installing optional modules

Note: If you will install the FPBA-01 module, see section *FPBA-01 PROFIBUS DP adapter module connectors* on page *65* for suitable connector types.

Mechanical installation of option modules

See section *Overview of power and control connections* page *36* for the available slots for each module. Install the optional modules as follows:

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. If you ignore them, injury or death, or damage to the equipment can occur.

Note: Slot 2 in frames R0…R3 is at U_{DC} potential. You must disconnect power supplies before installing or removing an I/O extension module.

Stop the drive and do the steps in section *Precautions before electrical work* on page *20* before you start the work.

1. Remove the front cover(s) if not already removed. See page *81* (R0…R3), page *55* (R5) or page *58* (R6…R9).

The figures for frames R0…R3 (page *111*) and R6…R9 (page *112*) show an example of installing optional modules.

Option slot 3 (embedded fieldbus adapter modules)

2. The drive is delivered with the standard embedded fieldbus adapter module CEIA-01 installed.
   If you have ordered another optional module, remove the CEIA-01 module by carefully bending the retaining clips to the sides while pulling the module outward, and put the other module carefully into its position.

Note: Frames R0…R3: The module in option slot 3 is under the module in option slot 1. If you have to change the module in option slot 3, remove first the any module in option slot 1, if present.

Option slot 2 (I/O extension modules)

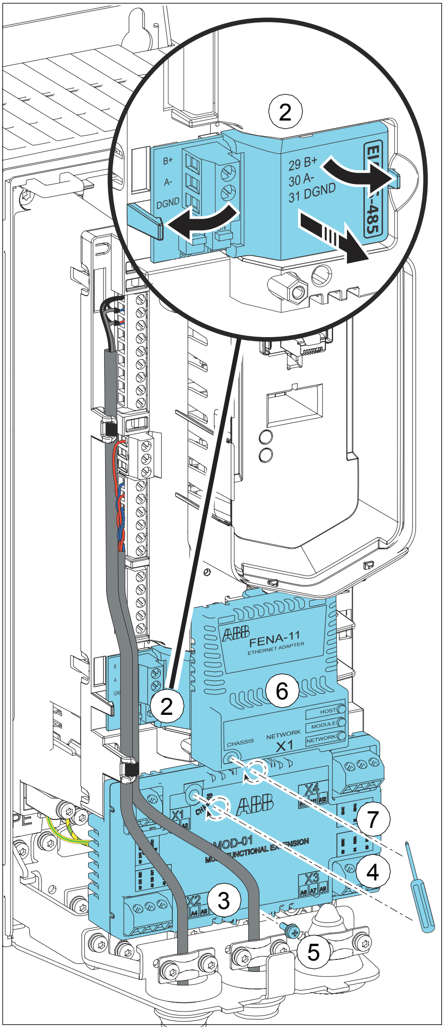
3. Put the module carefully into its position on the control board.
4. Tighten the mounting screw.
5. Tighten the grounding screw (CHASSIS). **Note:** The screw grounds the module. It is necessary for fulfilling the EMC requirements and for proper operation of the module.

Note: Frames R0…R3: The module in option slot 2 covers the power terminals. Do not install a module in option slot 2 before you have installed the power cables.

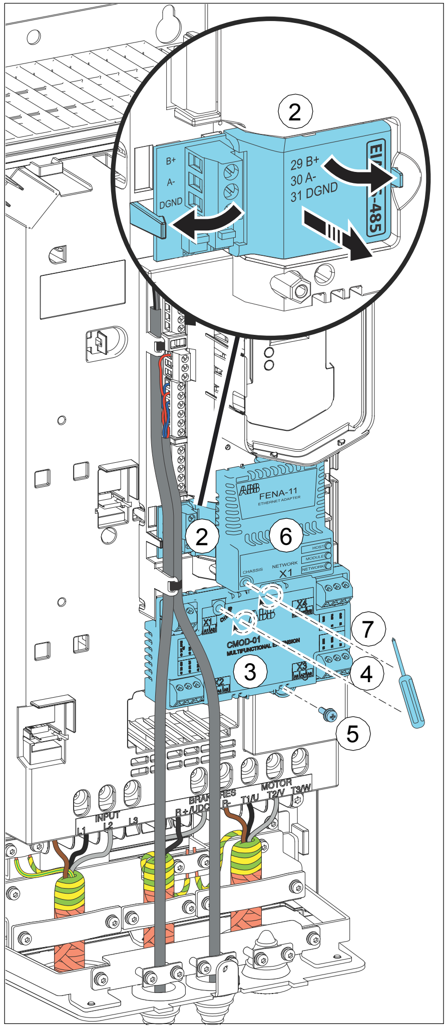
Option slot 1 (fieldbus adapter modules)

6. Put the module carefully into its position on the control board.
7. Tighten the mounting screw (CHASSIS). **Note:** The screw tightens the connections and grounds the module. It is necessary for fulfilling the EMC requirements and for proper operation of the module.

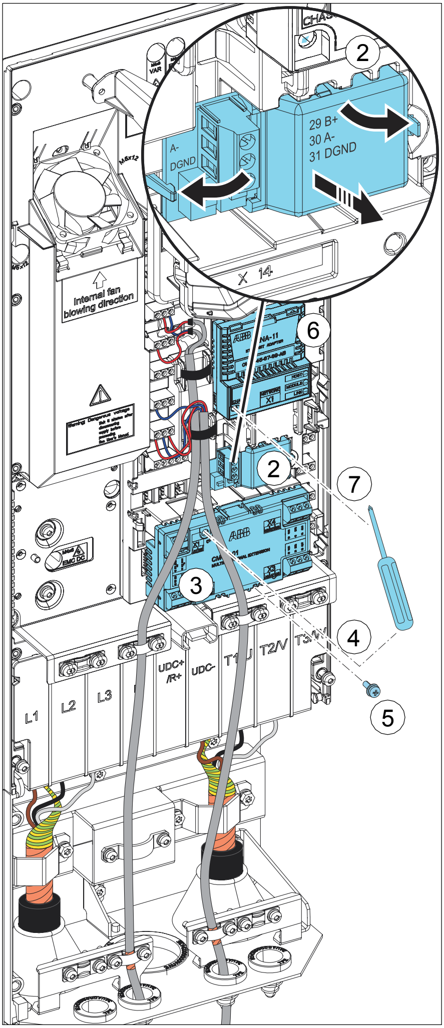
R0…R2



R3



R6…R9



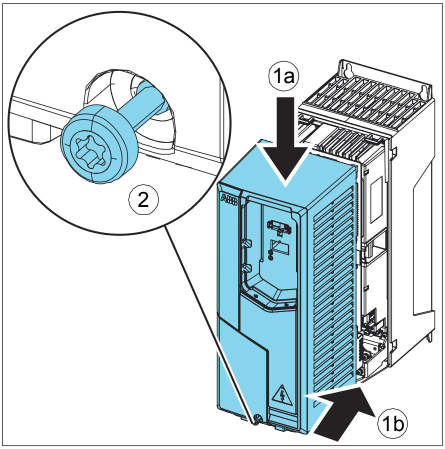
Wiring the modules

See the appropriate optional module manual for specific installation and wiring instructions.

Reinstalling covers

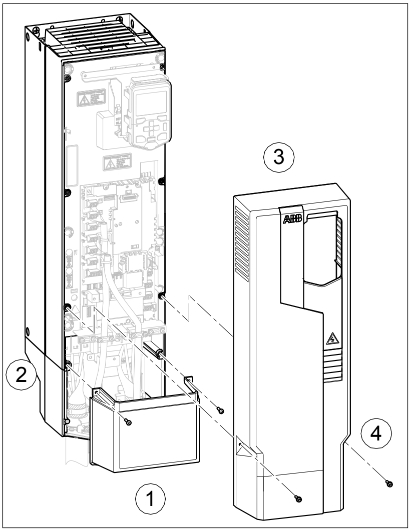
Reinstalling cover, frames R0…R3

1. Reinstall the cover: Put the tabs on the cover top in their counterparts on the housing (1a) and the press the cover (1b).
2. Tighten the retaining screw at the bottom with a screwdriver.



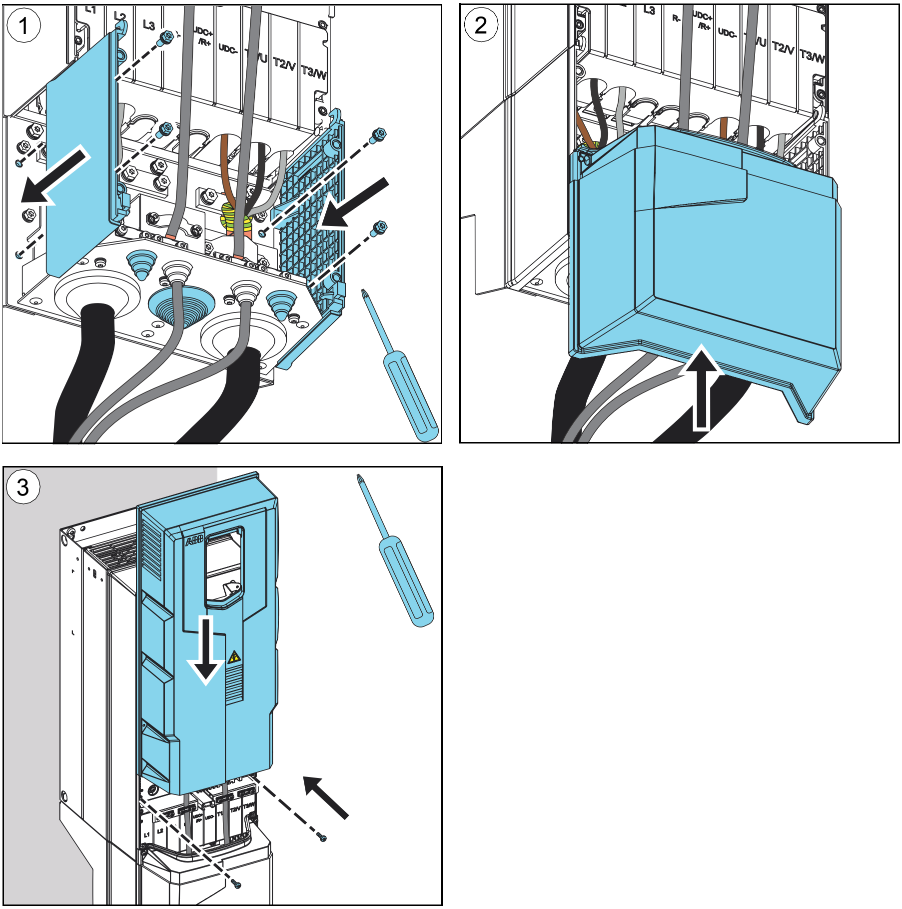
Reinstalling covers, frame R5

1. Install the cover of the cable entry box.
2. Tighten the two retaining screws with a screwdriver.
3. Reinstall the module cover. Put the tabs on the cover top in their counterparts on the housing and then press the cover.
4. Tighten the two retaining screws with a screwdriver.



Reinstalling side plates and covers, frames R6…R9

1. Reinstall the side plates of the cable entry box. Tighten the retaining screws with a screwdriver.
2. Slide the cover of the cable entry box on the module from below until the cover snaps into place.
3. Reinstall the module cover. Tighten the two retaining screws with a screwdriver.



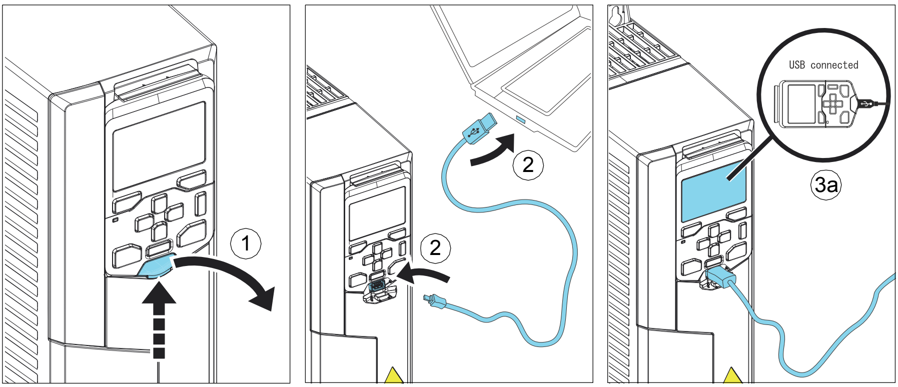
Connecting a PC

To be able to connect a PC to the drive, you need an assistant control panel.

Connect a PC to the drive with a USB data cable (USB Type A <-> USB Type Mini-B) as follows:

1. Lift the USB connector cover from bottom upwards.
2. Put the USB cable Mini-B plug in the control panel USB connector.
3. Put the USB cable A-plug in the USB connector of the PC (3a). The panel displays text “USB connected” (3b).

Note: Panel keys cannot be used when a USB data cable is connected to the panel.



For information on using the Drive composer PC tool, see *Drive composer PC tool user's manual* (3AUA0000094606 [English]).

7

Installation checklist

Contents of this chapter

This chapter contains an installation checklist which you must complete before you start up the drive.

Warnings

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. If you ignore them, injury or death, or damage to the equipment can occur.

Checklist

Do the steps in section *Precautions before electrical work* on page *20* before you start the work. Go through the checklist together with another person.

☑	**Check that …**
☐	The ambient operating conditions meet the specification in section *Ambient conditions* on page *515*.
☐	If the drive will be connected to an IT (ungrounded) or corner-grounded TN supply network: Internal EMC filter has been disconnected. See section *Checking the compatibility with IT (ungrounded) and corner-grounded TN systems* on page *77*.
☐	If the drive has been stored over one year: The electrolytic DC capacitors in the DC link of the drive have been reformed. See section *Capacitors* on page *490*.
☐	There is an adequately sized protective earth (ground) conductor between the drive and the switchboard.

☑	**Check that …**
☐	There is an adequately sized protective earth (ground) conductor between the motor and the drive.
☐	All protective earth (ground) conductors have been connected to the appropriate terminals and the terminals have been tightened (pull conductors to check).
☐	The supply voltage matches the nominal input voltage of the drive. Check the type designation label.
☐	The input power cable has been connected to appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull conductors to check.)
☐	Appropriate supply fuses and disconnector have been installed.
☐	The motor cable has been connected to appropriate terminals, the phase order is right, and the terminals have been tightened. (Pull conductors to check.)
☐	The brake resistor cable (if present) has been connected to appropriate terminals, and the terminals have been tightened. (Pull conductors to check.)
☐	The motor cable (and brake resistor cable, if present) has been routed away from other cables.
☐	The control cables (if any) have been connected to the control board.
☐	<u>If a drive bypass connection will be used:</u> The direct-on-line contactor of the motor and the drive output contactor are either mechanically or electrically interlocked (cannot be closed simultaneously).
☐	There are no tools, foreign objects or dust from drilling inside the drive.
☐	Drive and motor connection box covers are in place.
☐	The motor and the driven equipment are ready for start-up.

8

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

Contents of this chapter

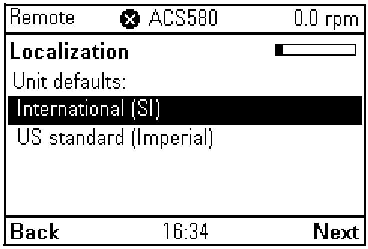
The chapter tells how to:

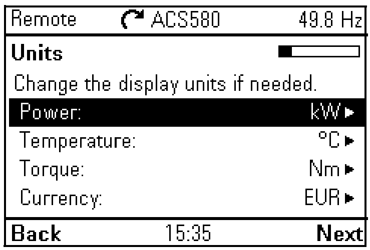
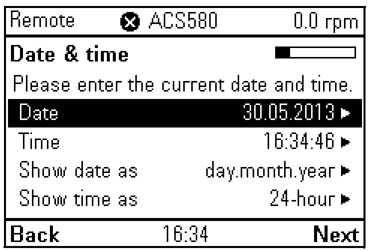
- perform the start-up
- start, stop, change the direction of the motor rotation and adjust the speed of the motor through the I/O interface
- perform an Identification run (ID run) for the drive.

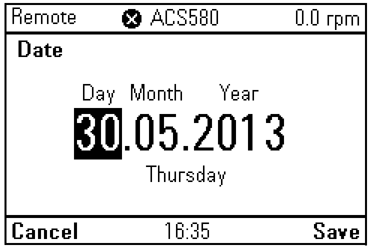
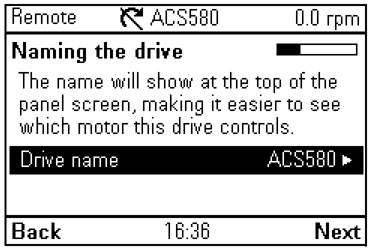
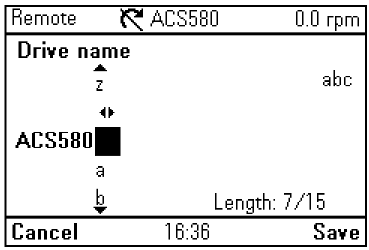
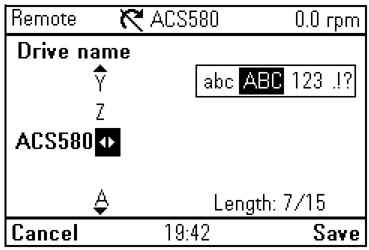
How to start up the drive

How to start up the drive using the First start assistant on the assistant control panel

Safety		
Do not start-up the drive unless you are a qualified electrician. Read and obey the instructions in chapter *Safety instructions* on page *17* during the start-up procedure. Ignoring the instructions can cause physical injury or death, or damage to the equipment.		
☐	Check the installation. See the checklist in chapter *Installation checklist* on page *117*.	
☐	Make sure there is no active start on (DI1 in factory settings, that is, ABB standard macro). The drive will start up automatically at power-up if the external run command is on and the drive is in the remote control mode. Check that the starting of the motor does not cause any danger. **De-couple the driven machine** if • there is a risk of damage in case of an incorrect direction of rotation, or • a **Normal** ID run is required during the drive start-up, when the load torque is higher than 20% or the machinery is not able to withstand the nominal torque transient during the ID run.	
Hints on using the assistant control panel		
	The two commands at the bottom of the display (in the figure on the right, **Options** and **Menu**), show the functions of the two softkeys and located below the display. The commands assigned to the softkeys vary depending on the context. Use keys ◄, ►, ▲ and ▼ to move the cursor and/or change values depending on the active view. Key ? shows a context-sensitive help page. For more information, see *ACS-AP-x assistant control panels user's manual* (3AUA0000085685 [English]).	
1 – First start assistant guided settings: Language, date and time, and motor nominal values		
☐	Have the motor name plate data at hand. Power up the drive.	

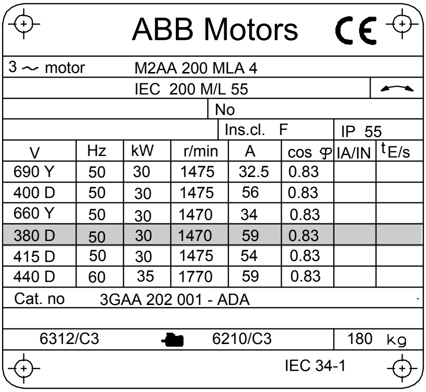
<table>
<tr>
<td>☐</td>
<td>The First start assistant guides you through the first start-up.
The start-up begins automatically. Wait until the control panel enters the view shown on the right.
Select the language you want to use by highlighting it (if not already highlighted) and pressing (OK).
Note: After you have selected the language, it takes a few minutes for the control panel to wake up.</td>
<td>
</td>
</tr>
<tr>
<td>☐</td>
<td>Highlight Start set-up (if not already highlighted) and press (Next).</td>
<td>
</td>
</tr>
<tr>
<td>☐</td>
<td>Highlight the localization you want to use (if not already highlighted) and press (Next).</td>
<td>
</td>
</tr>
<tr>
<td>☐</td>
<td>Change the units shown on the panel if needed. If it is not already highlighted,
• Go to the edit view by pressing .
• Scroll the view with and .

Go to the next view by pressing (Next).</td>
<td>
</td>
</tr>
<tr>
<td>☐</td>
<td>Set the date, time as well as date and time display formats.
• Go to the edit view of a highlighted row by pressing .
• Scroll the view with and .
Go to the next view by pressing (Next).</td>
<td>
</td>
</tr>
</table>

☐	In an edit view: • Use and to move the cursor left and right. • Use and to change the value. • Press (**Save**) to accept the new setting, or press (**Cancel**) to go back to the previous view without making changes.	
☐	To give the drive a name that will be shown at the top, press . If you do not want to change the default name (ACS580), continue straight to the set-up of the motor nominal values by pressing (**Next**).	
☐	Enter the name: • To select the character mode (lower case / upper case / numbers / special characters), press until symbol ◂▸ is highlighted and then select the mode with and . Now you can start adding characters. The mode remains selected until you select another one. • To add a character, highlight it with and , and press . • To remove a letter, press . • Press (**Save**) to accept the new setting, or press (**Cancel**) to go back to the previous view without making changes.	

Refer to the motor nameplate for the following nominal value settings of the motor. Whenever possible, enter the values exactly as shown on the motor nameplate.

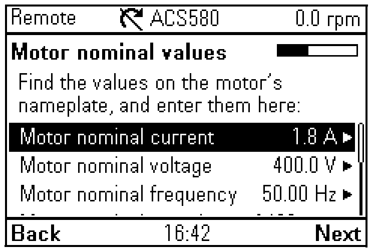
Example of a nameplate of an induction (asynchronous) motor:



☐ 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.

Start with the motor nominal current.

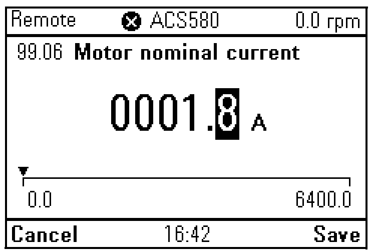
If you have to change the value, go to the edit view of the highlighted row by pressing ▶ (when this symbol is shown at the end of the row).



☐ Set the correct value:

- Use ◀ and ▶ to move the cursor left and right.
- Use ▲ and ▼ to change the value.

Press (**Save**) to accept the new setting, or press (**Cancel**) to go back to the previous view without making changes.



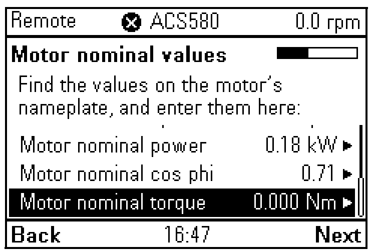
☐ Continue to check/edit the nominal values.

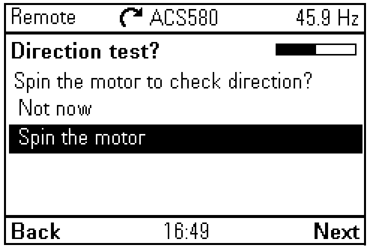
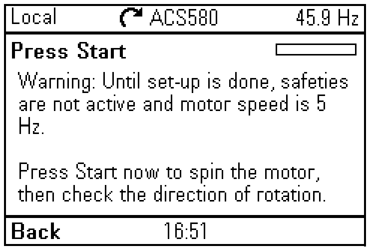
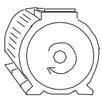
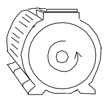
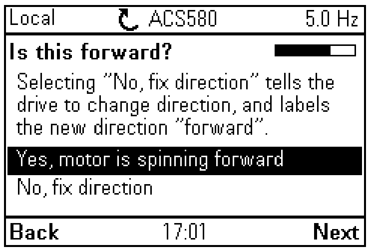
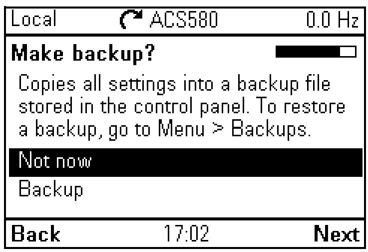
Motor nominal cos phi and nominal torque are optional.

Roll down with ▼ to see the last nominal value in the view.

After editing the last one, the panel goes to the next view.

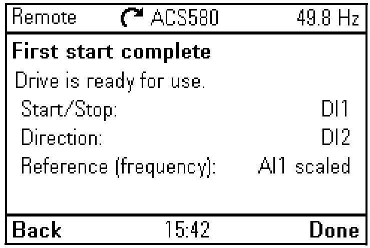
To go directly to the next view, press (**Next**).



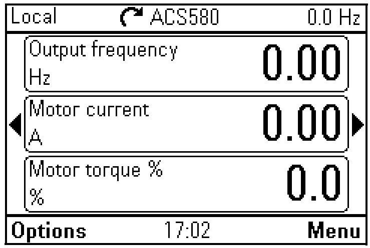
☐	This step is optional, and requires rotating the motor. Do not do this if it could cause any risk, or if the mechanical set-up does not allow it. To do the direction test, highlight **Spin the motor** and press (**Next**).	
☐	First switch to local control by pressing the Loc/Rem key. Local control is indicated by text “Local” on the top pane. Then press the Start key on the panel to start the drive.	
☐	Check the direction of the motor. If it is forward, highlight (if not already highlighted) **Yes, motor is spinning forward** and press (**Next**) to continue. If the direction is not forward, highlight **No, fix direction** and press (**Next**) to continue.  Forward direction  Reverse direction	
☐	If you want to make a backup of the settings made so far, select **Backup** and press (**Next**). If you do not want to make a backup, select **Not now** and press (**Next**).	

☐ The first start is now complete and the drive is ready for use.

Press (**Done**) to enter the Home view.



☐ The Home view monitoring the values of the selected signals is shown on the panel.



2 – Additional settings in the Primary settings menu

☐ Make any additional adjustments, for example, macro, ramps, and limits, starting from the **Main** menu – press (**Menu**) to enter the **Main** menu.

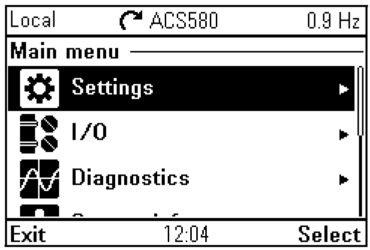
Highlight **Primary settings** and press (**Select**) (or ▶).

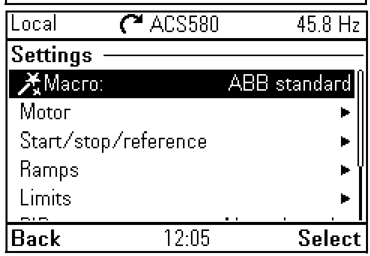
We recommend that you make at least these additional settings:

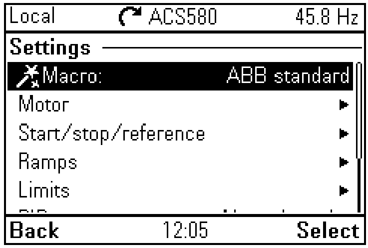
- Choose a macro or set start, stop and reference values individually
- Ramps
- Limits

With the **Primary settings** menu, you can also adjust settings related to the motor, PID, fieldbus, advanced functions and clock, region and display. In addition, the menu contains an item to reset the panel Home view.

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





<table>
<tr><th colspan="3">2 – Additional settings: Macro</th></tr>
<tr>
<td>☐</td>
<td>Highlight Macro: and press (Select) (or).</td>
<td>


</td>
</tr>
<tr>
<td>☐</td>
<td>
To change the macro in use, highlight the new macro and press (Select), or to go back without changes, press (Back).

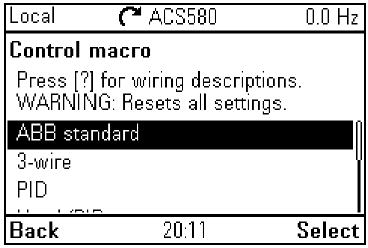
Notes:

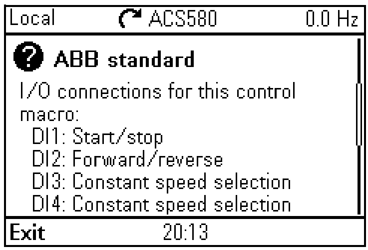
Changing macro resets all settings except motor data to the default values of the selected macro.
Changing macro resets all settings except motor data to the default values of the selected macro.
When you change the macro, you also change the use of the I/O signals in the drive. Make sure the actual I/O wiring and the use of I/O in the control program match each other. You can check the current I/O use in the I/O menu under the Main menu (see page 128).

To get information on a highlighted macro, press ? .The help page shows the use of signals and I/O connections. For detailed I/O connection diagrams, see chapter Control macros on page 161.

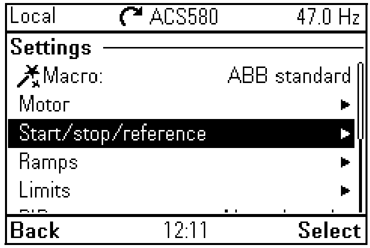
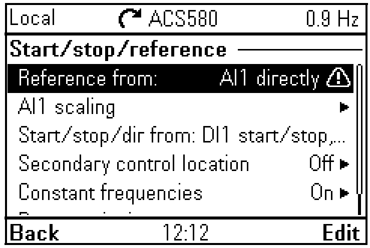
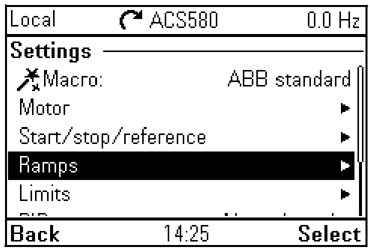
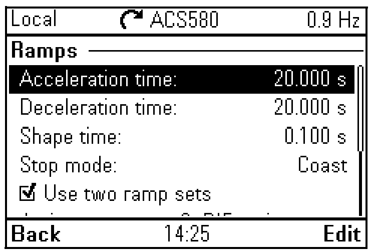
Scroll the page with and .

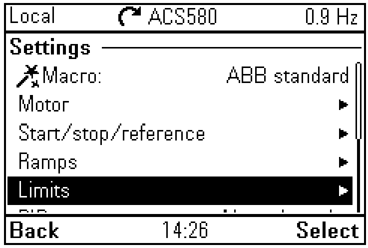
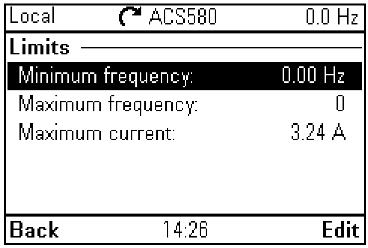
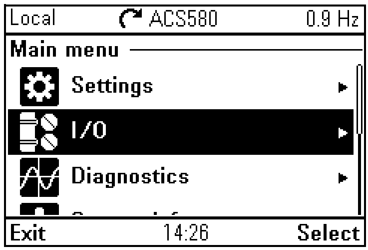
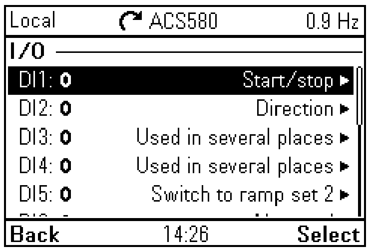
To return to the Control macro submenu, press (Exit).
All macros use scalar motor control by default. If you want to use vector motor control instead, Select Menu - Primary settings - Motor - Control mode and follow the instructions.

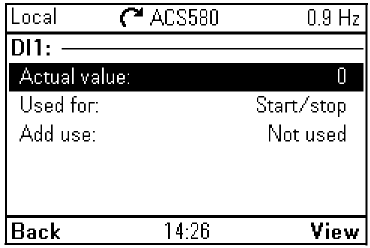
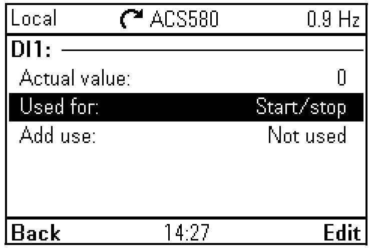
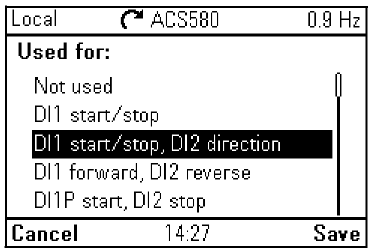
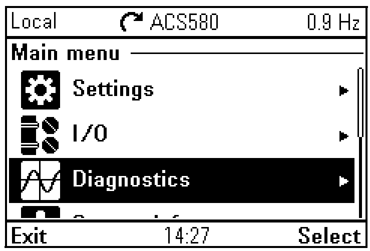
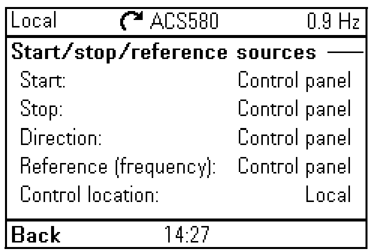
</td>
<td>


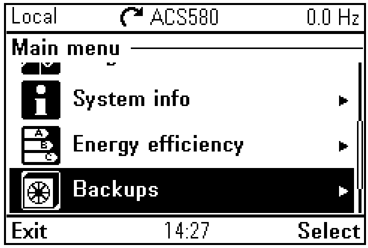
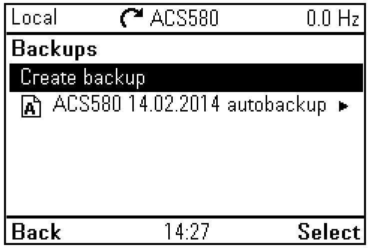


</td>
</tr>
</table>

<table>
<tr><th colspan="3">2 – Additional settings: Start, stop and reference values</th></tr>
<tr><td>☐</td><td>If you do not wish to use a macro, define the settings for start, stop and reference:
Highlight Start, stop, reference and press (Select) (or ▶).</td><td>
</td></tr>
<tr><td>☐</td><td>Adjust the parameters according to your needs.
Highlight parameter and press (Select).
When you change the settings, you also change the use of the I/O signals in the drive. Make sure the actual I/O wiring and the use of I/O in the control program match each other. You can check the current I/O use in the I/O menu under the Main menu (see page 128).
After making the adjustments, go back to the Primary settings menu by pressing (Back).</td><td>
</td></tr>
<tr><th colspan="3">2 – Additional settings: Ramps
(acceleration and deceleration times for the motor)</th></tr>
<tr><td>☐</td><td>Highlight Ramps and press (Select) (or ▶).</td><td>
</td></tr>
<tr><td>☐</td><td>Adjust the parameters according to your needs.
Highlight parameter and press (Edit).
After making the adjustments, go back to the Primary settings menu by pressing (Back).</td><td>
</td></tr>
</table>

	2 – Additional settings: Limits	
☐	Highlight **Limits** and press (**Select**) (or).	
☐	Adjust the parameters according to your needs. Highlight parameter and press (**Select**). After making the adjustments, go back to the **Primary settings** menu by pressing (**Back**).	
	3 – I/O menu	
☐	After the additional adjustments, make sure that the actual I/O wiring matches the I/O use in the control program. In the **Main** menu, highlight **I/O** and press (**Select**) to enter the **I/O** menu.	
☐	Highlight the connection you want to check and press (**Select**) (or).	

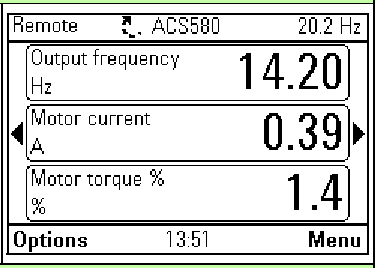
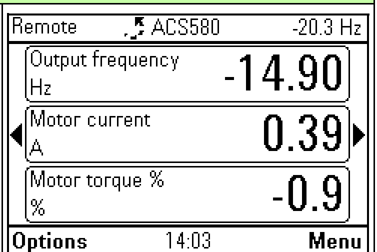
☐	To view the details of a parameter that cannot be adjusted via the **I/O** menu, press (**View**).	
☐	To adjust the value of a parameter, press (**Edit**), adjust the value using ▲, ▼, ◄ and ► keys and press (**Save**). Note that the actual wiring must match the new value. Go back to the **Main** menu by pressing (**Back**) repeatedly.	 
	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. In the **Main** menu, highlight **Diagnostics** and press (**Select**) (or ►).	
☐	Highlight the diagnostics item you want to view and press (**Select**). Return to the **Diagnostics** menu by pressing (**Back**.)	

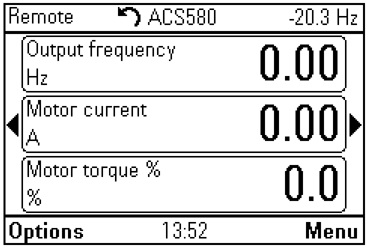
5 – Backup		
☐	After you have finished start-up we recommend that you make a backup. In the **Main** menu, highlight **Backups** and press (**Select**) (or).	
☐	Press (**Select**) to start backup.	

How to control the drive through the I/O interface

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

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

<table>
<tr><th colspan="2">Preliminary settings</th></tr>
<tr><td>If you need to change the direction of rotation, check that limits allow reverse direction: Go to Menu - Primary settings - Limits and make sure that the minimum limit has a negative value and the maximum limit has a positive value.</td><td></td></tr>
<tr><td>Make sure that the control connections are wired according to the connection diagram given for the ABB standard macro.</td><td>See section Default I/O connection diagram (ABB standard macro) on page 98.</td></tr>
<tr><td>Make sure that the drive is in remote control. Press key Loc/Rem to switch between remote and local control.</td><td>In remote control, the panel display shows text Remote at the top left.</td></tr>
<tr><th colspan="2">Starting and controlling the speed of the motor</th></tr>
<tr><td>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 AI1.</td><td>
</td></tr>
<tr><th colspan="2">Changing the direction of the motor rotation</th></tr>
<tr><td>Reverse direction: Switch digital input DI2 on.
Forward direction: Switch digital input DI2 off.</td><td>
</td></tr>
</table>

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

How to perform the ID run

The drive automatically estimates motor characteristics using identification magnetization when the drive is started for the first time and after any motor parameter (group *99 Motor data*) is changed. This is valid when

- parameter *99.13 ID run requested* is set to *Standstill* and
- parameter *99.04 Motor control mode* is set to *Vector*.

In most applications there is no need to perform a separate ID run. The ID run should be selected 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
- operation point is near zero speed, or
- operation at torque range above the motor nominal torque, over a wide speed range, and without any measured speed feedback is needed.

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

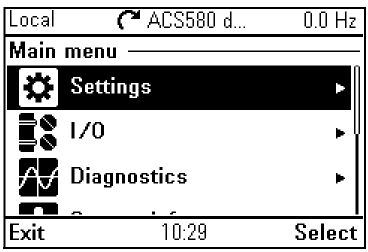
Note: If you have already parameterized your application using the scalar motor control mode (*99.04 Motor control mode* is set to *Scalar*) and you need to change motor control mode to *Vector*,

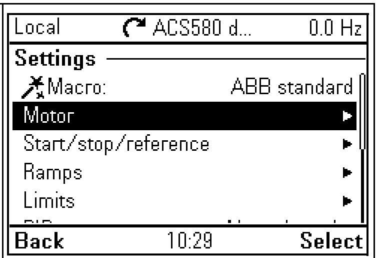
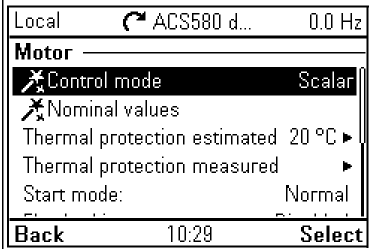
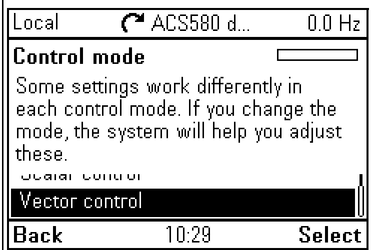
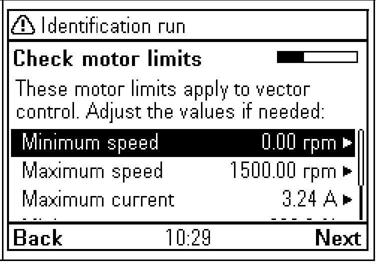
- change the control mode to vector with the **Control mode** assistant and follow the instructions (go to **Main - Primary settings - Motor - Control mode)**

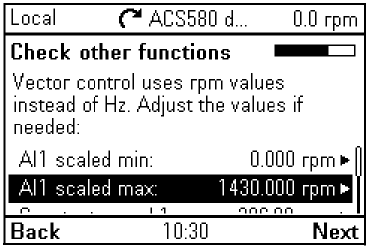
or

- 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*.
  - for torque controlled drive, check also parameters in group *26 Torque reference chain*.

ID Run procedure

Pre-check	
	WARNING! The motor will run at up to approximately 50…80% of the nominal speed during the ID run. The motor will rotate in the forward direction. **Make sure that it is safe to run the motor before performing the ID run!**
☐	De-couple the motor from the driven equipment
☐	Check that the values of the motor data parameters are equivalent to those on the motor nameplate.
☐	Check that the STO circuit is closed.
	If parameter values (from group *10 Standard DI, RO* to group *99 Motor data*) are changed before the ID run, check that the new settings meet the following conditions:
☐	*30.11 Minimum speed* ≤ 0 rpm
☐	*30.12 Maximum speed* = motor rated speed (Normal ID run procedure needs the motor to be run at 100% speed.)
☐	*30.17 Maximum current* > I_{HD}
☐	*30.20 Maximum torque 1* > 50% 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 enable (parameter *20.12 Run enable 1 source*) is active
☐	start enable (parameter *20.19 Enable start command*) is active
☐	enable to rotate (parameter *20.22 Enable to rotate*) is active.
☐	Make sure that the panel is in local control (text Local shown at the top left). Press key Loc/Rem to switch between local and remote control.
ID run	
☐	Go to the **Main** menu by pressing (**Menu**) in the Home view. Highlight **Primary settings** and press (**Select**) (or ▶). 

☐	Highlight **Motor** and press (**Select**) (or).	
☐	Highlight **Control mode** and press (**Select**) (or).	
☐	Change motor control mode from scalar to vector: Highlight **Vector control** and press (**Select**). The reference unit at the top right changes rom Hz to rpm.	
☐	Warning message **Identification run** is shown at the top for a few seconds. Panel LED starts blinking green to indicate an active warning. Check the motor limits shown on the panel. Press (**Next**).	

☐	Check other functions, for example AI settings according to the vector control mode. Press (**Next**). Press the start 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 stop key (). 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 *423* for more information.	

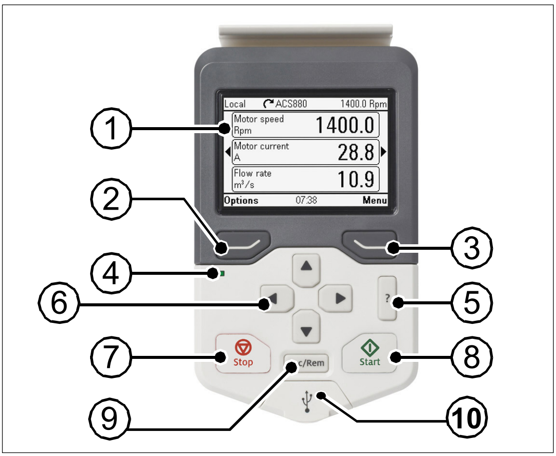
9

Control panel

Contents of this chapter

This chapter briefly describes the display, keys and key shortcuts of the assistant control panel. For more information, see *ACS-AP-x assistant control panels user's manual* (3AUA0000085685 [English]).

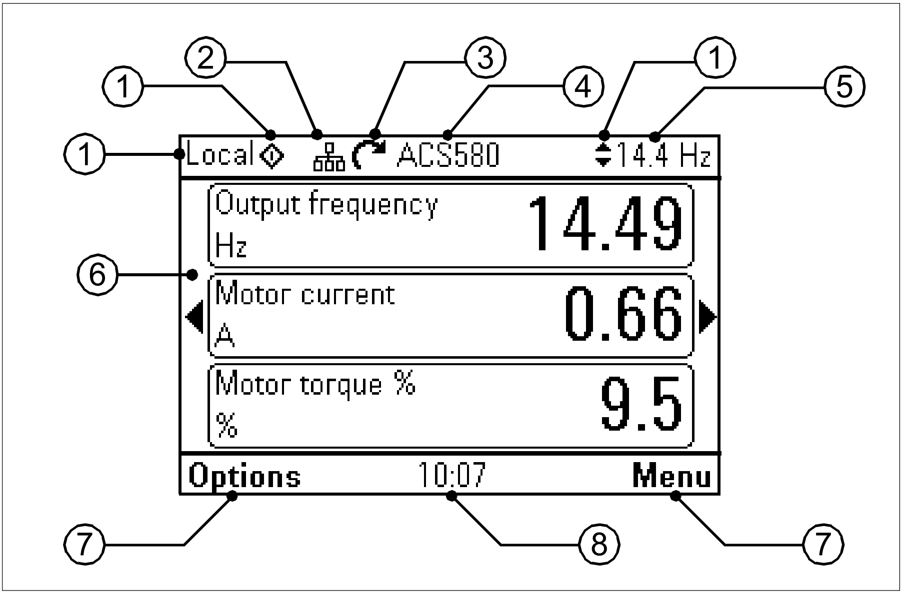
Control panel



1	*Control panel display*		6	*The arrow keys*
2	*Left softkey*		7	Stop (see *Start and Stop*)
3	*Right softkey*		8	Start (see *Start and Stop*)
4	Status LED, see page *493*.		9	Local/Remote (see *Loc/Rem*)
5	*Help*		10	USB connector

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 pane indicate which actions are allowed:

Text/Icons	Starting from this control panel	Stopping from this control panel	Giving reference from this panel
Local	Allowed	Allowed	Allowed

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

Text/Icons	Starting from this control panel	Stopping from this control panel	Giving reference from this panel
Remote	Not allowed	Not allowed	Not allowed
Remote	Allowed	Allowed	Not allowed
Remote	Not allowed	Allowed	Allowed
Remote	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

4. **Drive name**: If a name has been given, it is displayed in the top pane. By default, it is “ACS580”. You can change the name on the control panel by selecting **Menu - Primary settings - Clock, region, display** (see page *156*).
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 *148*).
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 *138* 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 *156*).

You can adjust the display contrast and backlight functionality on the control panel by selecting **Menu - Primary settings - Clock, region, display** (see page *156*).

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.

Start and Stop

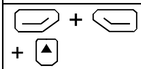
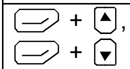
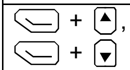
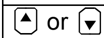
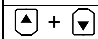
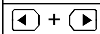
In local control, the start key ( ) and the stop key ( ) start and stop the drive, respectively.

Loc/Rem

The location key (Loc/Rem) is used for switching the control between the control panel (Local) and remote connections (Remote). When switching from Remote to Local while the drive is running, the drive keeps running at the same speed. When switching from Local to Remote, the status of the remote location is adopted.

Key shortcuts

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

Shortcut	Available in	Effect
	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 *ACS-AP-x assistant control panels user's manual* (3AUA0000085685 [English]).
	any view	Adjust backlight brightness.
	any view	Adjust display contrast.
	Home view	Adjust reference.
	parameter edit views	Revert an editable parameter to its default value.
	any view	Show/hide parameter index and parameter group numbers.
 (keep down)	any view	Return to the Home view by pressing down the key until the Home view is shown.

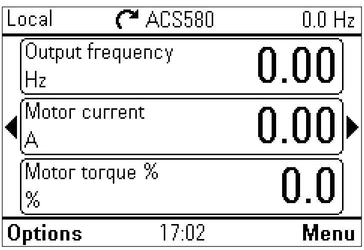
10

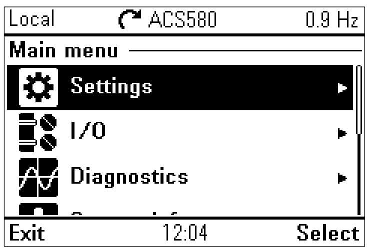
Settings, I/O and diagnostics on the control panel

Contents of this chapter

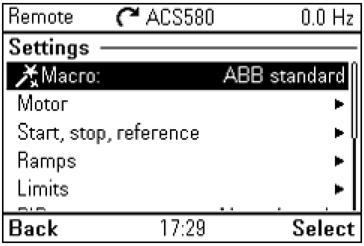
This chapter provides detailed information about the **Primary settings**, **I/O** and **Diagnostics** menus on the control panel.

To get to the **Primary settings**, **I/O** or **Diagnostic** menu from the Home view, first select **Menu** to go the **Main** menu, and in the **Main** menu, select **Primary settings**, **I/O** or **Diagnostics**.





Primary settings menu



To go the **Primary settings** menu from the Home view, select **Main - Menu - Primary settings**.

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

After making the guided settings using the first start assistant, we recommend that you make at least these additional settings:

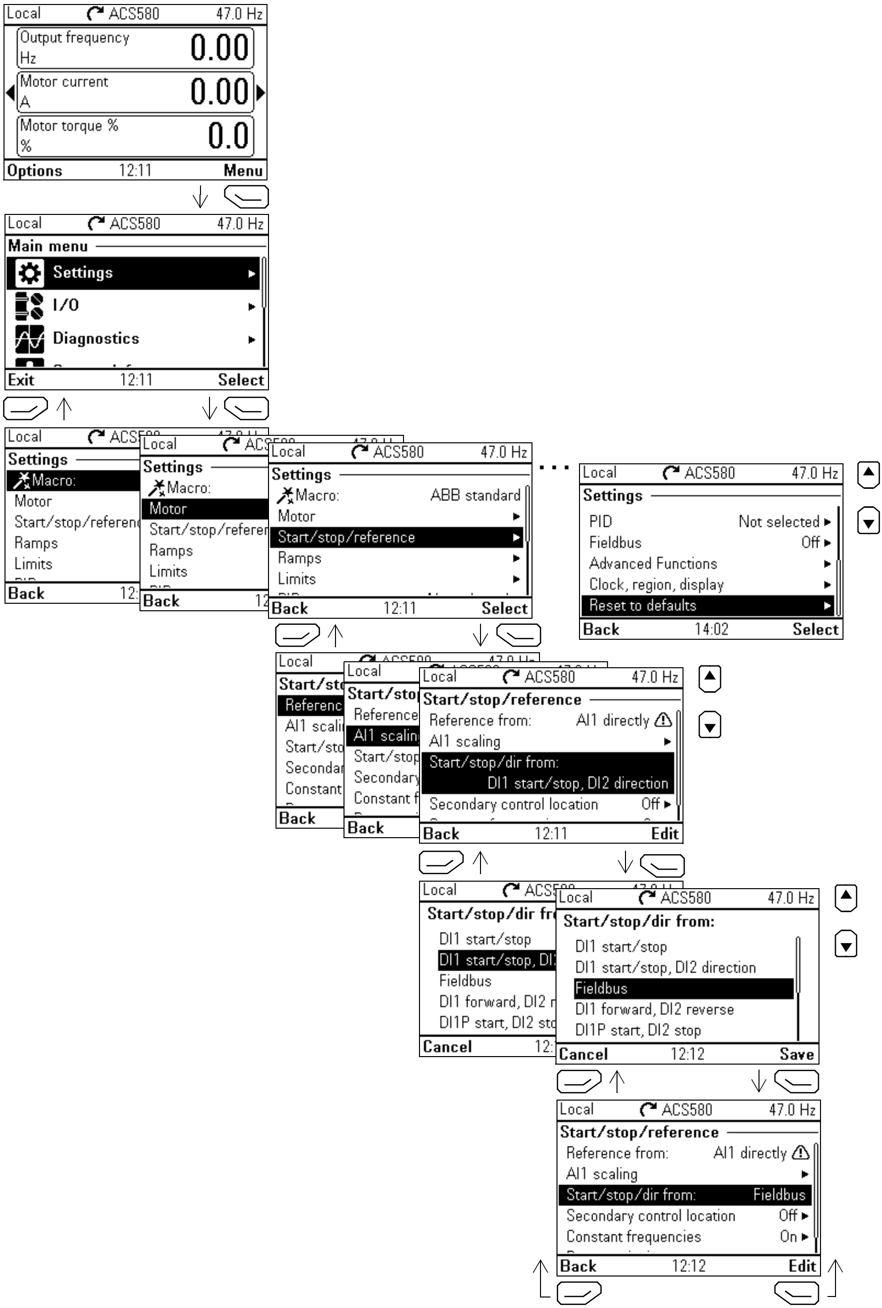
- Select a **Macro** or set **Start, stop, reference** values
- **Ramps**
- **Limits**

With the **Primary settings** menu, you can also adjust settings related to the motor, PID, fieldbus, advanced functions and clock, region and display. In addition, the menu contains an item to reset the panel Home view. 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 225.

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

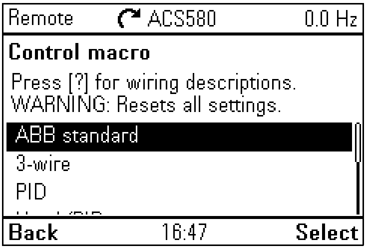
To get more information on **Primary settings** menu items, press the ? key to open the help page.

The figure below shows how to navigate in the **Primary settings** menu.



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

Macro

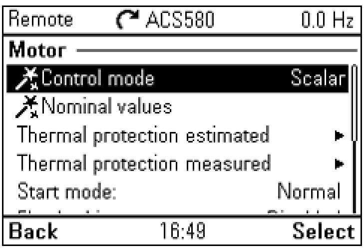


Use the **Macro** submenu to quickly set up drive control and reference source by selecting from a set of predefined wiring configurations.

Note: For detailed information about the available macros, see *Control macros* on page *143*.

If you do not wish to use a macro, manually define the settings for **Start, stop, reference**. Note that even if you select to use a macro, you can also modify the other settings to suit your needs.

Motor



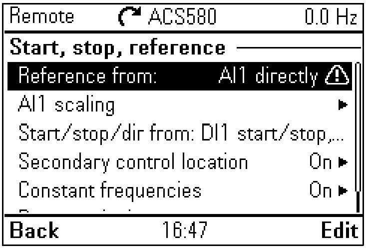
Use the **Motor** submenu to adjust motor-related settings, such as nominal values, control mode or thermal protection.

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

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

Menu item	Description	Corresponding parameter
Control mode	Selects whether to use scalar or vector control mode. For information on scalar control mode, see *Scalar motor control* on page *196*. For information on vector control mode, see *Vector control* on page *188*.	*99.04 Motor control mode*
Nominal values	Enter the motor's nominal values from the motor's nameplate.	*99.06 Motor nominal current* … *99.12 Motor nominal torque*
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. By default, motor thermal estimate protection is on. We recommend checking the values for the protection to function properly. For more information, see *Motor thermal protection* on page *214*.	*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. For more information, see *Motor thermal protection* on page *214*.	*35 Motor thermal protection*
Start mode:	Sets how the drive starts the motor (e.g. pre-magnetize or not).	*21 Start/stop mode*
Flux braking:	Sets how much current to use for braking, ie. how the motor is magnetized before starting. For more information, see *Flux braking* on page *198*.	*97.05 Flux braking*
U/f ratio:	The form of voltage to frequency ratio below field weakening point. For more information, see *U/f ratio* on page *198*.	*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 *IR compensation for scalar motor control* on page *196*.	*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.	*21.14 Pre-heating input source* *21.16 Pre-heating current*
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.	*99.06 Motor phase order*

Start, stop, reference



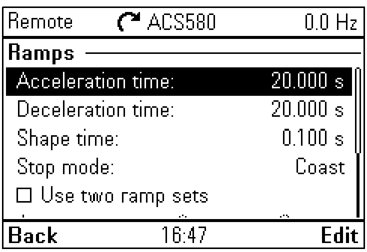
Use the **Start, stop, reference** submenu to set up start/stop commands, reference, and related features, such as constant speeds or run permissions.

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

Menu item	Description	Corresponding parameter
Reference from	Sets where the drive gets its reference when remote control (Ext1) is active.	*28.11 Ext1 frequency ref1* or *22.11 Ext1 speed ref1* *12.19 AI1 scaled at AI1 min*
Reference-related settings (e.g. AI scaling, AI2 scaling, Motor potentiometer settings) depending on the selected reference	The voltage or current fed to the input is converted into a value the drive can use (e.g. reference).	*12.20 AI1 scaled at AI1 max*
Start/stop/dir from:	Sets where the drive gets start, stop, and (optionally) direction commands when remote control (Ext1) is active.	*20.01 Ext1 commands*
Secondary control location	Settings for the secondary remote control location, Ext2. These settings include reference source, start, stop, direction and command sources for Ext2. By default, Ext2 is set to **Off**.	*19.11 Ext1/Ext2 selection* *28.15 Ext2 frequency ref1* or *22.18 Ext2 speed ref1* *12.17 AI1 min* *12.18 AI1 max* *12.27 AI2 min* *12.28 AI2 max* *20.06 Ext2 commands* *20.08 Ext2 in1 source* *20.09 Ext2 in2 source* *20.10 Ext2 in3 source*

Menu item	Description	Corresponding parameter
Constant speeds / Constant frequencies	These settings are for using a constant value as the reference. By default, this is set to **Off**. For more information, see *Constant speeds/frequencies* on page *190*.	*28.21 Constant frequency function* or *22.21 Constant speed function* *28.26 Constant frequency 1* *28.27 Constant frequency 2* *28.28 Constant frequency 3* *22.26 Constant speed 1* *22.27 Constant speed 2* *22.28 Constant speed 3*
Jogging	These settings allow you to use a digital input to briefly run the motor using predefined speed and acceleration/deceleration ramps. By default, jogging is disabled and it can only be used in the Vector control mode. For more information, see *Jogging* on page *192*.	*20.25 Jogging enable* *22.42 Jogging 1 ref* *22.43 Jogging 2 ref* *23.20 Acc time jogging* *23.21 Dec time jogging*
Run permissions	Settings to prevent the drive from running or starting when a specific digital input is low.	*20.12 Run enable 1 source* *20.11 Run enable stop mode* *20.19 Enable start command* *20.22 Enable to rotate* *21.05 Emergency stop source* *21.04 Emergency stop mode* *23.23 Emergency stop time*

Ramps

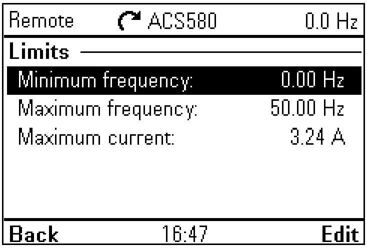


Use the **Ramps** submenu to set up acceleration and deceleration settings.

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

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* *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* *28.73 Freq deceleration time 1*
Shape time:	Sets the shape of the default ramps (set 1).	*23.32 Shape time 1* *28.82 Shape time 1*
Stop mode:	Sets how the drive stops the motor.	*21.03 Stop mode*
Use two ramp sets	Enables the use of a second acceleration/deceleration ramp set. If unselected, only one ramp set is used. Note that if this selection is not enabled, the selection below are not available.	
Activate ramp set 2:	To switch ramp sets, you can either: • use a digital input (low = set 1; high = set 2), or • automatically switch to set 2 above a certain frequency/speed.	*23.11 Ramp set selection* *28.71 Freq ramp set selection*
Limit to activate ramp set 2:	Above this limit, ramp set 2 is used. Below this limit, ramp set 1 is used. The drive automatically switches ramp sets when crossing this limit.	*32.60 Supervision 6 high* *32.59 Supervision 6 low*
Acceleration time 2:	Sets the time between standstill and "scaling speed" when using ramp set 2.	*23.14 Acceleration time 2* *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* *28.75 Freq deceleration time 2*
Shape time 2:	Sets the shape of ramps in set 2.	*23.33 Shape time 2* *28.83 Shape time 2*

Limits

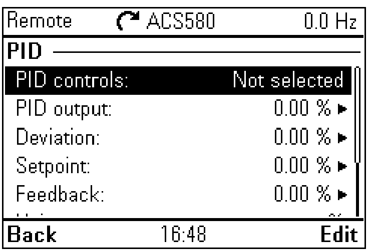


Use the **Limits** submenu to set the allowed operating range. This function is intended to protect the motor, connected hardware and mechanics. The drive stays within these limits, no matter what reference value it gets.

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

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*
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 Minimum torque 1*
Maximum current	Sets the maximum output current.	*30.17 Maximum current*

PID



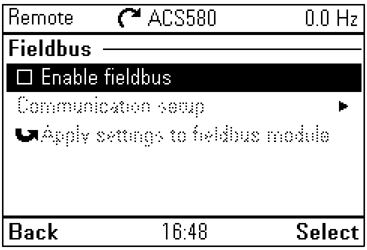
The **PID** submenu contains settings and actual values for the process PID controller. PID is only used in remote control.

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

Menu item	Description	Corresponding parameter
PID controls:	Sets what to use PID output for: • **Not selected**: PID not used. • **Reference**: Uses PID output as reference when remote control (Ext1) is active. • **Secondary reference**: Uses PID output as reference when the secondary remote control location (Ext2) is active.	*40.07 Process PID operation mode*
PID output:	View the process PID output or set its range.	*40.01 Process PID output actual* *40.36 Set 1 output min* *40.37 Set 1 output max*
Deviation:	View or invert process PID deviation.	*40.04 Process PID deviation actual* *40.31 Set 1 deviation inversion*
Setpoint:	View or configure the process PID setpoint, ie. the target process value. 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* *40.16 Set 1 setpoint 1 source*
Feedback:	View or configure process PID feedback, ie. the measured value.	*40.02 Process PID feedback actual* *40.08 Set 1 feedback 1 source* *40.11 Set 1 feedback filter time*
Unit:	Sets the text shown as the unit for setpoint, feedback and deviation.	
Tuning	The **Tuning** submenu contains settings for gain, integration time and derivation time. 1. Make sure it is safe to start the motor and run the actual process. 2. Start the motor in remote control. 3. Change setpoint by a small amount. 4. Watch how feedback reacts. 5. Adjust gain/integration/derivation. 6. Repeat steps 3-5 until feedback reacts as desired.	*40.32 Set 1 gain* *40.33 Set 1 integration time* *40.34 Set 1 derivation time* *40.35 Set 1 derivation filter time*

Menu item	Description	Corresponding parameter
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. See section *Sleep and boost functions for process PID control* on page 204.	*40.43 Set 1 sleep level* *40.44 Set 1 sleep delay* *40.45 Set 1 sleep boost time* *40.46 Set 1 sleep boost step* *40.47 Set 1 wake-up deviation* *40.48 Set 1 wake-up delay*

Fieldbus



Use the settings in the **Fieldbus** submenu to use the drive with a fieldbus:

- Modbus (RTU or TCP)
- PROFIBUS
- PROFINET
- Ethernet/IP

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*, *53 FBA A data out*), but the purpose of the **Fieldbus** menu is to make the protocol configurations easier.

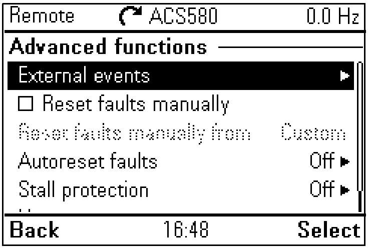
Note that only Modbus RTU is embedded and the other fieldbus modules are optional adapters. For the optional modules, the following adapters are required to enable the needed protocols:

- ModbusTCP: FENA-11/-21
- PROFIBUS: FBPA-01
- PROFINET FENA-11/-21
- Ethernet/IP: FENA-11/-21

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

Menu item	Description	Corresponding parameter
Enable fieldbus	Select this if you want to use the drive with a fieldbus.	*51.01 FBA A type* *51.02 FBA A Par2*
Communication setup	To set up communication between the drive and the fieldbus master, define these settings and then select **Apply settings to fieldbus module**.	*51 FBA A settings* *51.27 FBA A par refresh* *51.31 D2FBA A comm status* *50.13 FBA A control word* *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* *19.11 Ext1/Ext2 selection* *22.11 Ext1 speed ref1* *28.11 Ext1 frequency ref1* *22.41 Speed ref safe* *28.41 Frequency ref safe* *50.03 FBA A comm loss t out* *46.01 Speed scaling* *46.02 Frequency scaling* *23.12 Acceleration time 1* *23.13 Deceleration time 1* *28.72 Freq acceleration time 1* *28.73 Freq deceleration time 1* *51.27 FBA A par refresh*
Cyclical data out (master to drive)	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* *53 FBA A data out* *51.27 FBA A par refresh*
Cyclical data in (drive 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* *52 FBA A data in* *51.27 FBA A par refresh*
Apply settings to fieldbus module	Applies modified settings to the fieldbus module.	*51.27 FBA A par refresh*

Advanced functions



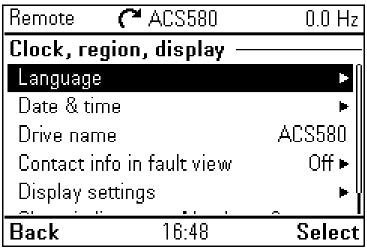
The **Advanced functions** submenu contains settings for advanced functions, such as triggering or resetting faults via I/O, or switching between several entire sets of settings.

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

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.	*31.01 External event 1 source* *31.02 External event 1 type* *31.03 External event 2 source* *31.04 External event 2 type* *31.05 External event 3 source* *31.06 External event 3 type*
Reset faults manually	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 faults manually from:	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*
Autoreset faults	Reset faults automatically. For more information, see *Automatic fault resets* on page *219*.	*31.12 Autoreset selection* *31.16 Delay time* *31.15 Total trials time* *31.14 Number of trials*

Menu item	Description	Corresponding parameter
Stall protection	The drive can detect a motor stall and automatically fault or show a warning message. Stall condition is detected when: • current is high (above certain % of motor nominal current), and • output frequency (scalar control) or motor speed (vector control) is below a certain limit, and • the conditions above have been true for a certain minimum duration.	*31.24 Stall function* *31.25 Stall current limit* *31.26 Stall speed limit* *31.27 Stall frequency limit* *31.28 Stall time*
User sets	This submenu enables you to save multiple sets of settings for easy switching. For more information about user sets, see *User parameter sets* on page *223*.	*96.11 User set save/load* *96.10 User set status* *96.12 User set I/O mode in1* *96.13 User set I/O mode in2*

Clock, region, display



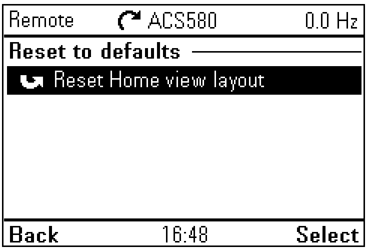
The **Clock, region, display** submenu contains settings for language, date and time, display (such as brightness) and settings for changing how information is displayed on screen.

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

Menu item	Description	Corresponding parameter
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.	
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.	

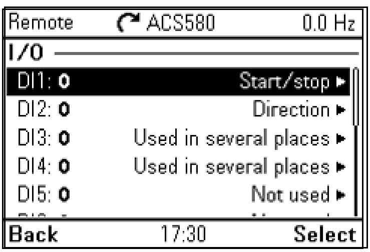
Menu item	Description	Corresponding parameter
Contact info in fault view	Define a fixed text that is shown during any fault (for example, who to contact in case of a fault). If a fault occurs, this information appears on the panel screen (in addition to the fault-specific information).	
Display settings	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: • parameters and groups • option list items • bits • devices in **Options** > **Select drive**	

Reset to defaults



The **Reset to defaults** submenu enables you to reset the Home view to its original factory state.

I/O menu



To go the **I/O** menu from the Home view, select **Main - 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?

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

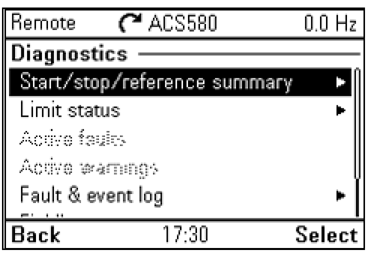
- Terminal name and number
- Electrical status
- Logical meaning of the drive

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



To go the **Diagnostics** menu from the Home view, select **Main - 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.

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

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 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.
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 and reset them.
Fault & event log	This view lists the faults, warnings and other events that have occurred in the drive.
Fieldbus	This view provides status information and sent and received data from fieldbus for troubleshooting.
Load profile	This view provides status information regarding load distribution (that is, how much of the drive's running time was spent on each load level) and peak load levels.

11

Control macros

Contents of this chapter

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

General

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

Control macros can be selected in the Primary settings menu: **Menu - Primary settings - Macro** or with parameter *96.04 Macro select* (page *379*).

Note: All macros are made for scalar control. If you want to use vector control, do as follows:

- Select the macro.
- Check nominal values of the motor: **Menu - Primary settings - Motor - Nominal values**.
- Change motor control mode to vector: **Menu - Primary settings - Motor - Control mode**, and follow the instructions (see the figure on the right).

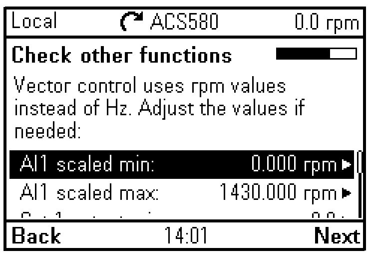
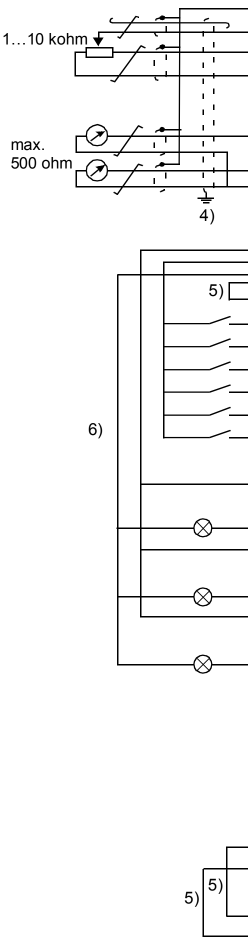


ABB standard macro

This is the default macro. It provides a general purpose, 2-wire I/O configuration with three constant speeds. One signal is used to start or stop the motor and another to select the direction.

Default control connections for the ABB standard macro



S1	AI1 U/I	Voltage/Current selection for AI1: U I
S2	AI2 U/I	Voltage/Current selection for AI2: U I
XI	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Output frequency/speed reference**: 0…10 V[1)]
3	AGND	Analog input circuit common
4	+10V	Reference voltage 10 V DC
5	AI2	Not configured
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0…20 mA
8	AO2	**Output current:** 0…20 mA
9	AGND	Analog output circuit common
S3	AO1 I/U	Voltage/Current selection for AO1: I U
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Auxiliary voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1)**
14	DI2	**Forward (0) / Reverse (1)**
15	DI3	**Constant frequency/speed selection**[2)]
16	DI4	**Constant frequency/speed selection**[2)]
17	DI5	**Ramp set 1 (0) / Ramp set 2 (1)**[3)]
18	DI6	Not configured
X6, X7, X8	Relay outputs	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	EIA-485 Modbus RTU	
29	B+	Embedded Modbus RTU (EIA-485). See chapter *Fieldbus control through the embedded fieldbus interface (EFB)* on page *441*.
30	A-	
31	DGND	
S4	TERM	Serial data link termination switch
S5	BIAS	Serial data link bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter *The Safe torque off function* on page *555*.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	
40	24 V AC/DC- in	R5…R9 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.
41	24 V AC/DC+ in	

See the notes on the next page.

Terminal sizes:

R0…R3: 0.2…2.5 mm^2 (terminals +24V, DGND, DCOM, B+, A-)
0.14…1.5 mm^2 (terminals DI, AI, AO, AGND, RO, STO)

R5…R9: 0.14…2.5 mm^2 (all terminals)

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

Notes:

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

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

DI3	DI4	Operation/Parameter	
		Scalar control (default)	**Vector control**
0	0	Set frequency through AI1	Set speed through AI1
1	0	*28.26 Constant frequency 1*	*22.26 Constant speed 1*
0	1	*28.27 Constant frequency 2*	*22.27 Constant speed 2*
1	1	*28.28 Constant frequency 3*	*22.28 Constant speed 3*

3) In scalar control (default): See **Menu - Primary settings - Ramps** or parameter group *28 Frequency reference chain*.
In vector control: See **Menu - Primary settings - Ramps** or parameter group *23 Speed reference ramp*.

DI5	Ramp set	Parameters	
		Scalar control (default)	**Vector control**
0	1	*28.72 Freq acceleration time 1* *28.73 Freq deceleration time 1*	*23.12 Acceleration time 1* *23.13 Deceleration time 1*
1	2	*28.74 Freq acceleration time 2* *28.75 Freq deceleration time 2*	*23.14 Acceleration time 2* *23.15 Deceleration time 2*

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

5) Connected with jumpers at the factory.

6) **Note:** Use shielded twisted-pair cables for digital signals.

Input signals

- Analog frequency/speed reference (AI1)
- Start/stop selection (DI1)
- Direction selection (DI2)
- Constant frequency/speed selection (DI3, DI4)
- Ramp set (1 of 2) selection (DI5)

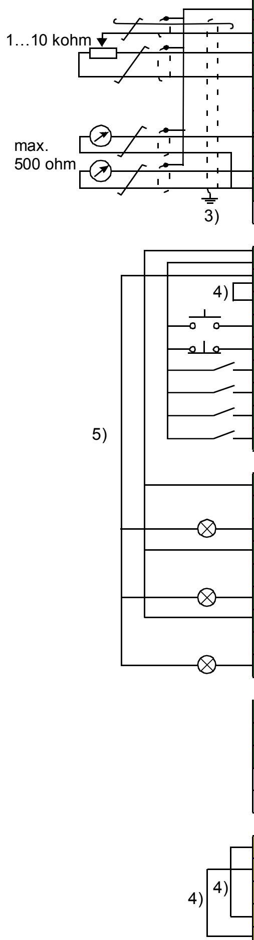
Output signals

- Analog output AO1: Frequency
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

3-wire macro

This macro is used when the drive is controlled using momentary push-buttons. It provides three constant speeds. To enable the macro, set the value of parameter *96.04 Macro select* to *3-wire*.

Default control connections for the 3-wire macro



S1	AI1 U/I	Voltage/Current selection for AI1: U I
S2	AI2 U/I	Voltage/Current selection for AI2: U I
XI	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Ext. speed/frequency reference 1**: 0…10 V[1)]
3	AGND	Analog input circuit common
4	+10V	Reference voltage 10 V DC
5	AI2	Not configured
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0…20 mA
8	AO2	**Output current:** 0…20 mA
9	AGND	Analog output circuit common
S3	AO1 I/U	Voltage/Current selection for AO1: I U
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Auxiliary voltage output common
12	DCOM	Digital input common for all
13	DI1	**Start (pulse)**
14	DI2	**Stop (pulse)**
15	DI3	**Forward (0) / Reverse (1)**
16	DI4	**Constant speed/frequency selection**[2)]
17	DI5	**Constant speed/frequency selection**[2)]
18	DI6	Not configured
X6, X7, X8	Relay outputs	
19	RO1C	**Ready run**
20	RO1A	250 V AC / 30 V DC
21	RO1B	2 A
22	RO2C	**Running**
23	RO2A	250 V AC / 30 V DC
24	RO2B	2 A
25	RO3C	**Fault (-1)**
26	RO3A	250 V AC / 30 V DC
27	RO3B	2 A
X5	EIA-485 Modbus RTU	
29	B+	Embedded Modbus RTU (EIA-485). See chapter *Fieldbus control through the embedded fieldbus interface (EFB)* on page *441*.
30	A-	
31	DGND	
S4	TERM	Serial data link termination switch
S5	BIAS	Serial data link bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter *The Safe torque off function* on page *555*.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	
40	24 V AC/DC- in	R5…R9 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.
41	24 V AC/DC+ in	

See the notes on the next page.

Terminal sizes:

R0…R3: 0.2…2.5 mm^2 (terminals +24V, DGND, DCOM, B+, A-)
0.14…1.5 mm^2 (terminals DI, AI, AO, AGND, RO, STO)

R5…R9: 0.14…2.5 mm^2 (all terminals)

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

Notes:

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

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

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

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

[4] Connected with jumpers at the factory.

[5] **Note:** Use shielded twisted-pair cables for digital signals.

Input signals

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

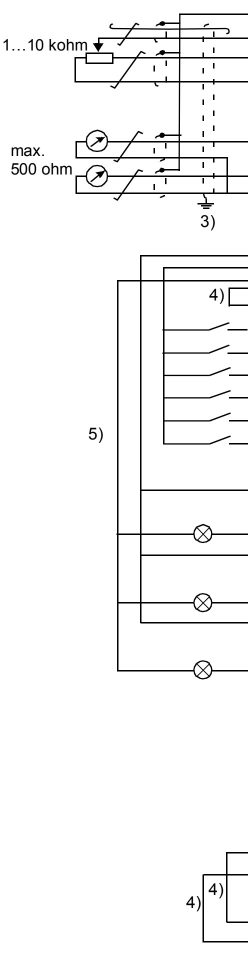
Output signals

- Analog output AO1: Frequency
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Alternate macro

This macro provides an I/O configuration where one signal starts the motor in the forward direction and another signal to start the motor in the reverse direction. To enable the macro, set the value of parameter *96.04 Macro select* to *Alternate*.

Default control connections for the Alternate macro



S1	AI1 U/I	Voltage/Current selection for AI1: U I
S2	AI2 U/I	Voltage/Current selection for AI2: U I
XI	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Ext. speed/frequency reference 1**: 0…10 V
3	AGND	Analog input circuit common
4	+10V	Reference voltage 10 V DC
5	AI2	Not configured
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0…20 mA
8	AO2	**Output current:** 0…20 mA
9	AGND	Analog output circuit common
S3	AO1 I/U	Voltage/Current selection for AO1: I U
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Auxiliary voltage output common
12	DCOM	Digital input common for all
13	DI1	**Start forward;** If DI1 = DI2: **Stop**
14	DI2	**Start reverse**
15	DI3	**Constant speed/frequency selection**[1)]
16	DI4	**Constant speed/frequency selection**[1)]
17	DI5	**Ramp set 1 (0) / Ramp set 2 (1)**[2)]
18	DI6	**Run enable;** if 0, drive stops
X6, X7, X8	Relay outputs	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	EIA-485 Modbus RTU	
29	B+	Embedded Modbus RTU (EIA-485). See chapter *Fieldbus control through the embedded fieldbus interface (EFB)* on page *441*.
30	A-	
31	DGND	
S4	TERM	Serial data link termination switch
S5	BIAS	Serial data link bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter *The Safe torque off function* on page *555*.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	
40	24 V AC/DC- in	R5…R9 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.
41	24 V AC/DC+ in	

See the notes on the next page.

Terminal sizes:

R0…R3: 0.2…2.5 mm^2 (terminals +24V, DGND, DCOM, B+, A-)
0.14…1.5 mm^2 (terminals DI, AI, AO, AGND, RO, STO)

R5…R9: 0.14…2.5 mm^2 (all terminals)

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

Notes:

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

DI3	DI4	Operation/Parameter	
		Scalar control (default)	**Vector control**
0	0	Set frequency through AI1	Set speed through AI1
1	0	*28.26 Constant frequency 1*	*22.26 Constant speed 1*
0	1	*28.27 Constant frequency 2*	*22.27 Constant speed 2*
1	1	*28.28 Constant frequency 3*	*22.28 Constant speed 3*

2) In scalar control (default): See **Menu - Primary settings - Ramps** or parameter group *28 Frequency reference chain*.
In vector control: See **Menu - Primary settings - Ramps** or parameter group *23 Speed reference ramp*.

DI5	Ramp set	Parameters	
		Scalar control (default)	**Vector control**
0	1	*28.72 Freq acceleration time 1* *28.73 Freq deceleration time 1*	*23.12 Acceleration time 1* *23.13 Deceleration time 1*
1	2	*28.74 Freq acceleration time 2* *28.75 Freq deceleration time 2*	*23.14 Acceleration time 2* *23.15 Deceleration time 2*

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

4) Connected with jumpers at the factory.

5) **Note:** Use shielded twisted-pair cables for digital signals.

Input signals

- Analog speed/frequency reference (AI1)
- Start motor forward (DI1)
- Start motor in reverse (DI2)
- Constant speed/frequency selection (DI3, DI4)
- Ramp set (1 of 2) selection (DI5)
- Run enable (DI6)

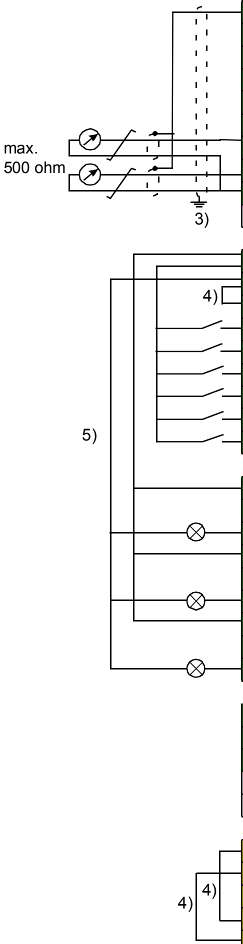
Output signals

- Analog output AO1: Frequency
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Motor potentiometer macro

This macro provides a way to adjust the speed with the help of two-push buttons, or a cost-effective interface for PLCs that vary the speed of the motor using only digital signals. To enable the macro, set the value of parameter *96.04 Macro select* to *Motor potentiometer*.

Default control connections for the Motor potentiometer macro



S1	AI1 U/I	Voltage/Current selection for AI1: U I
S2	Voltage/Curre	Voltage/Current selection for AI2: U I
XI	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	Not configured
3	AGND	Analog input circuit common
4	+10V	Reference voltage 10 V DC
5	AI2	Not configured
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0…20 mA
8	AO2	**Output current:** 0…20 mA
9	AGND	Analog output circuit common
S3	AO1 I/U	Voltage/Current selection for AO1: I U
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Auxiliary voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1)**
14	DI2	**Forward (0) / Reverse (1)**
15	DI3	**Reference up**[1)]
16	DI4	**Reference down**[1)]
17	DI5	**Constant frequency/speed 1**[2)]
18	DI6	**Run enable;** If 0, drive stops
X6, X7, X8	Relay outputs	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	EIA-485 Modbus RTU	
29	B+	Embedded Modbus RTU (EIA-485). See chapter *Fieldbus control through the embedded fieldbus interface (EFB)* on page *441*.
30	A-	
31	DGND	
S4	TERM	Serial data link termination switch
S5	BIAS	Serial data link bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter *The Safe torque off function* on page *555*.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	
40	24 V AC/DC- in	R5…R9 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.
41	24 V AC/DC+ in	

See the notes on the next page.

Terminal sizes:
R0…R3: 0.2…2.5 mm^2 (terminals +24V, DGND, DCOM, B+, A-)
0.14…1.5 mm^2 (terminals DI, AI, AO, AGND, RO, STO)
R5…R9: 0.14…2.5 mm^2 (all terminals)

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

Notes:

1) If DI3 and DI4 are both active or inactive, the frequency/speed reference is unchanged. The existing frequency/speed reference is stored during stop and power down.

2) In scalar control (default): See **Menu - Primary settings - Start, stop, reference - Constant frequencies** or parameter *28.26 Constant frequency 1*.
In vector control: See **Menu - Primary settings - Start, stop, reference - Constant speeds** or parameter *22.26 Constant speed 1*.

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

4) Connected with jumpers at the factory.

5) **Note:** Use shielded twisted-pair cables for digital signals.

Input signals

- Start/Stop selection (DI1)
- Direction selection (DI2)
- Reference up (DI3)
- Reference down (DI4)
- Constant frequency/speed 1 (DI5)
- Run enable (DI6)

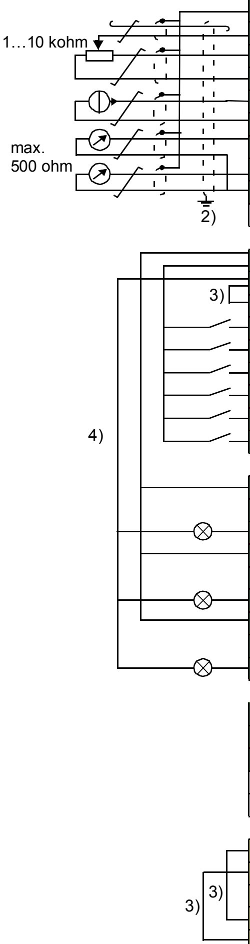
Output signals

- Analog output AO1: Frequency
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Hand/Auto macro

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

Default control connections for the Hand/Auto macro



S1	AI1 U/I	Voltage/Current selection for AI1: U I
S2	AI2 U/I	Voltage/Current selection for AI2: U I
XI	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Output speed/freq, reference (Hand)**: 0…10 V
3	AGND	Analog input circuit common
4	+10V	Reference voltage 10 V DC
5	AI2	**Output speed/freq, ref. (Auto)**: 4…20 mA[1)]
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0…20 mA
8	AO2	**Output current:** 0…20 mA
9	AGND	Analog output circuit common
S3	AO1 I/U	Voltage/Current selection for AO1: I U
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Auxiliary voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1) (Hand)**
14	DI2	**Forward (0) / Reverse (1) (Hand)**
15	DI3	**Hand control (0) / Auto control (1)**
16	DI4	**Run enable;** if 0, drive stops
17	DI5	**Forward (0) / Reverse (1) (Auto)**
18	DI6	**Stop (0) / Start (1) (Auto)**
X6, X7, X8	Relay outputs	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	EIA-485 Modbus RTU	
29	B+	Embedded Modbus RTU (EIA-485). See chapter *Fieldbus control through the embedded fieldbus interface (EFB)* on page *441*.
30	A-	
31	DGND	
S4	TERM	Serial data link termination switch
S5	BIAS	Serial data link bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter *The Safe torque off function* on page *555*.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	
40	24 V AC/DC- in	R5…R9 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.
41	24 V AC/DC+ in	

See the notes on the next page.

Terminal sizes:

R0…R3: 0.2…2.5 mm^2 (terminals +24V, DGND, DCOM, B+, A-)
0.14…1.5 mm^2 (terminals DI, AI, AO, AGND, RO, STO)

R5…R9: 0.14…2.5 mm^2 (all terminals)

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

Notes:

[1] The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see page *103*.

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

[3] Connected with jumpers at the factory.

[4] **Note:** Use shielded twisted-pair cables for digital signals.

Input signals

- Two speed/frequency analog reference (AI1, AI2)
- Control location (Hand or Auto) selection (DI3)
- Start/stop selection, Hand (DI1)
- Direction selection, Hand (DI2)
- Start/stop selection, Auto (DI6)
- Direction selection, Auto (DI5)
- Run enable (DI4)

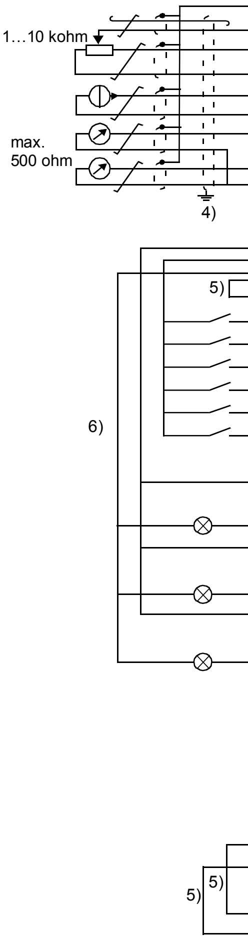
Output signals

- Analog output AO1: Frequency
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Hand/PID macro

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

Default control connections for the Hand/PID macro



S1	AI1 U/I	Voltage/Current selection for AI1: U I
S2	AI2 U/I	Voltage/Current selection for AI2: U I
XI	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Ext. Hand reference or Ext. PID ref.**: 0…10 V[1)]
3	AGND	Analog input circuit common
4	+10V	Reference voltage 10 V DC
5	AI2	**Actual PID feedback**: 4…20 mA[2)]
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0…20 mA
8	AO2	**Output current:** 0…20 mA
9	AGND	Analog output circuit common
S3	AO1 I/U	Voltage/Current selection for AO1: I U
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Auxiliary voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1) Hand**
14	DI2	**Hand (0) / PID (1) selection**
15	DI3	**Constant frequency selection**[3)]
16	DI4	**Constant frequency selection**[3)]
17	DI5	**Run enable;** if 0, drive stops
18	DI6	**Stop (0) / Start (1) PID**
X6, X7, X8	Relay outputs	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	EIA-485 Modbus RTU	
29	B+	Embedded Modbus RTU (EIA-485). See chapter *Fieldbus control through the embedded fieldbus interface (EFB)* on page *441*.
30	A-	
31	DGND	
S4	TERM	Serial data link termination switch
S5	BIAS	Serial data link bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter *The Safe torque off function* on page *555*.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	
40	24 V AC/DC- in	R5…R9 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.
41	24 V AC/DC+ in	

See the notes on the next page.

Terminal sizes:

R0…R3: 0.2…2.5 mm^2 (terminals +24V, DGND, DCOM, B+, A-)
0.14…1.5 mm^2 (terminals DI, AI, AO, AGND, RO, STO)

R5…R9: 0.14…2.5 mm^2 (all terminals)

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

Notes:

1) Hand: 0…10 V -> frequency reference.
PID: 0…10 V -> 0…100% PID setpoint.

2) The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see page *103*.

3) In scalar control (default): See **Menu - Primary settings - Start, stop, reference - Constant frequencies** or parameter group *28 Frequency reference chain*.

DI3	DI4	Operation (parameter)
		Scalar control (default)
0	0	Set frequency through AI1
1	0	*28.26 Constant frequency 1*
0	1	*28.27 Constant frequency 2*
1	1	*28.28 Constant frequency 3*

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

5) Connected with jumpers at the factory.

6) **Note:** Use shielded twisted-pair cables for digital signals.

Input signals

- Analog reference (AI1)
- Actual feedback from PID (AI2)
- Control location (Hand or PID) selection (DI2)
- Start/stop selection, Hand (DI1)
- Start/stop selection, PID (DI6)
- Constant frequency selection (DI3, DI4)
- Run enable (DI5)

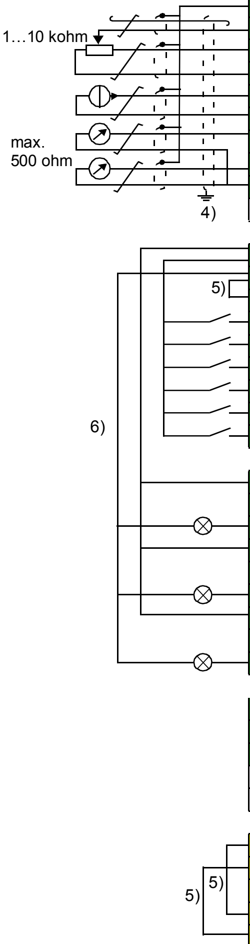
Output signals

- Analog output AO1: Frequency
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

PID macro

This macro provides parameter settings for closed-loop control systems such as pressure control, flow control, etc. To enable the macro, set the value of parameter *96.04 Macro select* to *PID*.

Default control connections for the PID macro



S1	AI1 U/I	Voltage/Current selection for AI1: U I
S2	AI2 U/I	Voltage/Current selection for AI2: U I
XI	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Ext. PID reference**: 0…10 V[1)]
3	AGND	Analog input circuit common
4	+10V	Reference voltage 10 V DC
5	AI2	**Actual PID feedback**: 4…20 mA[2)]
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0…20 mA
8	AO2	**Output current:** 0…20 mA
9	AGND	Analog output circuit common
S3	AO1 I/U	Voltage/Current selection for AO1: I U
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Auxiliary voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1) PID**
14	DI2	**Constant PID setpoint 1:** parameter *40.21*
15	DI3	**Constant PID setpoint 2:** parameter *40.22*
16	DI4	**Constant frequency 1:** parameter *28.26* [3)]
17	DI5	**Run enable;** if 0, drive stops
18	DI6	Not configured
X6, X7, X8	Relay outputs	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	EIA-485 Modbus RTU	
29	B+	Embedded Modbus RTU (EIA-485). See chapter *Fieldbus control through the embedded fieldbus interface (EFB)* on page *441*.
30	A-	
31	DGND	
S4	TERM	Serial data link termination switch
S5	BIAS	Serial data link bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter *The Safe torque off function* on page *555*.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	
40	24 V AC/DC- in	R5…R9 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.
41	24 V AC/DC+ in	

See the notes on the next page.

Terminal sizes:

R0…R3: 0.2…2.5 mm^2 (terminals +24V, DGND, DCOM, B+, A-)
0.14…1.5 mm^2 (terminals DI, AI, AO, AGND, RO, STO)

R5…R9: 0.14…2.5 mm^2 (all terminals)

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

Notes:

1) Hand: 0…10 V -> frequency reference.
PID: 0…10 V -> 0…100% PID setpoint.

2) The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see page *103*.

3) If Constant frequency is activated it overrides the reference from the PID controller output.

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

5) Connected with jumpers at the factory.

6) **Note:** Use shielded twisted-pair cables for digital signals.

Input signals

- Analog reference (AI1)
- Actual feedback from PID (AI2)
- Start/Stop selection, PID (DI1)
- Constant setpoint 1 (DI2)
- Constant setpoint 1 (DI3)
- Constant frequency 1 (DI4)
- Run enable (DI5)

Output signals

- Analog output AO1: Frequency
- Analog output AO2: Current
- Relay output 1: Ready
- Relay output 2: Running
- Relay output 3: Fault (-1)

Parameter default values for different macros

Chapter *Parameters* on page *225* shows the default values of all parameters for the ABB standard macro (factory macro). Some parameters have different default values for other macros. The tables below lists the default values for those parameter for each macro.

96.04 Macro select	**1 = ABB standard**	**11 = 3-wire**	**12 = Alternate**	**13 = Motor potenti-ometer**	**2 = Hand/Auto**	**3 = Hand/PID**	**14 = PID**
12.20 AI1 scaled at AI1 max	50.0	50.0	50.0	50.0	50.0	50.0	50.0
19.11 Ext1/Ext2 selection	0 = *EXT1*	0 = *EXT1*	0 = *EXT1*	0 = *EXT1*	5 = *DI3*	4 = *DI2*	0 = *EXT1*
20.01 Ext1 commands	2 = *In1 Start; In2 Dir*	5 = *In1P Start; In2 Stop; In3 Dir*	3 = *In1 Start fwd; In2 Start rev*	2 = *In1 Start; In2 Dir*	2 = *In1 Start; In2 Dir*	1 = *In1 Start*	1 =*In1 Start*
20.03 Ext1 in1 source	2 = *DI1*	2 = *DI1*	2 = *DI1*	2 = *DI1*	2 = *DI1*	2 = *DI1*	2 = *DI1*
20.04 Ext1 in2 source	3 = *DI2*	3 = *DI2*	3 = *DI2*	3 = *DI2*	3 = *DI2*	0 = *Not selected*	0 = *Not selected*
20.05 Ext1 in3 source	0 = *Not selected*	4 = *DI3*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*
20.06 Ext2 commands	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	2 = *In1 Start; In2 Dir*	1 = *In1 Start*	0 = *Not selected*
20.08 Ext2 in1 source	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	7 = *DI6*	7 = *DI6*	0 = *Not selected*
20.09 Ext2 in2 source	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	6 = *DI5*	0 = *Not selected*	0 = *Not selected*
20.12 Run enable 1 source	1 = *Selected*	1 = *Selected*	7 = *DI6*	7 = *DI6*	5 = *DI4*	6 = *DI5*	6 = *DI5*
22.11 Ext1 speed ref1	1 = *AI1 scaled*	1 = *AI1 scaled*	1 = *AI1 scaled*	15 = *Motor potentiometer*	1 = *AI1 scaled*	1 = *AI1 scaled*	16 = *PID*
22.18 Ext2 speed ref1	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*	2 = *AI2 scaled*	16 = *PID*	0 = *Zero*
22.22 Constant speed sel1	4 = *DI3*	5 = *DI4*	4 = *DI3*	6 = *DI5*	0 = *Not selected*	4 = *DI3*	5 = *DI4*
22.23 Constant speed sel2	5 = *DI4*	6 = *DI5*	5 = *DI4*	0 = *Not selected*	0 = *Not selected*	5 = *DI4*	0 = *Not selected*
22.71 Motor potentiometer function	0 = *Disabled*	0 = *Disabled*	0 = *Disabled*	1 = *Enabled (init at power-up)*	0 = *Disabled*	0 = *Disabled*	0 = *Disabled*
22.73 Motor potentiometer up source	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	4 = *DI3*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*
22.74 Motor potentiometer down source	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	5 = *DI4*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*
23.11 Ramp set selection	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*

96.04 Macro select	**1 = ABB standard**	**11 = 3-wire**	**12 = Alternate**	**13 = Motor potenti-ometer**	**2 = Hand/Auto**	**3 = Hand/PID**	**14 = PID**
28.11 Ext1 frequency ref1	1 = *AI1 scaled*	1 = *AI1 scaled*	1 = *AI1 scaled*	15 = *Motor potentiometer*	1 = *AI1 scaled*	1 = *AI1 scaled*	16 = *PID*
28.15 Ext1 frequency ref2	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*	2 = *AI2 scaled*	16 = *PID*	0 = *Zero*
28.22 Constant frequency sel1	4 = *DI3*	5 = *DI4*	4 = *DI3*	6 = *DI5*	0 = *Not selected*	4 = *DI3*	5 = *DI4*
28.23 Constant frequency sel2	5 = *DI4*	6 = *DI5*	5 = *DI4*	0 = *Not selected*	0 = *Not selected*	5 = *DI4*	0 = *Not selected*
28.71 Freq ramp set selection	6 = *DI5*	0 = *Acc/Dec time 1*	6 = *DI5*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*
40.07 Process PID operation mode	0 = *Off*	0 = *Off*	0 = *Off*	0 = *Off*	0 = *Off*	2 = *On when drive running*	2 = *On when drive running*
40.08 Set 1 feedback 1 source	2 = *AI2 scaled*	2 = *AI2 scaled*	2 = *AI2 scaled*	2 = *AI2 scaled*	2 = *AI2 scaled*	2 = *AI2 scaled*	2 = *AI2 scaled*
40.16 Set 1 setpoint 1 source	3 = *AI1 scaled*	3 = *AI1 scaled*	3 = *AI1 scaled*	3 = *AI1 scaled*	3 = *AI1 scaled*	3 = *AI1 scaled*	3 = *AI1 scaled*
40.17 Set 1 setpoint 2 source	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	2 = *Internal setpoint*
40.19 Set 1 internal setpoint sel1	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	3 = *DI2*
40.20 Set 1 internal setpoint sel2	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	4 = *DI3*

12

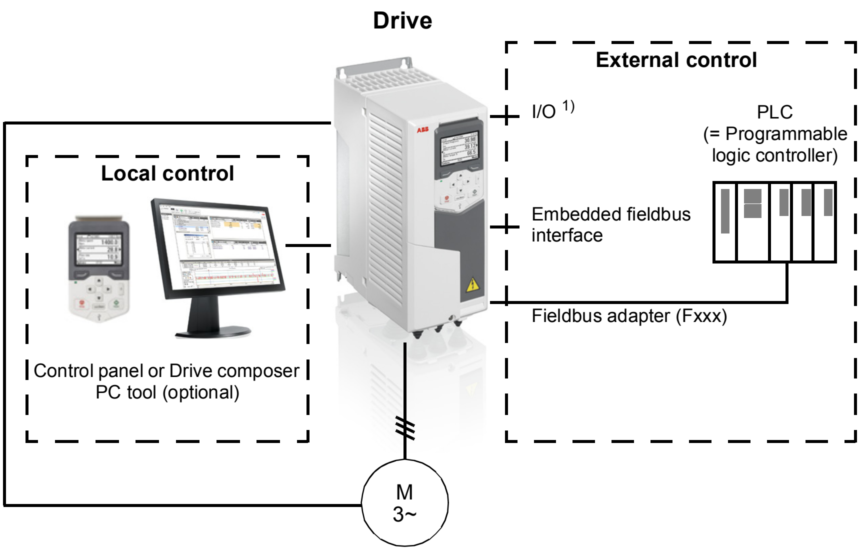
Program features

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 AC580 has two main control locations: external and local. The control location is selected with the Loc/Rem key on the control panel or in the PC tool.



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

Local control

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

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

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

External control

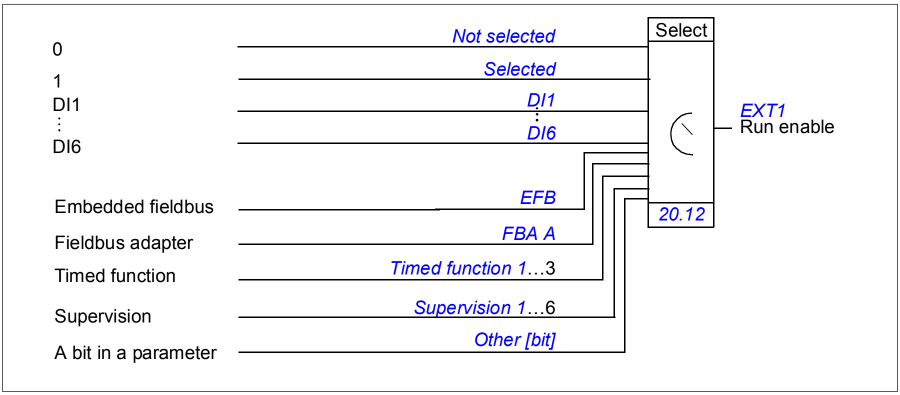
When the drive is in external control, control commands are given through

- 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 in the Primary settings menu (**Menu - Primary settings - Start, stop, reference**) or setting parameters *20.01*…*20.10*. The operating mode can be selected separately for each location, which enables quick switching between different operating modes, for example speed and torque control. Selection between EXT1 and EXT2 is done via any binary source such as a digital input or fieldbus control word (**Menu - Primary settings** - **Start, stop, reference - Secondary control location** or parameter *19.11 Ext1/Ext2 selection*). The source of reference is selectable for each operating mode separately.

Block diagram: Run enable source for EXT1

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



Settings

- **Menu - Primary settings** - **Start, stop, reference - Secondary control location; Menu - Primary settings - Start, stop, reference**
- Parameters *19.11 Ext1/Ext2 selection* (page *258*); *20.01*…*20.10* (page *259*).

Motor potentiometer

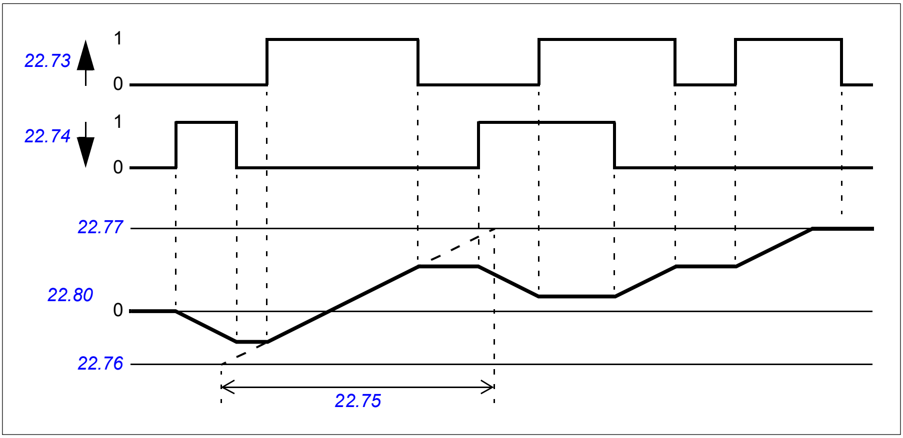
The motor potentiometer is, in effect, a counter whose value can be adjusted up and down using two digital signals selected by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*.

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

The 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 motor potentiometer value does not change.

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

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



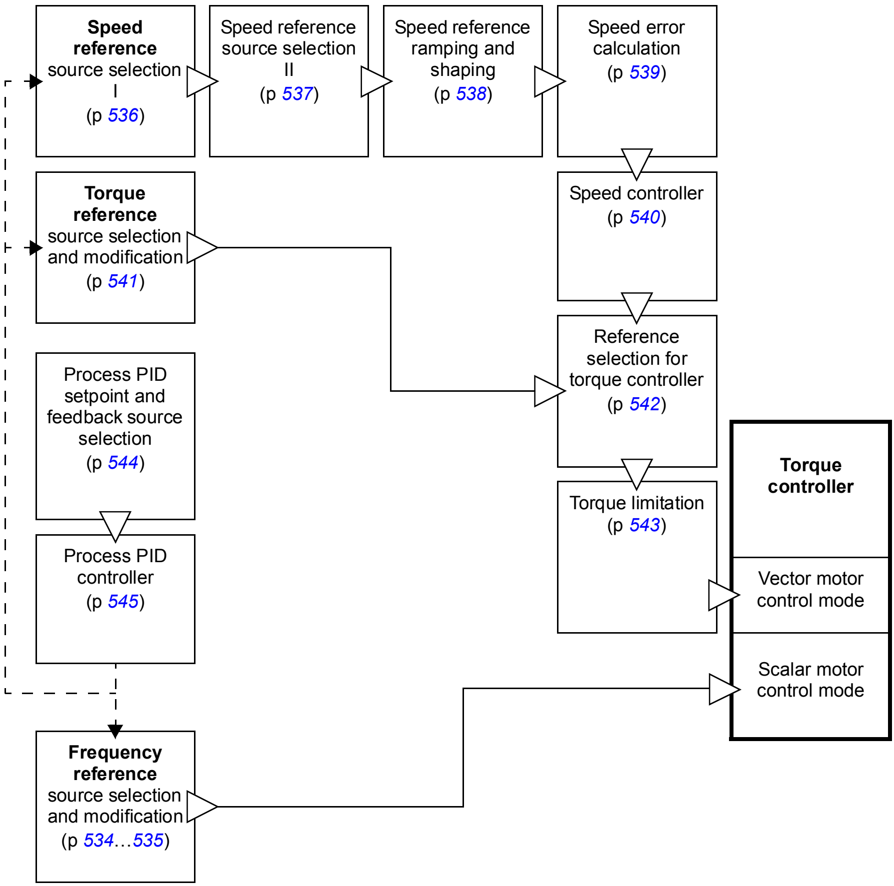
Settings

Parameters *22.71*…*22.80* (page *280*).

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*.

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



Speed control mode

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

Speed control mode is available in both local and external control. It is also available both in vector and scalar motor control modes.

Torque control mode

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

Frequency control mode

The motor follows a frequency reference given to the drive. Frequency control is only available for scalar motor control.

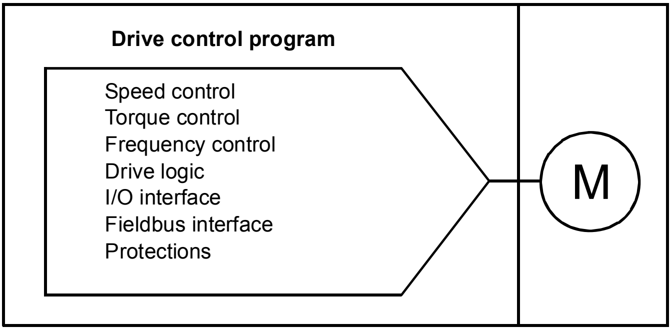
Special control modes

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

- Process PID control. For more information, see section *Process PID control* (page *203*).
- Emergency stop modes OFF1 and OFF3: Drive stops along the defined deceleration ramp and drive modulation stops.
- Jogging mode: Drive starts and accelerates to the defined speed when the jogging signal is activated. For more information, see section *Rush control* (page *191*).
- Pre-magnetization: DC magnetization of the motor before start. For more information, see section *Pre-magnetization* (page *199*).
- DC hold: Locking the rotor at (near) zero speed in the middle of normal operation. For more information, see section *DC hold* (page *199*).
- Pre-heating (motor heating): Keeping the motor warm when the drive is stopped. For more information, see section *Pre-heating (Motor heating)* (page *200*).

Drive configuration and programming

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



Configuring via parameters

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

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

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

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

Control interfaces

Programmable analog inputs

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

Settings

Parameter group *12 Standard AI* (page *243*).

Programmable analog outputs

The control unit has two current (0…20 mA) analog outputs. Each output can be filtered, inverted and scaled.

Settings

Parameter group *13 Standard AO* (page *247*).

Programmable digital inputs and outputs

The control unit has six digital inputs.

Digital input/output DI1 can be used as a frequency input.

Six digital inputs can be added by using a CHDI-01 115/230 V digital input extension module and one digital output by using a CMOD-01 multifunction extension module.

Settings

Parameter groups *10 Standard DI, RO* (page *238*) and *11 Standard DIO, FI, FO* (page *241*).

Programmable frequency input and output

Digital input (DI6) can be configured as a frequency input. A frequency output can be implemented with a CMOD-01 multifunction extension module.**Settings**

Parameter groups *10 Standard DI, RO* (page *238*) and *11 Standard DIO, FI, FO* (page *241*).

Programmable relay outputs

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

Two relay outputs can be added by using a CMOD-01 multifunction extension module or a CHDI-01 115/230 V digital input extension module.

Settings

Parameter group *10 Standard DI, RO* (page *238*).

Programmable I/O extensions

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

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

Location	Digital inputs (DI)	Digital outputs (DO)	Digital I/Os (DIO)	Analog inputs (AI)	Analog outputs (AO)	Relay outputs (RO)
Control unit	6	-	-	2	2	3
CMOD-01	-	1	-	-	-	2
CHDI-01	6	-	-	-	-	2

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

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. To connect to an input, choose the setting *Other* in the source selector parameter, then specify the appropriate value parameter (and bit, for digital signals) in group 15.

Settings

Parameter group *15 I/O extension module* (page *252*).

Fieldbus control

The drive can be connected to several different automation systems through its fieldbus interfaces. See chapters *Fieldbus control through the embedded fieldbus interface (EFB)* (page *441*) and *Fieldbus control through a fieldbus adapter* (page *467*).

Settings

Parameter groups *50 Fieldbus adapter (FBA)* (page *363*), *51 FBA A settings* (page *367*), *52 FBA A data in* (page *368*), and *53 FBA A data out* (page *369*) and *58 Embedded fieldbus* (page *369*).

Motor control

Motor types

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

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 to allow the motor model to be created. This identification method is suitable for most applications.

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

Settings

99.13 ID run requested (page *390*)

Power loss ride-through

See section *Undervoltage control (power loss ride-through)* on page *210*.

Vector control

The switching of the output semiconductors is controlled to achieve the required stator flux and motor torque. The switching frequency is changed only if the actual torque and stator flux values differ from their reference values by more than the allowed hysteresis. The reference value for the torque controller comes from the speed controller or directly from an external torque reference source.

Motor control requires measurement of the DC voltage and two motor phase currents. Stator flux is calculated by integrating the motor voltage in vector space. Motor torque is calculated as a cross product of the stator flux and the rotor current. By utilizing the identified motor model, the stator flux estimate is improved. Actual motor shaft speed is not needed for the motor control.

The main difference between traditional control and vector control is that torque control operates at the same time level as the power switch control. There is no separate voltage and frequency controlled PWM modulator; the output stage switching is wholly based on the electromagnetic state of the motor.

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

See also section *Speed control performance figures* (page *195*).

Settings

- **Menu - Primary settings - Motor - Control mode**
- Parameters *99.04 Motor control mode* (page *388*) and *99.13 ID run requested* (page *390*).

Reference ramping

Acceleration and deceleration ramping times can be set individually for speed, torque and frequency reference (**Menu - Primary settings - Ramps**).

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

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

Variable slope

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

Variable slope is only supported in remote control.

Settings

Parameters *23.28 Variable slope enable* (page *284*) and *23.29 Variable slope rate* (page *284*).

Special acceleration/deceleration ramps

The acceleration/deceleration times for the jogging function can be defined separately; see section *Rush control* (page *191*).

The change rate of the motor potentiometer function (page *195*) is adjustable. The same rate applies in both directions.

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

Settings

- Speed reference ramping: Parameters *23.11*…*23.15* and *46.01* (pages *282* and *359*).
- Torque reference ramping: Parameters *01.30*, *26.18* and *26.19* (pages *230* and *293*).
- Frequency reference ramping: Parameters *28.71*…*28.75* and *46.02* (pages *300* and *359*).
- Jogging: Parameters *23.20* and *23.21* (page *283*).
- Motor potentiometer: Parameter *22.75* (page *281*).
- Emergency stop ("Off3" mode): Parameter *23.23 Emergency stop time* (page *284*).

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 frequencies, Menu - Primary settings - Start, stop, reference - Constant speeds**
- Parameter groups *22 Speed reference selection* (page *274*) and *28 Frequency reference chain* (page *294*).

Critical speeds/frequencies

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

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

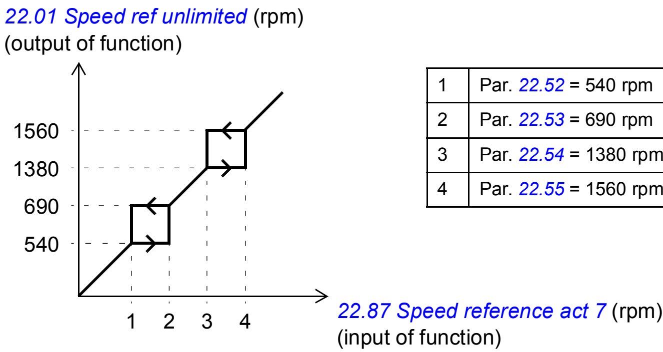
When the drive is limiting the allowed output speeds/frequencies, it limits to the absolutely lowest critical speed (critical speed low or critical frequency low) when accelerating from standstill, unless the speed reference is over the upper critical speed/ frequency limit.

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

Example

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

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



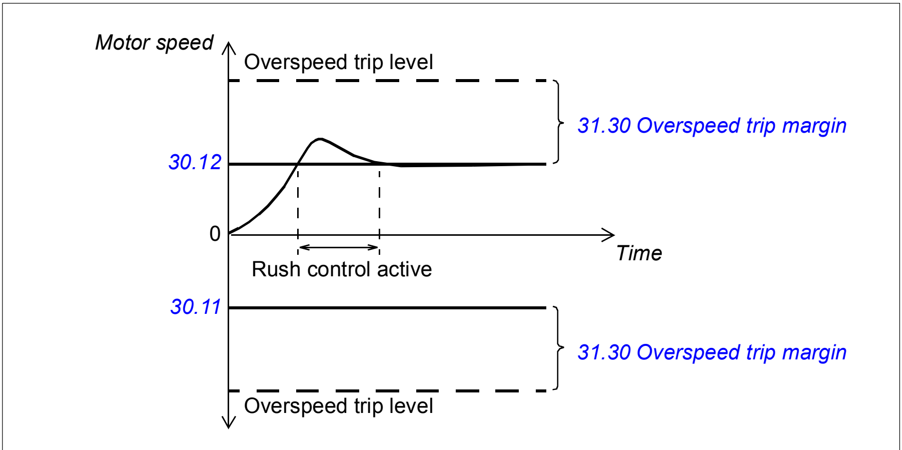
1	Par. *22.52* = 540 rpm
2	Par. *22.53* = 690 rpm
3	Par. *22.54* = 1380 rpm
4	Par. *22.55* = 1560 rpm

Settings

- Critical speeds: parameters *22.51*…*22.57* (page *279*)
- Critical frequencies: parameters *28.51*…*28.57* (page *299*).

Rush control

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



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

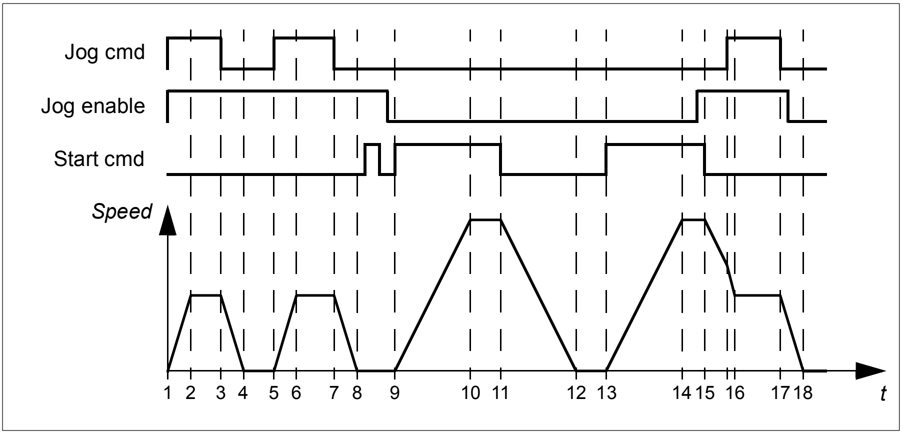
Jogging

The jogging function enables the use of a momentary switch to briefly rotate the motor. The jogging function is typically used during servicing or commissioning to control the machinery locally.

Two jogging functions (1 and 2) are available, each with their own activation sources and references. The signal sources are selected by parameters *20.26 Jogging 1 start source* and *20.27 Jogging 2 start source* (**Menu - Primary settings - Start, stop, reference - Jogging**). When jogging is activated, the drive starts and accelerates to the defined jogging speed (*22.42 Jogging 1 ref* or *22.43 Jogging 2 ref*) along the defined jogging acceleration ramp (*23.20 Acc time jogging*). After the activation signal switches off, the drive decelerates to a stop along the defined jogging deceleration ramp (*23.21 Dec time jogging*).

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

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



Phase	Jog cmd	Jog enable	Start cmd	Description
1-2	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
2-3	1	1	0	Drive follows the jog reference.
3-4	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
4-5	0	1	0	Drive is stopped.
5-6	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
6-7	1	1	0	Drive follows the jog reference.
7-8	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
8-9	0	1->0	0	Drive is stopped. As long as the jog enable signal is on, start commands are ignored. After jog enable switches off, a fresh start command is required.
9-10	x	0	1	Drive accelerates to the speed reference along the selected acceleration ramp (parameters *23.11*…*23.15*).
10-11	x	0	1	Drive follows the speed reference.
11-12	x	0	0	Drive decelerates to zero speed along the selected deceleration ramp (parameters *23.11*…*23.15*).
12-13	x	0	0	Drive is stopped.
13-14	x	0	1	Drive accelerates to the speed reference along the selected acceleration ramp (parameters *23.11*…*23.15*).

Phase	Jog cmd	Jog enable	Start cmd	Description
14-15	x	0->1	1	Drive follows the speed reference. As long as the start command is on, the jog enable signal is ignored. If the jog enable signal is on when the start command switches off, jogging is enabled immediately.
15-16	0->1	1	0	Start command switches off. The drive starts to decelerate along the selected deceleration ramp (parameters *23.11*…*23.15*). When the jog command switches on, the decelerating drive adopts the deceleration ramp of the jogging function.
16-17	1	1	0	Drive follows the jog reference.
17-18	0	1->0	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.

See also the block diagram on page *538*.

Notes:

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

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

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

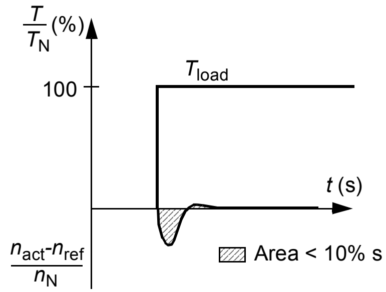
Settings

- **Menu - Primary settings - Start, stop, reference - Jogging**
- Parameters *20.25 Jogging enable* (page *266*), *20.26 Jogging 1 start source* (page *267*), *20.27 Jogging 2 start source* (page *268*), *22.42 Jogging 1 ref* (page *279*), *22.43 Jogging 2 ref* (page *279*), *23.20 Acc time jogging* (page *283*) and *23.21 Dec time jogging* (page *283*).

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

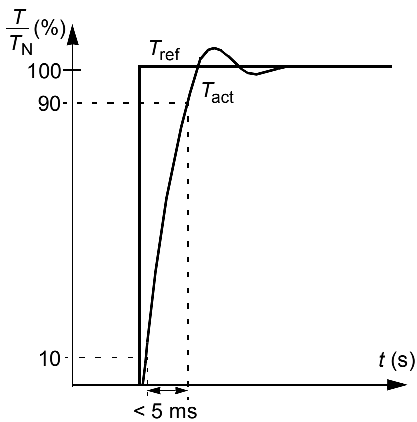


T_N = rated motor torque
n_N = rated motor speed
n_{act} = actual speed
n_{ref} = speed reference

Torque control performance figures

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

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



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

Scalar motor control

Scalar motor control is the default motor control method. In scalar control mode, the drive is controlled with a speed or 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:

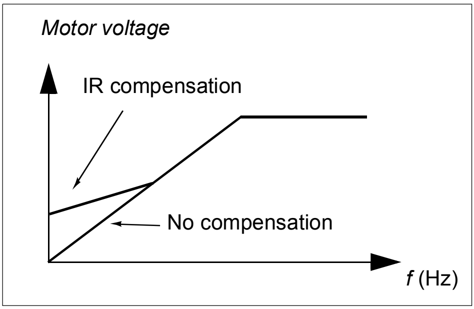
- In multimotor drives: 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after motor identification (ID run)
- If the nominal current of the motor is less than 1/6 of the nominal output current of the drive
- 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.

In scalar control, some standard features are not available.

See also section *Operating modes of the drive* (page *183*).

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 that require a high break-away torque.



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

Settings

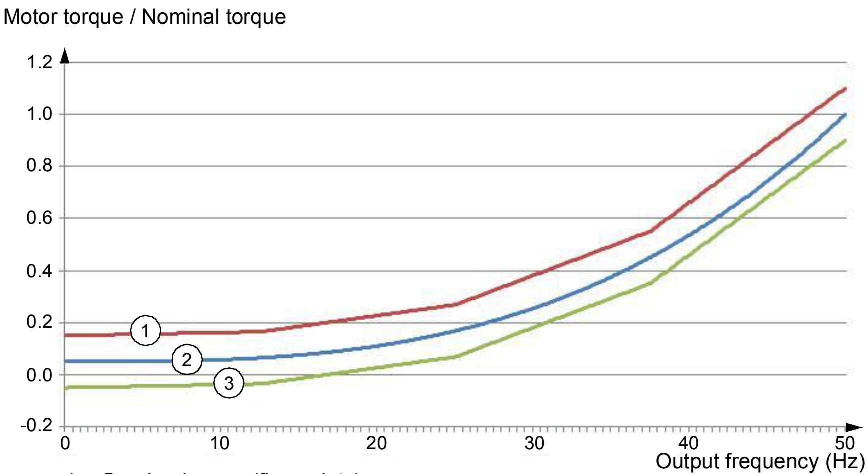
- **Menu - Primary settings - Motor - IR compensation**
- Parameters *97.13 IR compensation* (page *386*) and *99.04 Motor control mode* (page *388*)
- Parameter group *28 Frequency reference chain* (page *294*).

User load curve

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

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

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



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

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

Overload can be for example used to monitor for a saw blade hitting a knot or 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 *338*).

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.

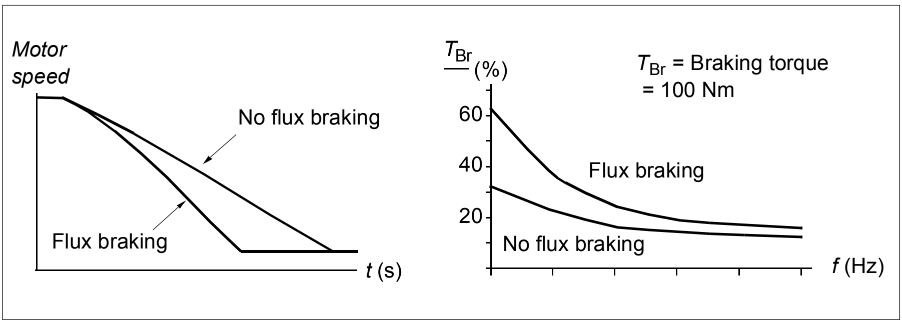
The *U*/f function cannot be used with energy optimization; if parameter *45.11 Energy optimizer* is set to *Enable*, parameter *97.20 U/F ratio* is ignored.

Settings

- **Menu - Primary settings - Motor - U/f ratio**
- Parameter *97.20 U/F ratio* (page *386*).

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 *384*).

DC magnetization

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

Pre-magnetization

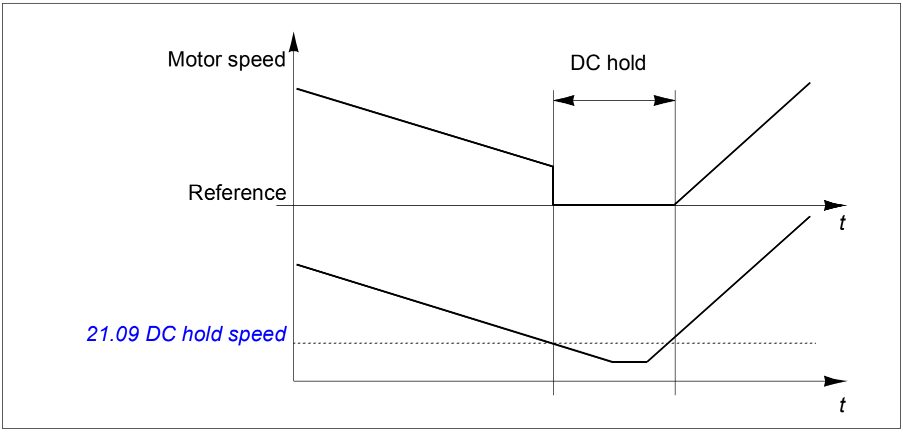
Pre-magnetization refers to DC magnetization of the motor before start. Depending on the selected start mode (*21.01 Vector start mode* or *21.19 Scalar start mode*), pre-magnetization can be applied to guarantee the highest possible breakaway torque, up to 200% of the nominal torque of the motor. By 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 Vector 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 ramping is the selected stop mode (see parameter *21.03 Stop mode*).

Settings

Parameters *21.01 Vector start mode*, *21.02 Magnetization time* and *21.08*…*21.11* (page *272*).

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 activated when the drive is in the stopped state, and starting the drive stops the heating.

The heating is only started after a delay when the start command has been removed to prevent excessive current if coast stop is used. The delay depends on the motor size and the rotating speed.

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.

The drive generates a warning when the pre-heating is active to indicate that current is being fed to the motor.

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 run enable, interlock and STO signals are active.
- The heating function requires that the drive is not faulted.
- Pre-heating uses DC hold to produce current.

Settings

- **Menu - Primary settings - Motor - Pre-heating**
- Parameters *21.14 Pre-heating input source* and *21.16 Pre-heating current* (page *272*)

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.

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

Settings

- **Menu - Energy efficiency**
- Parameter *45.11 Energy optimizer* (page *357*)

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 section *Switching frequency derating* on page *499*.

Example 1: If you need to fix the switching frequency to a certain value as with some external filters, set both the reference and the minimum switching frequency to this value and the drive will retain this switching frequency.

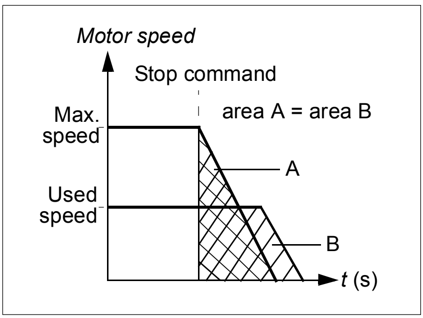
Example 2: If the reference switching frequency is set to 12kHz and the minimum switching frequency is set to 1kHz, the drive maintains the highest possible switching frequency to reduce motor noise and only when the drive heats it will decrease the switching frequency. This is useful, for example, in applications where low noise is necessary but higher noise can be tolerated when the full output current is needed.

Settings

Parameter *97.01 Switching frequency reference* and *97.02 Minimum switching frequency* (page *378*)

Speed compensated stop

Speed compensation stop is available for example for applications where a conveyer needs to travel a certain distance after receiving the stop command. At maximum speed, the motor is stopped normally along the defined deceleration ramp. Below maximum speed, stop is delayed by running the drive at current speed before the motor is ramped to a stop. As shown in the figure, the distance travelled after the stop command is the same in both cases, ie, area A equals area B.



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

Speed compensation is only supported in vector motor control.

Settings

Parameters *21.03 Stop mode* (page *269*), *21.30 Speed comp stop delay* (page *274*) and *21.31 Speed comp stop threshold* (page *274*).

Application control

Control macros

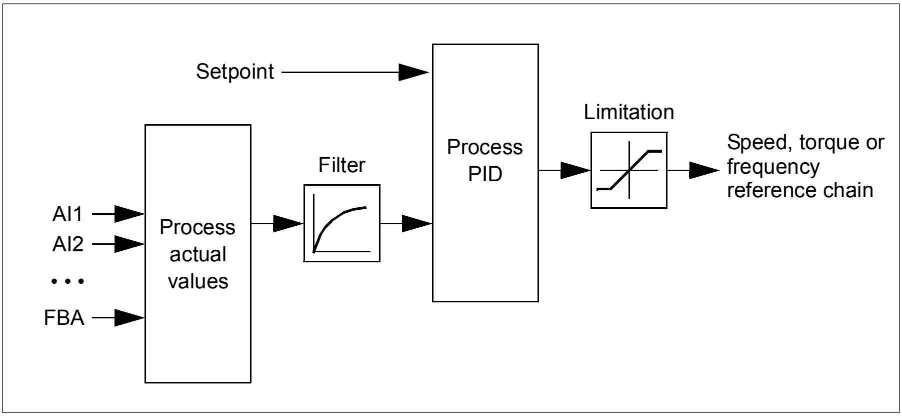
Control macros are predefined parameter edits and I/O configurations. See chapter *Control macros* (page *161*).

Process PID control

There is a built-in process PID controller in the drive. The controller can be used to control process 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 *544* and *545*.



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; see section *Local control vs. external control* (page *180*).

Quick configuration of the process PID controller

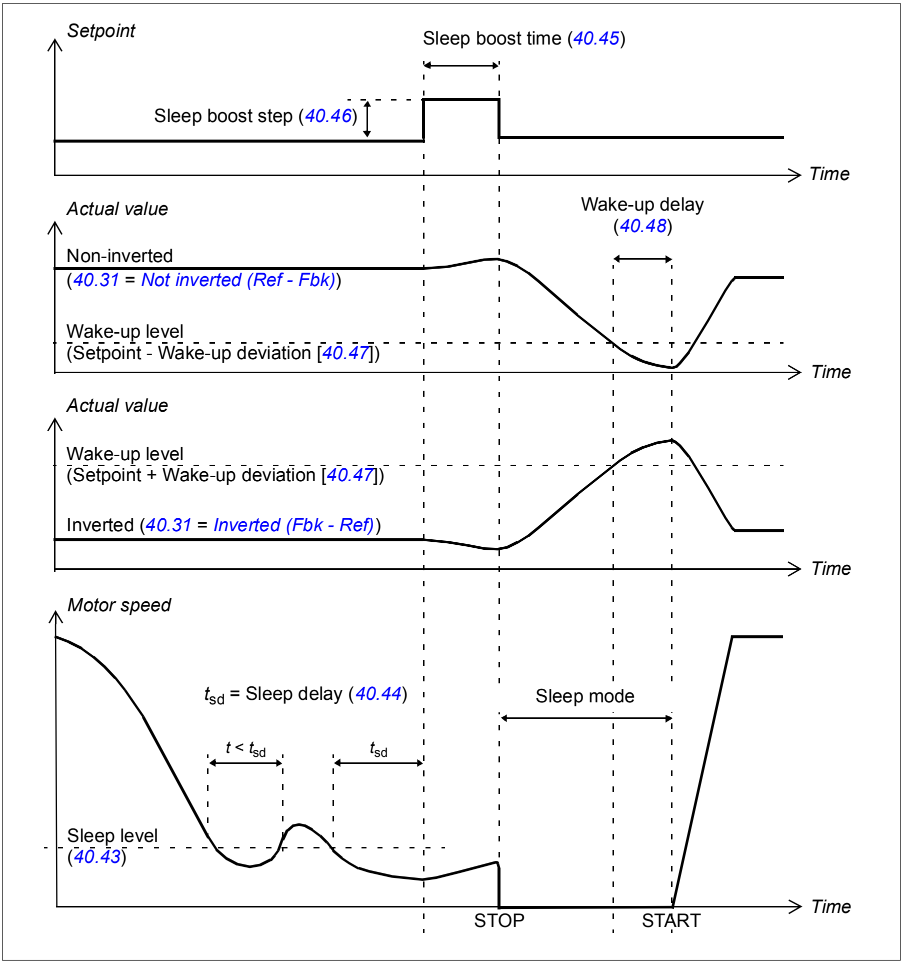
1. Activate the process PID controller: **Menu - Primary settings - PID - PID controls**
2. Select a feedback source: **Menu - Primary settings - PID - Feedback**
3. Select a setpoint source: **Menu - Primary settings - PID - Setpoint**
4. Set the gain, integration time, derivation time: **Menu - Primary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

Sleep and boost functions for process PID control

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

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

- **Menu - Primary settings - PID**
- Parameter *96.04 Macro select* (macro selection)
- Parameter groups *40 Process PID set 1* (page *341*) and *41 Process PID set 2* (page *351*).

Mechanical brake control

A mechanical brake can be used for holding the motor and driven machinery at zero speed when the drive is stopped, or not powered. The brake control logic observes the settings of parameter group *44 Mechanical brake control* as well as several external signals, and moves between the states presented in the diagram on page *207*. The tables below the state diagram detail the states and transitions. The timing diagram on page *208* shows an example of a close-open-close sequence.

Inputs of the brake control logic

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

Outputs of the brake control logic

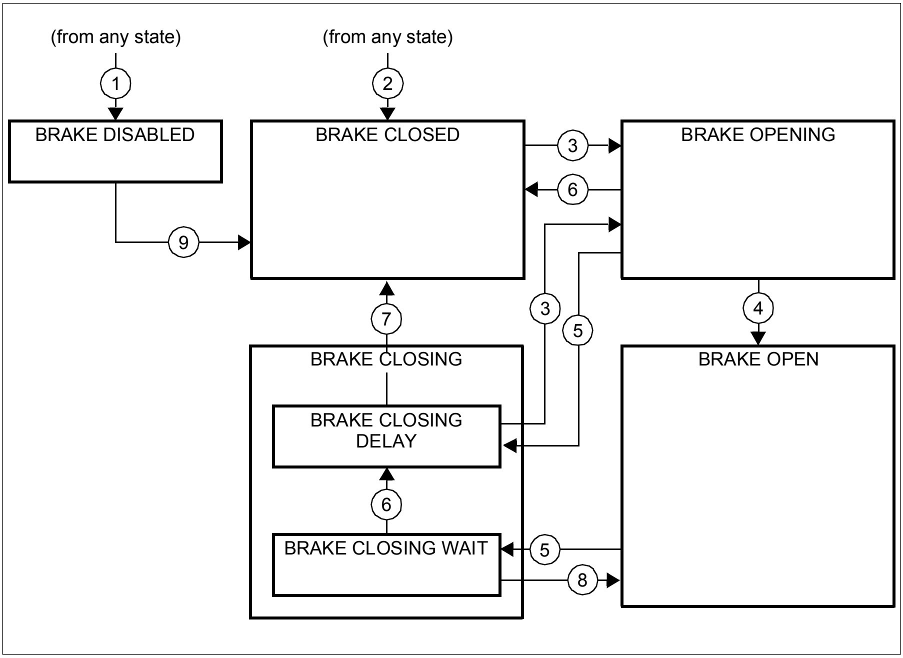
The mechanical brake is to be controlled by bit 0 of parameter *44.01 Brake control status*. This bit should be selected as the source of a relay output (or a digital input/output in output mode) which is then wired to the brake actuator through a relay. See the wiring example on page *209*.

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

Settings

Parameter group *44 Mechanical brake control* (page *354*).

Brake state diagram



State descriptions

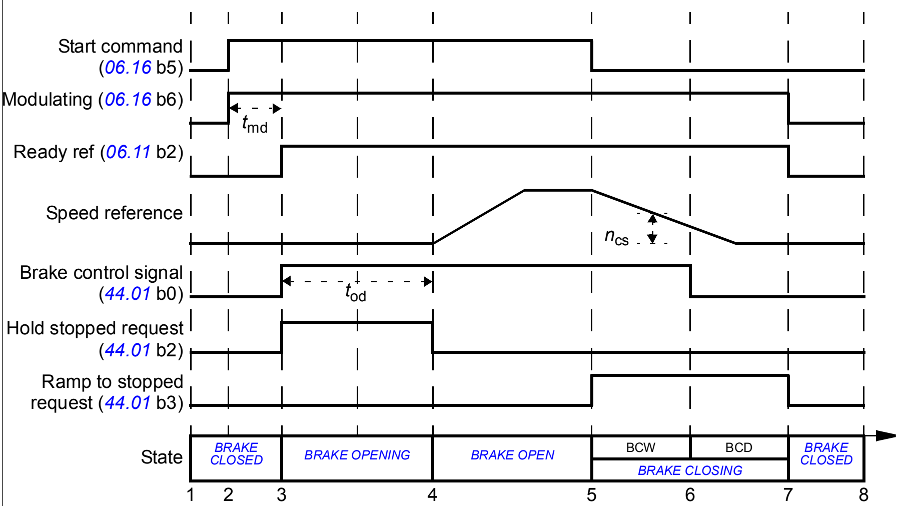
State name	Description
BRAKE DISABLED	Brake control is disabled (parameter *44.06 Brake control enable* = 0, and *44.01 Brake control status* b4 = 0). The open signal is active (*44.01 Brake control status* b0 = 1).
BRAKE OPENING:	Brake has been requested to open. (*44.01 Brake control status* b2 = 1).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

State change conditions (n)

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

Timing diagram

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



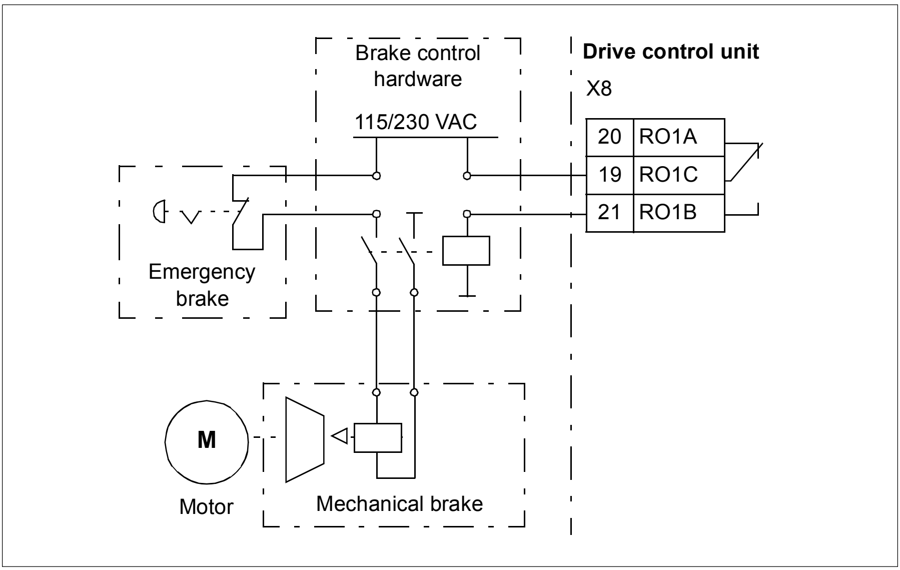
t_{md}	Motor magnetization delay
t_{od}	Brake open delay (parameter *44.08 Brake open delay*)
n_{cs}	Brake close speed (parameter *44.14 Brake close level*)
t_{cd}	Brake close delay (parameter *44.13 Brake close delay*)
BCW	*BRAKE CLOSING WAIT*
BCD	*BRAKE CLOSING DELAY*

Wiring example

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

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

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



Timed functions

TBA **Settings**

Parameter group *34 Timed functions* (page *321*).

DC voltage control

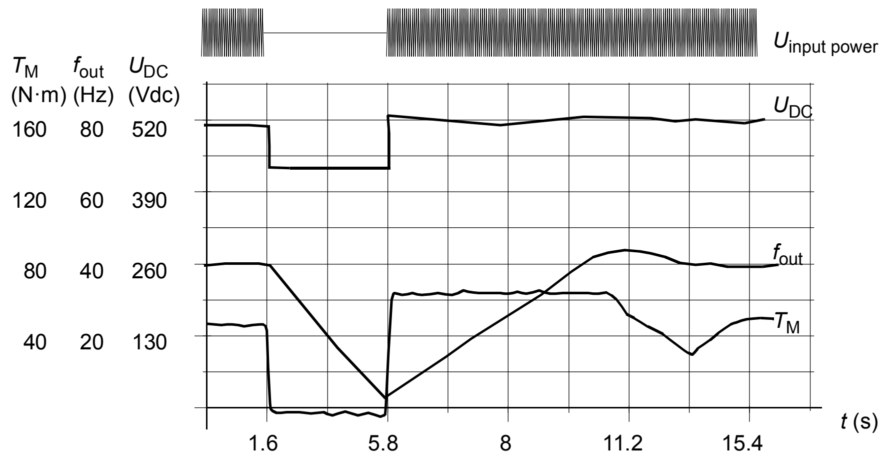
Overvoltage control

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 (e.g. UPS) to keep the contactor control circuit closed during a short supply break.



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

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

Automatic restart

It is possible to restart the drive automatically after a short (max. 5 seconds) power supply failure by using the Automatic restart function, provided that the drive is allowed to run for 5 seconds without the cooling fans operating.

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

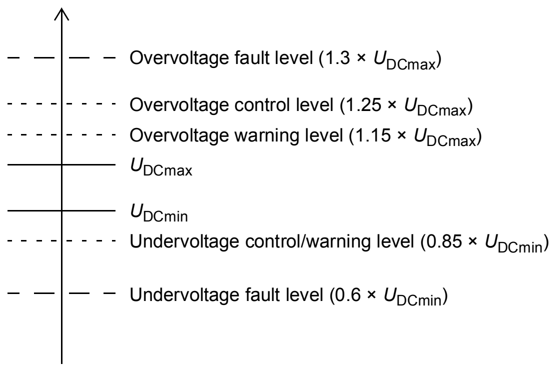
- The undervoltage fault is suppressed (but a warning is generated).
- Modulation and cooling is stopped to conserve any remaining energy.
- DC circuit pre-charging is enabled.

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*.

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 diagram shows the relation of selected DC voltage levels. Note that the absolute voltages vary according to drive/inverter type and AC supply voltage range.



U_{DCmax} = DC voltage corresponding to +10% × nominal AC voltage × 1.35
U_{DCmin} = DC voltage corresponding to -15% × nominal AC voltage × 1.35

Settings

Parameters *01.11 DC voltage* (page *229*), *30.30 Overvoltage control* (page *308*), *30.31 Undervoltage control* (page *308*) and *95.01 Supply voltage* (page *378*).

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 (in frames R0…R3) 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 *229*); parameter group *43 Brake chopper* (page *353*).

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 *210*.

DC undervoltage

See section *Undervoltage control (power loss ride-through)* on page *210*.

Drive temperature

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

Short circuit

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

Emergency stop

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

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

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

- **Menu - Primary settings - Start, stop, reference - Run permissions**
- Parameters *21.04 Emergency stop mode* (page *270*), *21.05 Emergency stop source* (page *270*), *23.23 Emergency stop time* (page *284*), *31.32 Emergency ramp supervision* (page *314*) and *31.33 Emergency ramp supervision delay* (page *314*).

Motor thermal protection

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

The motor temperature can be monitored using

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

Motor thermal protection model

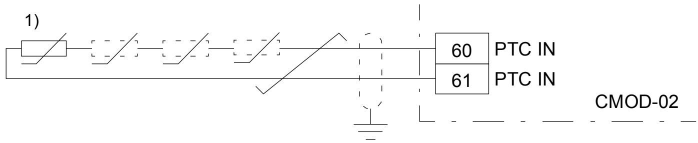
The drive calculates the temperature of the motor on the basis of the following assumptions:

1. When power is applied to the drive for the first time, the motor is assumed to be at ambient temperature (defined by parameter *35.50 Motor ambient temperature*). After this, when power is applied to the drive, the motor is assumed to be at the estimated temperature.
2. Motor temperature is calculated using the user-adjustable motor thermal time and motor load curve. The load curve should be adjusted in case the ambient temperature exceeds 30 °C.

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

Temperature monitoring using PTC sensors

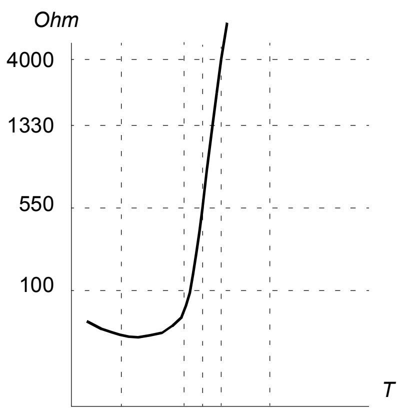
PTC sensors are connected through a CMOD-02 multifunction module (see *CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)* on page 576)



[1)] One or 3…6 PTC thermistors connected in series.

The resistance of the PTC sensor increases when its temperature rises. The increasing resistance of the sensor decreases the voltage at the input, and eventually its state switches from 1 to 0, indicating overtemperature.

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



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.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* on page 104.

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.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* on page *104*.

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.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* on page *104*.

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

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* on page *104*.

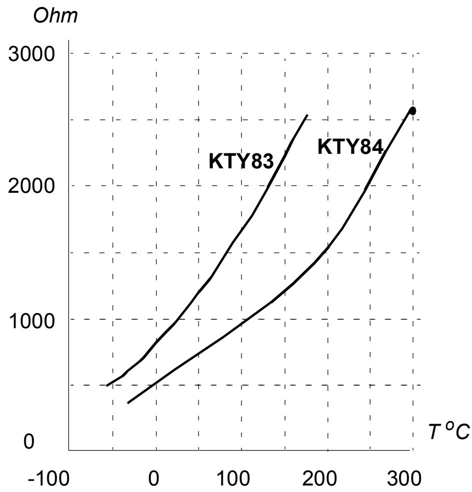
Temperature monitoring using KTY83 sensors

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.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* on page 104.

Settings

- **Menu - Primary settings - Motor - Thermal protection estimated**, **Menu - Primary settings - Motor - Thermal protection measured**
- Parameter group *35 Motor thermal protection* (page 327).

Programmable protection functions

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

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

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 section *Implementing the Safe torque off function* on page *69*.

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*)

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

Local control loss detection (parameter *49.05*)

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

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

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.

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.

Settings

- **Menu - Primary settings - Advanced functions - Autoreset faults**
- Parameters *31.12*…*31.16* (page *310*).

Diagnostics

Signal supervision

Six signals can be selected to be supervised by this function. Whenever a supervised signal exceeds or falls below predefined limits, a bit in *32.01 Supervision status* is activated, and a warning or fault generated. The contents of the message can be edited on the control panel by selecting **Menu - Primary settings** - **Edit texts**.

The supervised signal is low-pass filtered.

Settings

Parameter group *32 Supervision* (page *315*).

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 *220*).

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

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

Settings

- **Menu - Energy efficiency**
- Parameter group *45 Energy efficiency* (page *355*).
- Parameters *01.50 Current hour kWh*, *01.51 Previous hour kWh*, *01.52 Current day kWh* and *01.53 Previous day kWh* on page *230*.

Load analyzer

Peak value logger

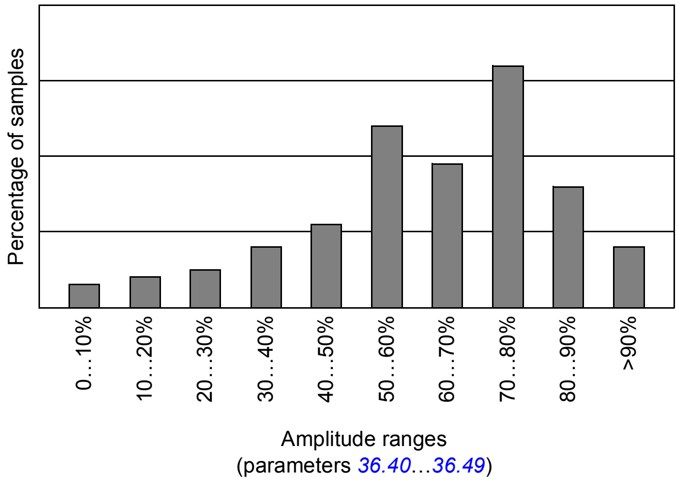
The user can select a signal to be monitored by a peak value logger. The logger records the peak value of the signal along with the time the peak occurred, as well as motor current, DC voltage and motor speed at the time of the peak. The peak value is sampled at 2 ms intervals.

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 percentage points wide, and displays the percentage 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.



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}). 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 *335*).

Miscellaneous

Backup and restore

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

Backup

Manual backup

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

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

Automatic backup

The assistant 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.

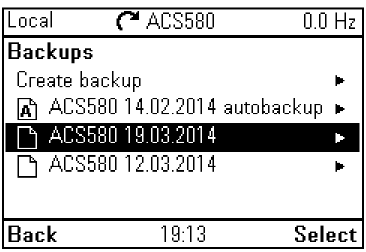
You cannot adjust the delay time or disable the automatic backup function.

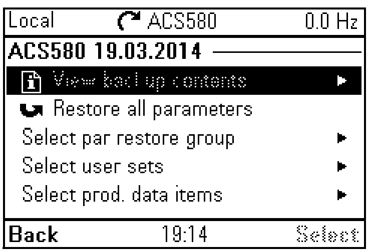
Parameter changes from fieldbus interfaces are ignored unless you have forced parameter saving with parameter *96.07 Parameter save manually*.

Restore

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

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





Settings

- **Menu - Backups**
- Parameter *96.07 Parameter save manually* (page *380*).

User parameter sets

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

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

- I/O extension module settings (groups 14…16)
- data storage parameters (group 47)
- fieldbus communication settings (groups 51…53 and 58).

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

Settings

- **Menu - Primary settings - Advanced functions - User sets**
- Parameters *96.10*…*96.13* (page *381*).

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 *361*).

13

Parameters

What this chapter contains

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

Terms and abbreviations

Term	Definition
Actual signal	Type of *parameter* that is the result of a measurement or calculation by the drive, or contains status information. Most actual signals are read-only, but some (especially counter-type actual signals) can be reset.
Def	(In the following table, shown on the same row as the parameter name) The default value of a *parameter* when used in the Factory macro. For information on other macro-specific parameter values, see chapter *Control macros* (page *161*).
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 *393*).
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

Summary of parameter groups

Parameter listing

No.	Name/Value	Description	Def/FbEq16
01 Actual values		Basic signals for monitoring the drive. All parameters in this group are read-only unless otherwise noted. **Note:** Values of these actual signals are filtered with the filter time defined in group *46 Monitoring/scaling settings*. The selection lists for parameters in other groups mean the raw value of the actual signal instead. For example, if a selection is "Output frequency" it does not point to the value of parameter *01.06 Output frequency* but to the raw value.	
01.01	*Motor speed used*	Estimated motor speed. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00…30000.00 rpm	Estimated motor speed.	See par. *46.01*
01.02	*Motor speed estimated*	Estimated motor speed in rpm. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00…30000.00 rpm	Estimated motor speed.	See par. *46.01*
01.03	*Motor speed %*	Motor speed in percent of the nominal motor speed.	-
	-1000.00…1000.00%	Motor speed.	See par. *46.01*
01.06	*Output frequency*	Estimated drive output frequency in Hz. A filter time constant for this signal can be defined by parameter *46.12 Filter time output frequency*.	-
	-500.00…500.00 Hz	Estimated output frequency.	See par. *46.02*
01.07	*Motor current*	Measured (absolute) motor current in A.	-
	0.00…30000.00 A	Motor current.	1 = 1 A
01.08	*Motor current % of motor nom*	Motor current (drive output current) in percent of the nominal motor current.	-
	0.0…1000.0%	Motor current.	1 = 1%
01.09	*Motor current % of drive nom*	Motor current (drive output current) in percent of the nominal drive current.	-
	0.0…1000.0%	Motor current.	1 = 1%
01.10	*Motor torque*	Motor torque in percent of the nominal motor torque. See also parameter *01.30 Nominal torque scale*. A filter time constant for this signal can be defined by parameter *46.13 Filter time motor torque*.	-
	-1600.0…1600.0%	Motor torque.	See par. *46.03*
01.11	*DC voltage*	Measured DC link voltage.	-
	0.00…2000.00 V	DC link voltage.	10 = 1 V
01.13	*Output voltage*	Calculated motor voltage in V AC.	-
	0…2000 V	Motor voltage.	1 = 1 V

No.	Name/Value	Description	Def/FbEq16
01.14	*Output power*	Drive output power. 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.	1 = 1 unit
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…999 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…999 kWh	Energy in kWh.	10 = 1 kWh
01.24	*Flux actual %*	Used flux reference in percent of nominal flux of motor.	-
	0…200%	Flux reference.	1 = 1%
01.30	*Nominal torque scale*	Torque that corresponds to 100% of nominal motor torque. The unit is selected by parameter *96.16 Unit selection*. **Note:** This value is copied from parameter *99.12 Motor nominal torque* if entered. Otherwise the value is calculated from other motor data.	-
	0.000… N·m or lb·ft	Nominal torque.	1 = 100 unit
01.31	*Ambient temperature*	Measured temperature of incoming cooling air. The unit is selected by parameter *96.16 Unit selection*. Only for frames R5…R9.	-
	-32768…32767 °C or °F	Cooling air temperature.	1 = 1°
01.50	*Current hour kWh*	Current hour energy consumption.	-
	-21474836.48… 21474836.47 kWh	Energy.	1 = 1 kWh
01.51	*Previous hour kWh*	Previous hour energy consumption.	-
	-21474836.48… 21474836.47 kWh	Energy.	1 = 1 kWh
01.52	*Current day kWh*	Current day energy consumption.	-
	-21474836.48… 21474836.47 kWh	Energy.	1 = 1 kWh

No.	Name/Value	Description	Def/FbEq16
01.53	*Previous day kWh*	Previous day energy consumption.	-
	-21474836.48… 21474836.47 kWh	Energy.	1 = 1 kWh
01.61	*Abs motor speed used*	Absolute value of parameter *01.01 Motor speed used*.	-
	0.00… 30000.00 rpm		1 = 1 rpm
01.62	*Abs motor speed %*	Absolute value of parameter *01.03 Motor speed %*.	-
	0.00… 1000.00%		1 = 1%
01.63	*Abs output frequency*	Absolute value of parameter *01.06 Output frequency*.	-
	0.00…500.00 Hz		1 = 1 Hz
01.64	*Abs motor torque*	Absolute value of parameter *01.10 Motor torque*.	-
	0.0…1600.0%		1 = 1%
01.65	*Abs output power*	Absolute value of parameter *01.14 Output power*.	-
	0.00… 32767.00 kW or hp		1 = 1 kW
01.66	*Abs output power % mot nom*	Absolute value of parameter *01.15 Output power % of motor nom*.	-
	0.00… 300.00%		1 = 1%
01.67	*Abs output power % drive nom*	Absolute value of parameter *01.16 Output power % of drive nom*.	-
	0.00… 300.00%		1 = 1%
01.68	*Abs motor shaft power*	Absolute value of parameter *01.17 Motor shaft power*.	-
	0.00… 32767.00 kW or hp		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
03.05	*FB A reference 1*	Reference 1 received through fieldbus adapter A. See also chapter *Fieldbus control through a fieldbus adapter* (page *467*).	-
	-100000.00… 100000.00	Reference 1 from fieldbus adapter A.	1 = 10
03.06	*FB A reference 2*	Reference 2 received through fieldbus adapter A.	-
	-100000.00… 100000.00	Reference 2 from fieldbus adapter A.	1 = 10
03.09	*EFB reference 1*	Scaled reference 1 received through the embedded fieldbus interface.	1 = 10
	-30000.00… 30000.00	Scaled reference 1 received through the embedded fieldbus interface.	1 = 10

No.	Name/Value	Description	Def/FbEq16
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.	
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
04.04	Active fault 4	Code of the 4th active fault.	-
	0000h…FFFFh	4th active fault.	1 = 1
04.05	Active fault 5	Code of the 5th active fault.	-
	0000h…FFFFh	5th 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
04.09	Active warning 4	Code of the 4th active warning.	-
	0000h…FFFFh	4th active warning.	1 = 1
04.10	Active warning 5	Code of the 5th active warning.	-
	0000h…FFFFh	5th 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
04.14	4th latest fault	Code of the 4th stored (non-active) fault.	-
	0000h…FFFFh	4th stored fault.	1 = 1
04.15	5th latest fault	Code of the 5th stored (non-active) fault.	-
	0000h…FFFFh	5th stored fault.	1 = 1
04.16	Latest warning	Code of the 1st stored (non-active) warning.	-
	0000h…FFFFh	1st stored warning.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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
04.19	*4th latest warning*	Code of the 4th stored (non-active) warning.	-
	0000h…FFFFh	4th stored warning.	1 = 1
04.20	*5th latest warning*	Code of the 5th stored (non-active) warning.	-
	0000h…FFFFh	5th stored warning.	1 = 1
05 Diagnostics		Various run-time-type counters and measurements related to drive maintenance. All parameters in this group are read-only unless otherwise noted.	
05.01	*On-time counter*	On-time counter. The counter runs when the drive is powered..	-
	0…65535 d	On-time counter.	1 = 1 d
05.02	*Run-time counter*	Motor run-time counter. The counter runs when the inverter modulates.	-
	0…65535 d	Motor run-time counter.	1 = 1 d
05.04	*Fan on-time counter*	Running time of the drive cooling fan. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…65535 d	Cooling fan run-time counter.	1 = 1 d
05.10	*Control board temperature*	Measured temperature of the control board	-
	-32768.00… 32767.00 °C or °F	Control board temperature in degrees Celsius.	1 = unit
05.11	*Inverter temperature*	Estimated drive temperature in percent of fault limit. The fault limit varies according to the type of the drive. 0.0% = 0 °C (32 °F) 100.0% = Fault limit	-
	-40.0…160.0%	Drive temperature in percent.	1 = 1%
05.22	*Diagnostic word 3*	Diagnostic word 3. For possible causes and remedies, see chapter *Fault tracing*.	-

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

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

No.	Name/Value	Description	Def/FbEq16
06 Control and status words		Drive control and status words.	
06.01	Main control word	The main control word of the drive. This parameter shows the control signals as received from the selected sources (such as digital inputs, the fieldbus interfaces and the application program). The bit assignments of the word are as described on page 473. The related status word and state diagram are presented on pages 475 and 476 respectively. This parameter is read-only.	-
	0000h…FFFFh	Main control word.	1 = 1
06.11	Main status word	Main status word of the drive. The bit assignments are described on page 475. The related control word and state diagram are presented on pages 473 and 476 respectively. This parameter is read-only.	-
	0000h…FFFFh	Main status word.	1 = 1
06.16	Drive status word 1	Drive status word 1. This parameter is read-only.	-

Bit	Name	Description
0	Enabled	1 = Both run enable (see par. 20.12) and start enable (20.19) signals are present. **Note:** This bit is not affected by the presence of a fault.
1	Inhibited	1 = Start inhibited. To start the drive, the inhibiting signal (see par. 06.18) must be removed and the start signal cycled.
2	DC charged	1 = DC circuit has been charged
3	Ready to start	1 = Drive is ready to receive a start command
4	Following reference	1 = Drive is ready to follow given reference
5	Started	1 = Drive has been started
6	Modulating	1 = Drive is modulating (output stage is being controlled)
7	Limiting	1 = Any operating limit (speed, torque, etc.) is active
8	Local control	1 = Drive is in local control
9	Network control	1 = Drive is in *network control* (see page 30).
10	Ext1 active	1 = Control location EXT1 active
11	Ext2 active	1 = Control location EXT2 active
12	Reserved	
13	Start request	1 = Start requested
14…15	Reserved	

	0000h…FFFFh	Drive status word 1.	1 = 1

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

Bit	Name	Description
0	Identification run done	1 = Motor identification (ID) run has been performed
1	Magnetized	1 = The motor has been magnetized
2	Torque control	1 = Torque control mode active
3	Speed control	1 = Speed control mode active
4	Reserved	
5	Safe reference active	1 = A “safe” reference is applied by functions such as parameters *49.05* and *50.02*
6	Last speed active	1 = A “last speed” reference is applied by functions such as parameters *49.05* and *50.02*
7	Loss of reference	1 = Reference signal lost
8	Emergency stop failed	1 = Emergency stop failed (see parameters *31.32* and *31.33*)
9	Jogging active	1 = Jogging enable signal is on
10	Above limit	1 = Actual speed, frequency or torque equals or exceeds limit (defined by parameters *46.31*…*46.33*). Valid in both directions of rotation.
11…15	Reserved	

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

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

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

No.	Name/Value	Description	Def/FbEq16
	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 is running at zero speed
1	Forward	1 = Drive is running in forward direction above zero speed limit (par. *21.06*)
2	Reverse	1 = Drive is running in reverse direction above zero speed limit (par. *21.06*)
3…6	Reserved	
7	Any constant speed request	1 = A constant speed or frequency has been selected; see par. *06.20*.
8…15	Reserved	

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

No.	Name/Value	Description	Def/FbEq16
06.20	*Constant speed status word*	Constant speed/frequency status word. Indicates which constant speed or frequency is active (if any). See also parameter *06.19 Speed control status word*, bit 7, and section *Constant speeds/frequencies* (page *190*). This parameter is read-only.	-

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

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

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Drive status word 1.	1 = 1
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 *234*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
06.31	*MSW bit 12 selection*	Selects a binary source whose status is transmitted as bit 12 (User bit 1) of *06.11 Main status word*.	*Ext run enable*
	False	0.	0
	True	1.	1
	Ext run enable	Status of the external run enable signal (see parameter *20.12 Run enable 1 source*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
06.32	*MSW bit 12 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 *226*).	-

No.	Name/Value	Description	Def/FbEq16
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 *226*).	-

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/inverter unit.	-
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%

10 Standard DI, RO		Configuration of digital inputs and relay outputs.	
10.02	*DI delayed status*	Displays the status of digital inputs DI1…DI6. This word is updated only after activation/deactivation delays (if any are specified). Bits 0…5 reflect the delayed status of DI1…DI6. This parameter is read-only.	-
	0000h…FFFFh	Delayed status of digital inputs.	1 = 1
10.03	*DI force selection*	The electrical statuses of the digital inputs can be overridden for eg. testing purposes. A bit in parameter *10.04 DI forced data* is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *10.03* and *10.04*).	0000h

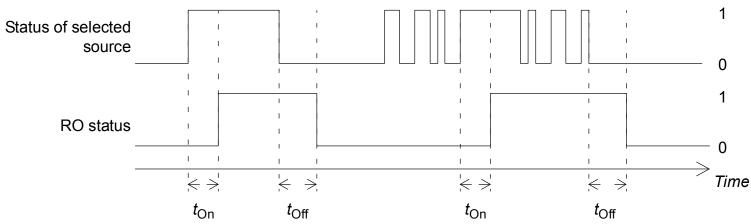
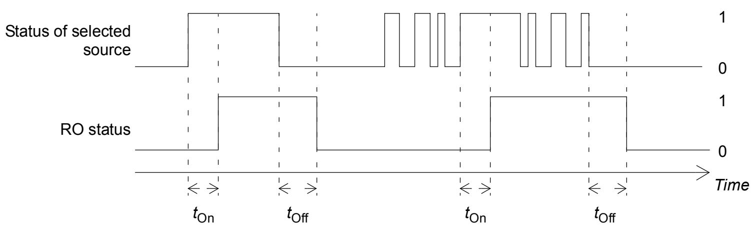
Bit	Value
0	1 = Force DI1 to value of bit 0 of parameter *10.04 DI forced data*.
1	1 = Force DI2 to value of bit 1 of parameter *10.04 DI forced data*.
2	1 = Force DI3 to value of bit 2 of parameter *10.04 DI forced data*.
3	1 = Force DI4 to value of bit 3 of parameter *10.04 DI forced data*.
4	1 = Force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

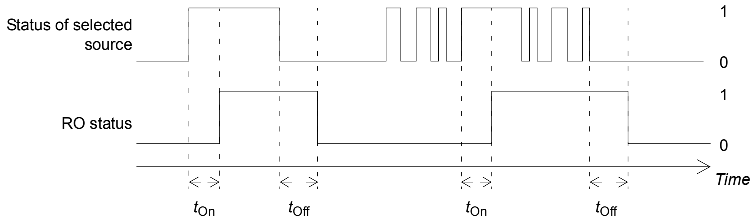
	0000h…FFFFh	Override selection for digital inputs.	1 = 1
10.04	*DI forced data*	Allows the data value of a forced digital input to be changed from 0 to 1. It is only possible to force an input that has been selected in parameter *10.03 DI force selection*. Bit 0 is the forced value for DI1; bit 5 is the forced value for the DI6.	0000h
	0000h…FFFFh	Forced values of digital inputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
10.21	*RO status*	Status of relay outputs **RO3…RO1**. **Example:** 00000**001**b = RO1 is energized, RO2…RO3 are de-energized.	-
	0000h…FFFFh	Status of relay outputs.	1 = 1
10.22	*RO force selection*	The signals connected to the relay outputs can be overridden for eg. testing purposes. A bit in parameter *10.23 RO forced data* is provided for each relay output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *10.22* and *10.23*).	

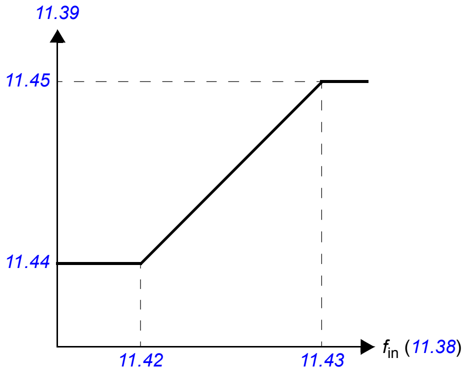
Bit	Value
0	1 = Force RO1 to value of bit 0 of parameter *10.23 RO forced data*.
1	1 = Force RO2 to value of bit 1 of parameter *10.23 RO forced data*.
2	1 = Force RO3 to value of bit 2 of parameter *10.23 RO forced data*.
3…7	Reserved

No.	Name/Value	Description	Def/FbEq16
10.23	*RO forced data*	Contains the values of relay outputs that are used instead of the connected signals if selected in parameter *10.22 RO force selection*. Bit 0 is the forced value for RO1.	
	0000h…FFFFh	Forced RO values.	1 = 1
10.24	*RO1 source*	Selects a drive signal to be connected to relay output RO1.	*Ready run*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *234*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *234*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *234*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *235*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *234*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *234*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *234*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *236*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *236*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *235*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *234*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *234*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *234*).	15
	Brake command	Bit 0 of *44.01 Brake control status* (see page *354*).	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *234*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *234*).	24
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	27
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	28
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	29
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	34

No.	Name/Value	Description	Def/FbEq16
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	35
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
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
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)*

No.	Name/Value	Description	Def/FbEq16
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
10.101	*RO1 toggle counter*	Displays the number of times relay output RO1 has changed states.	-
	0…4294967000	State change count.	1 = 1
10.102	*RO2 toggle counter*	Displays the number of times relay output RO2 has changed states.	-
	0…4294967000	State change count.	1 = 1
10.103	*RO3 toggle counter*	Displays the number of times relay output RO3 has changed states.	-
	0…4294967000	State change count.	1 = 1

11 Standard DIO, FI, FO		Configuration of the frequency input.	
11.25	*DI6 configuration*	Selects how digital input 6 is used.	*Digital input*
	Digital input	DI6 is used as a digital input.	0
	Frequency input	DI6 is used as a frequency input.	1
11.38	*Freq in 1 actual value*	Displays the value of frequency input 1 (via DI6 when it is used as a frequency input) before scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	-
	0 … 16000 Hz	Unscaled value of frequency input 1.	1 = 1 Hz
11.39	*Freq in 1 scaled value*	Displays the value of frequency input 1 (via DI6 when it is used as a frequency input) after scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	-
	-32768.000… 32767.000	Scaled value of frequency input 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
11.42	*Freq in 1 min*	Defines the minimum for the frequency actually arriving at frequency input 1 (DI6 when it is used as a frequency input). The incoming frequency signal (*11.38 Freq in 1 actual value*) is scaled into an internal signal (*11.39 Freq in 1 scaled value*) by parameters *11.42*…*11.45* as follows: 	1 Hz
	1 … 16000 Hz	Minimum frequency of frequency input 1 (DI6).	1 = 1 Hz
11.43	*Freq in 1 max*	Defines the maximum for the frequency actually arriving at frequency input 1 (DI6 when it is used as a frequency input). See parameter *11.42 Freq in 1 min*.	16000 Hz
	1 … 16000 Hz	Maximum frequency for frequency input 1 (DI6).	1 = 1 Hz
11.44	*Freq in 1 at scaled min*	Defines the value that is required to correspond internally to the minimum input frequency defined by parameter *11.42 Freq in 1 min*. See diagram at parameter *11.42 Freq in 1 min*.	0.000
	-32768.000… 32767.000	Value corresponding to minimum of frequency input 1.	1 = 1
11.45	*Freq in 1 at scaled max*	Defines the value that is required to correspond internally to the maximum input frequency defined by parameter *11.43 Freq in 1 max*. See diagram at parameter *11.42 Freq in 1 min*.	1500.000
	-32768.000… 32767.000	Value corresponding to maximum of frequency input 1.	1 = 1

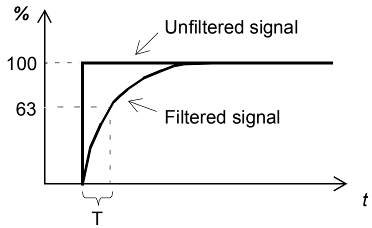
No.	Name/Value	Description	Def/FbEq16
12 Standard AI		Configuration of standard analog inputs.	
12.02	*AI force selection*	The true readings of the analog inputs can be overridden for eg. testing purposes. A forced value parameter is provided for each analog input, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** AI filter times (parameters *12.16 AI1 filter time* and *12.26 AI2 filter time*) have no effect on forced AI values (parameters *12.13 AI1 forced value* and *12.23 AI2 forced value*). **Note:** Boot and power cycle reset the force selections (parameters *12.02* and *12.03*).	0000h

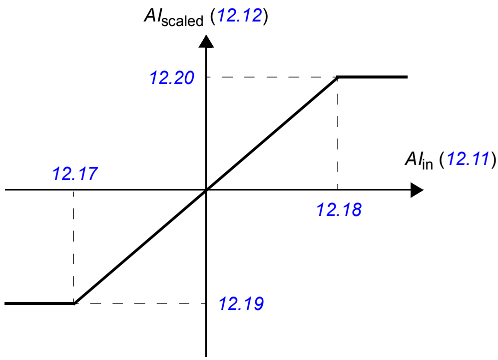
Bit	Value
0	1 = Force AI1 to value of parameter *12.13 AI1 forced value*.
1	1 = Force AI2 to value of parameter *12.23 AI2 forced value*.
2…7	reserved

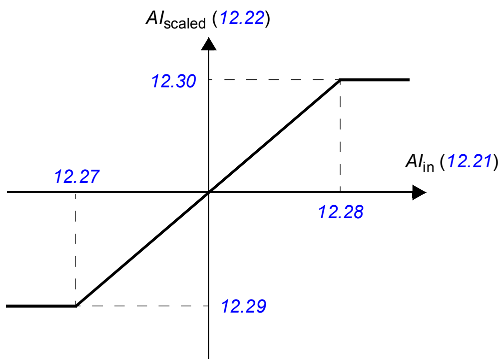
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Forced values selector for analog inputs AI1 and AI2.	1 = 1
12.03	*AI supervision function*	Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. The inputs and the limits to be observed are selected by parameter *12.04 AI supervision selection*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *80A0 AI supervision*.	1
	Warning	Drive generates an *A8A0 AI supervision* warning.	2
	Last speed	Drive generates a warning (*A8A0 AI supervision*) and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Speed ref safe	Drive generates a warning (*A8A0 AI supervision*) and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	4
12.04	*AI supervision selection*	Specifies the analog input limits to be supervised. See parameter *12.03 AI supervision function*.	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

No.	Name/Value	Description	Def/FbEq16
12.11	*AI1 actual value*	Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	4.000…20.000 mA or 0.000…10.000 V	Value of analog input AI1.	1000 = 1 unit
12.12	*AI1 scaled value*	Displays the value of analog input AI1 after scaling. See parameters *12.19 AI1 scaled at AI1 min* and *12.20 AI1 scaled at AI1 max*. This parameter is read-only.	-
	-32768.000… 32767.000	Scaled value of analog input AI1.	1 = 1
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*.	-
	4.000…20.000 mA or 0.000…10.000 V	Forced value of analog input AI1.	1000 = 1 unit
12.15	*AI1 unit selection*	Selects the unit for readings and settings related to analog input AI1. **Note:** This setting must match the corresponding hardware setting on the drive control unit. See section *Switches* (page *100*) and the default control connections for the macro in use in chapter *Control macros* (page *161*). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.	*V*
	V	Volts.	2
	mA	Milliamperes.	10
12.16	*AI1 filter time*	Defines the filter time constant for analog input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware (approximately 0.25 ms time constant). This cannot be changed by any parameter.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1 s

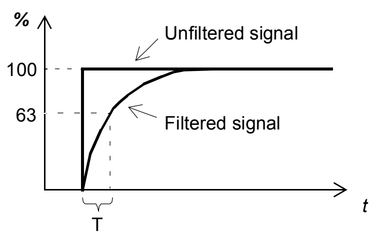
No.	Name/Value	Description	Def/FbEq16
12.17	*AI1 min*	Defines the minimum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.	4.000 mA or 0.000 V
	4.000…20.000 mA or 0.000…10.000 V	Minimum value of AI1.	1000 = 1 unit
12.18	*AI1 max*	Defines the maximum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting.	20.000 mA or 10.000 V
	4.000…20.000 mA or 0.000…10.000 V	Maximum value of AI1.	1000 = 1 unit
12.19	*AI1 scaled at AI1 min*	Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter *12.17 AI1 min*. (Changing the polarity settings of *12.19* and *12.20* can effectively invert the analog input.)  	0.000
	-32768.000… 32767.000	Real value corresponding to minimum AI1 value.	1 = 1
12.20	*AI1 scaled at AI1 max*	Defines the real internal value that corresponds to the maximum analog input AI1 value defined by parameter *12.18 AI1 max*. See the drawing at parameter *12.19 AI1 scaled at AI1 min*.	50.000
	-32768.000… 32767.000	Real value corresponding to maximum AI1 value.	1 = 1
12.21	*AI2 actual value*	Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	4.000…20.000 mA or 0.000…10.000 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 *12.30 AI2 scaled at AI2 max*. 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*.	-

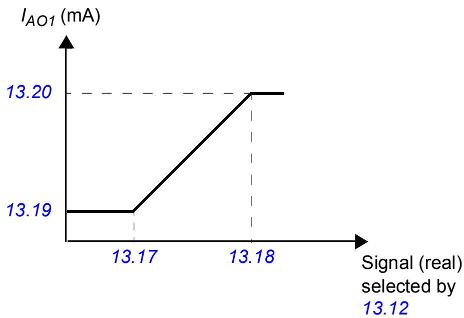
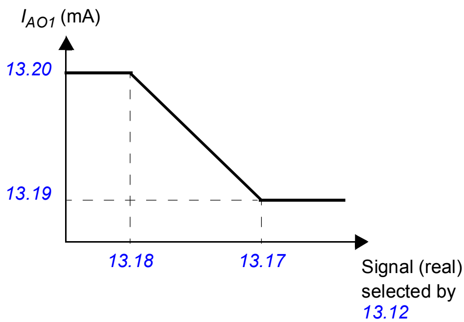
No.	Name/Value	Description	Def/FbEq16
	4.000…20.000 mA or 0.000…10.000 V	Forced value of analog input AI2.	1000 = 1 unit
12.25	*AI2 unit selection*	Selects the unit for readings and settings related to analog input AI2. **Note:** This setting must match the corresponding hardware setting on the drive control unit. See section *Switches* (page *100*) and the default control connections for the macro in use in chapter *Control macros* (page *161*). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
12.26	*AI2 filter time*	Defines the filter time constant for analog input AI2. See parameter *12.16 AI1 filter time*.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1 s
12.27	*AI2 min*	Defines the minimum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.	4.000 mA or 0.000 V
	4.000…20.000 mA or 0.000…10.000 V	Minimum value of AI2.	1000 = 1 unit
12.28	*AI2 max*	Defines the maximum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting.	20.000 mA or 10.000 V
	4.000…20.000 mA or 0.000…10.000 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 *12.30* can effectively invert the analog input.)  	0.000
	-32768.000… 32767.000	Real value corresponding to minimum AI2 value.	1 = 1

No.	Name/Value	Description	Def/FbEq16
12.30	AI2 scaled at AI2 max	Defines the real value that corresponds to the maximum analog input AI2 value defined by parameter 12.28 AI2 max. See the drawing at parameter 12.29 AI2 scaled at AI2 min.	100.000
	-32768.000… 32767.000	Real value corresponding to maximum AI2 value.	1 = 1
13 Standard AO		Configuration of standard analog outputs.	
13.02	AO force selection	The source signals of the analog outputs can be overridden for eg. testing purposes. A forced value parameter is provided for each analog output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters 13.02 and 13.11).	0000h

Bit	Value
0	1 = Force AO1 to value of parameter 13.13 AO1 forced value.
1	1 = Force AO2 to value of parameter 13.23 AO2 forced value.
2…7	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Forced values selector for analog outputs AO1 and AO2.	1 = 1
13.11	AO1 actual value	Displays the value of AO1 in mA. This parameter is read-only.	-
	0.000…22.000 mA	Value of AO1.	1 = 1 mA
13.12	AO1 source	Selects a signal to be connected to analog output AO1.	Motor speed used
	Zero	None.	0
	Motor speed used	01.01 Motor speed used (page 229).	1
	Output frequency	01.06 Output frequency (page 229).	3
	Motor current	01.07 Motor current (page 229).	4
	Motor current % of motor nom	01.08 Motor current % of motor nom (page 229).	5
	Motor torque	01.10 Motor torque (page 229).	6
	DC voltage	01.11 DC voltage (page 229).	7
	Output power	01.14 Output power (page 230).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 282).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 282).	11
	Speed ref used	24.01 Used speed reference (page 286).	12
	Freq ref used	28.02 Frequency ref ramp output (page 294).	14
	Process PID out	40.01 Process PID output actual (page 341).	16
	Temp sensor 1 excitation	The output is used to feed an excitation current to the temperature sensor 1, see parameter 35.11 Temperature 1 source. See also section Motor thermal protection (page 214).	20
	Temp sensor 2 excitation	The output is used to feed an excitation current to the temperature sensor 2, see parameter 35.21 Temperature 2 source. See aso section Motor thermal protection (page 214).	21

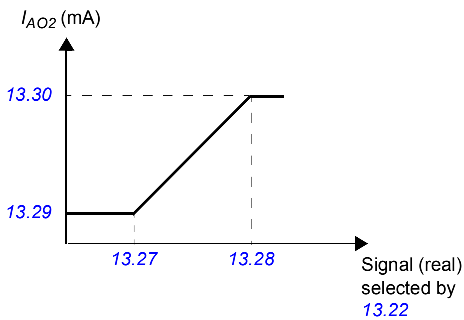
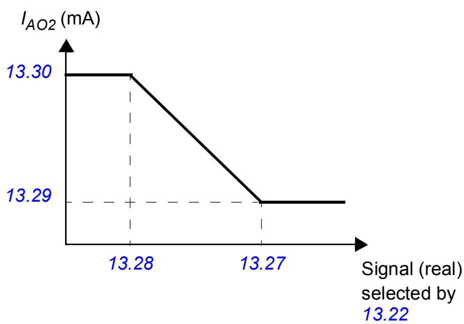
No.	Name/Value	Description	Def/FbEq16
	Abs motor speed used	*01.61 Abs motor speed used* (page *231*).	26
	Abs motor speed %	*01.62 Abs motor speed used* (page *231*).	27
	Abs output frequency	*01.63 Abs output frequency* (page *231*).	28
	Abs motor torque	*01.64 Abs motor torque* (page *231*).	30
	Abs output power	*01.65 Abs output power* (page *231*).	31
	Abs motor shaft power	*01.68 Abs motor shaft power* (page *231*).	32
	External PID1 out	*71.01 External PID act value* ((page *376*).	33
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
13.13	*AO1 forced value*	Forced value that can be used instead of the selected output signal. See parameter *13.02 AO force selection*.	0.000 mA
	0.000…32767.000 mA or V	Forced value for AO1.	1 = 1 unit
13.15	*AO1 unit selection*	Selects the unit for readings and settings related to analog input AO1. **Note:** This setting must match the corresponding hardware setting on the drive control unit. See section *Switches* (page *100*) and the default control connections for the macro in use in chapter *Control macros* (page *161*). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
13.16	*AO1 filter time*	Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

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

No.	Name/Value	Description	Def/FbEq16
	AO has automatic scaling. Every time the source for the AO is changed, the scaling range is changed accordingly. User given minimum and maximum values override the automatic values.		

	13.12 AO1 source, *13.22 AO2 source*	*13.17 AO1 source min*, *13.27 AO2 source min*	*13.18 AO1 source max*, *13.28 AO2 source max*
0	*Zero*	N/A (Output is constant zero.)	
1	*Motor speed used*	0	*46.01 Speed scaling*
3	*Output frequency*	0	*46.02 Frequency scaling*
4	*Motor current*	0	*30.17 Maximum current*
5	*Motor current % of motor nom*	0%	100%
6	*Motor torque*	0	*46.03 Torque scaling*
7	*DC voltage*	Min. value of *01.11 DC voltage*	Max. value of *01.11 DC voltage*
8	*Output power*	0	*46.04 Power scaling*
10	*Speed ref ramp in*	0	*46.01 Speed scaling*
11	*Speed ref ramp out*	0	*46.01 Speed scaling*
12	*Speed ref used*	0	*46.01 Speed scaling*
14	*Freq ref used*	0	*46.02 Frequency scaling*
16	*Process PID out*	Min. value of *40.01 Process PID output actual*	Max. value of *40.01 Process PID output actual*
20	*Temp sensor 1 excitation*	N/A (Analog output is not scaled; it is determined by the sensor's triggering voltage.)	
21	*Temp sensor 2 excitation*		
26	*Abs motor speed used*	0	*46.01 Speed scaling*
27	*Abs motor speed %*	0	*46.01 Speed scaling*
28	*Abs output frequency*	0	*46.02 Frequency scaling*
30	*Abs motor torque*	0	*46.03 Torque scaling*
31	*Abs output power*	0	*46.04 Power scaling*
32	*Abs motor shaft power*	0	*46.04 Power scaling*
33	*External PID1 out*	Min. value of *71.01 External PID act value*	Max. value of *71.01 External PID act value*
	Other	Min. value of the selected parameter	Max.. value of the selected parameter

No.	Name/Value	Description	Def/FbEq16
	-32768.0…32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1
13.18	*AO1 source max*	Defines the real maximum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the maximum required AO1 output value (defined by parameter *13.20 AO1 out at AO1 src max*). See parameter *13.17 AO1 source min*.	50.0
	-32768.0…32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
13.19	*AO1 out at AO1 src min*	Defines the minimum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO1 output value.	1000 = 1 mA
13.20	*AO1 out at AO1 src max*	Defines the maximum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	20.000 mA
	0.000 … 22.000 mA	Maximum AO1 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
13.21	*AO2 actual value*	Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA
13.22	*AO2 source*	Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For the selections, see parameter *13.12 AO1 source*.	*Motor current*
13.23	*AO2 forced value*	Forced value that can be used instead of the selected output signal. See parameter *13.02 AO force selection*.	0.000 mA
	0.000 … 22.000 mA	Forced value for AO2.	1000 = 1 mA
13.26	*AO2 filter time*	Defines the filtering time constant for analog output AO2. See parameter *13.16 AO1 filter time*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
13.27	*AO2 source min*	Defines the real minimum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the minimum required AO2 output value (defined by parameter *13.29 AO2 out at AO2 src min*). See parameter *13.17 AO1 source min* about the AO automatic scaling.  Programming *13.27* as the maximum value and *13.28* as the minimum value inverts the output. 	0.0
	-32768.0…32767.0	Real signal value corresponding to minimum AO2 output value.	1 = 1

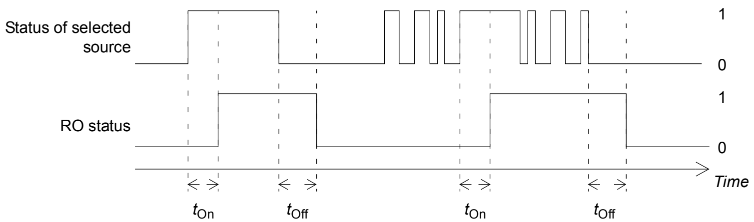
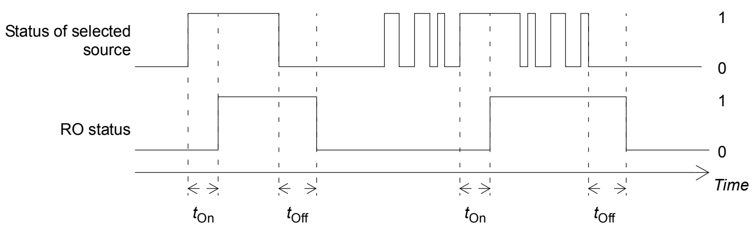
No.	Name/Value	Description	Def/FbEq16
13.28	*AO2 source max*	Defines the real maximum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the maximum required AO2 output value (defined by parameter *13.30 AO2 out at AO2 src max*). See parameter *13.27 AO2 source min*. See parameter *13.17 AO1 source min* about the AO automatic scaling.	100.0
	-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
	-32768.000… 32767.000	Real signal value corresponding to minimum AO8 output value.	1000 = 1

15 I/O extension module		Configuration of the I/O extension module installed in slot 2. See also section *Programmable I/O extensions* (page *187*). **Note:** The contents of the parameter group vary according to the selected I/O extension module type.	
15.01	*Extension module type*	Activates (and specifies the type of) I/O extension module. If the value is *None*, when an extension module has been installed and the dive is powered, the drive automatically sets the value to the type it has detected (= value of parameter *15.02 Detected extension module*); otherwise warning *A7AB Extension I/O configuration failure* is generated and you have to set the value of this parameter manually.	*None*
	None	Inactive.	0
	CMOD-01	CMOD-01.	1
	CMOD-02	CMOD-02.	2
	CHDI-01	CHDI-01.	3
15.02	*Detected extension module*	I/O extension module detected on the drive.	*None*
	None	Inactive.	0
	CMOD-01	CMOD-01.	1
	CMOD-02	CMOD-02.	2
	CHDI-01	CHDI-01.	3
15.03	*DI status*	Displays the status of the digital inputs DI7…DI12 on the extension module Bit 0 indicates the status of DI7. **Example:** 001001b = DI7 and DI10 are on, remainder are off. This parameter is read-only.	-
	0000h…FFFFh	Status of digital input/outputs.	1 = 1

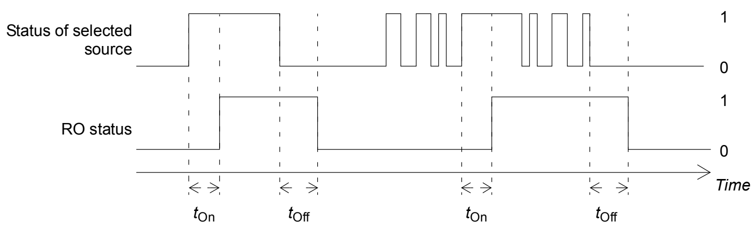
No.	Name/Value	Description	Def/FbEq16
15.04	*RO/DO status*	Displays the status of the relay outputs RO4 and RO5 and digital output DO1 on the extension module. Bits 0…1 indicates the status of RO4…RO5; bit 5 indicates the status of DO1. **Example:** 100101b = RO4 is on, RO5 is off. and DO1 is on. This parameter is read-only.	-
	0000h…FFFFh	Status of relay/digital outputs.	1 = 1
15.05	*RO/DO force selection*	The electrical statuses of the relay/digital outputs can be overridden for eg. testing purposes. A bit in parameter *15.06 RO/DO forced data* is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *15.05* and *15.06*).	0000h

Bit	Value
0	1 = Force RO4 to value of bit 0 of parameter *15.06 RO/DO forced data*.
1	1 = Force RO5 to value of bit 1 of parameter *15.06 RO/DO forced data*.
2…4	Reserved
5	1 = Force DO1 to value of bit 5 of parameter *15.06 RO/DO forced data*.
6…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Override selection for relay/digital outputs.	1 = 1
15.06	*RO/DO forced data*	Allows the data value of a forced relay or digital output to be changed from 0 to 1. It is only possible to force an output that has been selected in parameter *15.05 RO/DO force selection*. Bits 0…1 are the forced values for RO4…RO5; bit 5 is the forced value for DO1.	0000h
	0000h…FFFFh	Forced values of relay/digital outputs.	1 = 1
15.07	*RO4 source*	Selects a drive signal to be connected to relay output RO4.	*Not energized*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *234*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *234*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *234*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *235*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *234*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *234*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *234*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *236*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *236*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *235*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *234*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *234*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *234*).	15
	Brake command	Bit 0 of *44.01 Brake control status* (see page *354*).	22

No.	Name/Value	Description	Def/FbEq16
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *234*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *234*).	24
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	27
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	28
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	29
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	35
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
15.08	*RO4 ON delay*	Defines the activation delay for relay output RO4.	0.0 s
	 t_{On} = *15.08 RO4 ON delay* t_{Off} = *15.09 RO4 OFF delay*		
	0.0 … 3000.0 s	Activation delay for RO4.	10 = 1 s
15.09	*RO4 OFF delay*	Defines the deactivation delay for relay output RO4. See parameter *15.08 RO4 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO4.	10 = 1 s
15.10	*RO5 source*	Selects a drive signal to be connected to relay output RO4. For the available selections, see parameter *15.07 RO4 source*.	*Not energized*
15.11	*RO5 ON delay*	Defines the activation delay for relay output RO5.	0.0 s
	 t_{On} = *15.11 RO5 ON delay* t_{Off} = *15.12 RO5 OFF delay*		
	0.0 … 3000.0 s	Activation delay for RO5.	10 = 1 s
15.12	*RO5 OFF delay*	Defines the deactivation delay for relay output RO5. See parameter *15.11 RO5 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO5.	10 = 1 s
15.22	*DO1 configuration*	Selects how DO1 is used.	*Digital output*
	Digital output	DO1 is used as a digital output.	0

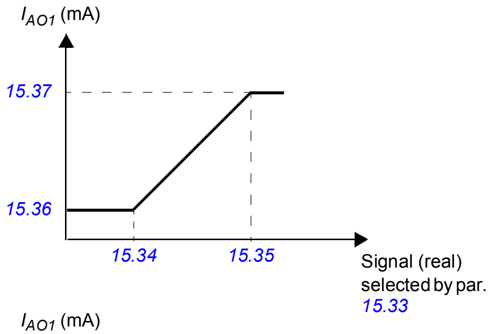
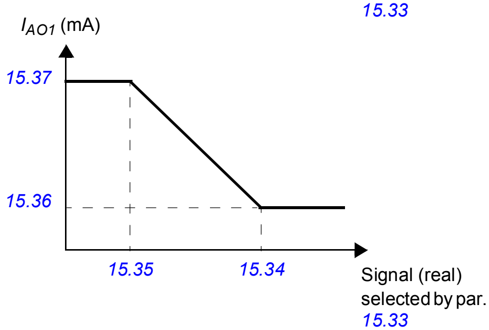
No.	Name/Value	Description	Def/FbEq16
	Frequency output	DO1 is used as a frequency output.	1
15.23	*DO1 source*	Selects a drive signal to be connected to digital output DO1 when *15.22 DO1 configuration* is set to *Digital output*.	*Not energized*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *234*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *234*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *234*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *235*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *234*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *234*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *234*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *236*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *236*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *235*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *234*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *234*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *234*).	15
	Brake command	Bit 0 of *44.01 Brake control status* (see page *354*).	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *234*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *234*).	24
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	27
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	28
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	29
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	35
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
15.24	*DO1 ON delay*	Defines the activation delay for relay output DO1 when *15.22 DO1 configuration* is set to *Digital output*.	0.0 s



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

	0.0 … 3000.0 s	Activation delay for DO1.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
15.25	*DO1 OFF delay*	Defines the deactivation delay for relay output DO1 when *15.22 DO1 configuration* is set to *Digital output*. See parameter *15.24 DO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DO1.	10 = 1 s
15.32	*Freq out 1 actual value*	Displays the value of frequency output 1 at digital output DO1 when *15.22 DO1 configuration* is set to *Frequency output*. This parameter is read-only.	-
	0 … 16000 Hz	Value of frequency output 1.	1 = 1 Hz
15.33	*Freq out 1 source*	Selects a signal to be connected to digital output DO1 when *15.22 DO1 configuration* is set to *Frequency output*. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	*Not selected*
	Not selected	None.	0
	Motor speed used	*01.01 Motor speed used* (page *229*).	1
	Output frequency	*01.06 Output frequency* (page *229*).	3
	Motor current	*01.07 Motor current* (page *229*).	4
	Motor torque	*01.10 Motor torque* (page *229*).	6
	DC voltage	*01.11 DC voltage* (page *229*).	7
	Output power	*01.14 Output power* (page *230*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *282*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *282*).	11
	Speed ref used	*24.01 Used speed reference* (page *286*).	12
	Freq ref used	*28.02 Frequency ref ramp output* (page *294*).	14
	Process PID out	*40.01 Process PID output actual* (page *341*).	16
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-

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

No.	Name/Value	Description	Def/FbEq16
19 Operation mode		Selection of local and external control location sources and operating modes. See also section *Operating modes of the drive* (page *183*).	
19.01	*Actual operation mode*	Displays the operating mode currently used. See parameters *19.11*…*19.14*. This parameter is read-only.	-
	Zero	None.	1
	Speed	Speed control (in vector motor control mode).	2
	Torque	Torque control (in vector motor control mode).	3
	In	The torque selector is comparing the output of the speed controller (*25.01 Torque reference speed control*) and torque reference (*26.74 Torque ref ramp out*) and the smaller of the two is used.	4
	Max	The torque selector is comparing the output of the speed controller (*25.01 Torque reference speed control*) and torque reference (*26.74 Torque ref ramp out*) and the greater of the two is used.	5
	Add	The speed controller output is added to the torque reference.	6
	Scalar (Hz)	Frequency control in scalar motor control mode.	10
	Scalar (rpm)	Speed control in scalar motor control mode.	11
	Forced magn.	Motor is in magnetizing mode.	20
19.11	*Ext1/Ext2 selection*	Selects the source for external control location EXT1/EXT2 selection. 0 = EXT1 1 = EXT2	*EXT1*
	EXT1	EXT1 (permanently selected).	0
	EXT2	EXT2 (permanently selected).	1
	MCW bit11: Ext ctrl loc	Control word bit 11 received through fieldbus interface A.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	20
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	21
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	25
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	26
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	27
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	28
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	29
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	30
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-

No.	Name/Value	Description	Def/FbEq16
19.12	*Ext1 control mode*	Selects the operating mode for external control location EXT1.	*Speed*
	Zero	None.	1
	Speed	Speed control. The torque reference used is *25.01 Torque reference speed control* (output of the speed reference chain).	2
	Torque	Torque control. The torque reference used is *26.74 Torque ref ramp out* (output of the torque reference chain).	3
	Minimum	Combination of selections *Speed* and *Torque*: the torque selector compares the speed controller output (*25.01 Torque reference speed control*) and the torque reference (*26.74 Torque ref ramp out*) and selects the smaller of the two. If speed error becomes negative, the drive follows the speed controller output until speed error becomes positive again. This prevents the drive from accelerating uncontrollably if the load is lost in torque control.	4
	Maximum	Combination of selections *Speed* and *Torque*: the torque selector compares the speed controller output (*25.01 Torque reference speed control*) and the torque reference (*26.74 Torque ref ramp out*) and selects the greater of the two. If speed error becomes positive, the drive follows the speed controller output until speed error becomes negative again. This prevents the drive from accelerating uncontrollably if the load is lost in torque control.	5
19.14	*Ext2 control mode*	Selects the operating mode for external control location EXT2. For the selections, see parameter *19.12 Ext1 control mode*.	*Speed*
19.16	*Local control mode*	Selects the operating mode for local control.	*Speed*
	Speed	Speed control. The torque reference used is *25.01 Torque reference speed control* (output of the speed reference chain).	0
	Torque	Torque control. The torque reference used is *26.74 Torque ref ramp out* (output of the torque reference chain).	1
19.17	*Local control disable*	Enables/disables local control (start and stop buttons on the control panel, and the local controls on the PC tool). ⚠ **WARNING!** Before disabling local control, ensure that the control panel is not needed for stopping the drive.	*No*
	No	Local control enabled.	0
	Yes	Local control disabled.	1

20 Start/stop/direction	Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection. For information on control locations, see section *Local control vs. external control* (page *180*).	
20.01 *Ext1 commands*	Selects the source of start, stop and direction commands for external control location 1 (EXT1). See also parameters *20.02*…*20.05*.	*In1 Start; In2 Dir*
Not selected	No start or stop command sources selected.	0

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.03 Ext1 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>Command</th></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.03 Ext1 in1 source is the start signal; the source selected by 20.04 Ext1 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by 20.03 Ext1 in1 source is the forward start signal; the source selected by 20.04 Ext1 in2 source is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Notes:
• Parameter 20.02 Ext1 start trigger type has no effect with this setting.
• When source 2 is 0, the Start and Stop keys on the control panel are disabled.</td><td>4</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The source selected by 20.05 Ext1 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>State of source 3 (20.05)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Notes:
Parameter 20.02 Ext1 start trigger type has no effect with this setting.
When source 2 is 0, the Start and Stop keys on the control panel are disabled.</td><td>5</td></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source, 20.04 Ext1 in2 source and 20.05 Ext1 in3 source. The source selected by 20.05 Ext1 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>State of source 3 (20.05)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>Any</td><td>1</td><td>Start forward</td></tr>
<tr><td>Any</td><td>0 -> 1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: Parameter 20.02 Ext1 start trigger type has no effect with this setting.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel (or PC connected to the panel connector).</td><td>11</td></tr>
<tr><td></td><td>Fieldbus A</td><td>The start and stop commands are taken from fieldbus adapter A.
Note: Set also 20.02 Ext1 start trigger type to Level.</td><td>12</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.
Note: Set also 20.02 Ext1 start trigger type to Level.</td><td>14</td></tr>
<tr><td>20.02</td><td>Ext1 start trigger type</td><td>Defines whether the start signal for external control location EXT1 is edge-triggered or level-triggered.
Note: This parameter is not effective if a pulse-type start signal is selected. See the descriptions of the selections of parameter 20.01 Ext1 commands.</td><td>Level</td></tr>
<tr><td></td><td>Edge</td><td>The start signal is edge-triggered.</td><td>0</td></tr>
<tr><td></td><td>Level</td><td>The start signal is level-triggered.</td><td>1</td></tr>
<tr><td>20.03</td><td>Ext1 in1 source</td><td>Selects source 1 for parameter 20.01 Ext1 commands.</td><td>DI1</td></tr>
<tr><td></td><td>Not selected</td><td>0 (always off).</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1 (always on).</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of 34.01 Combined timer status (see page 321).</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of 34.01 Combined timer status (see page 321).</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of 34.01 Combined timer status (see page 321).</td><td>20</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of 32.01 Supervision status (see page 315).</td><td>24</td></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of 32.01 Supervision status (see page 315).</td><td>25</td></tr>
<tr><td></td><td>Supervision 3</td><td>Bit 2 of 32.01 Supervision status (see page 315).</td><td>26</td></tr>
<tr><td></td><td>Supervision 4</td><td>Bit 3 of 32.01 Supervision status (see page 315).</td><td>27</td></tr>
<tr><td></td><td>Supervision 5</td><td>Bit 4 of 32.01 Supervision status (see page 315).</td><td>28</td></tr>
<tr><td></td><td>Supervision 6</td><td>Bit 5 of 32.01 Supervision status (see page 315).</td><td>29</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 226).</td><td>-</td></tr>
<tr><td>20.04</td><td>Ext1 in2 source</td><td>Selects source 2 for parameter 20.01 Ext1 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>DI2</td></tr>
<tr><td>20.05</td><td>Ext1 in3 source</td><td>Selects source 3 for parameter 20.01 Ext1 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Not selected</td></tr>
<tr><td>20.06</td><td>Ext2 commands</td><td>Selects the source of start, stop and direction commands for external control location 2 (EXT2).
See also parameters 20.07…20.10.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.08 Ext2 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>Command</th></tr>
<tr><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.08 Ext2 in1 source is the start signal; the source selected by 20.09 Ext2 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
</table>

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

Parameter 20.07 Ext2 start trigger type has no effect with this setting.
When source 2 is 0, the Start and Stop keys on the control panel are disabled.
</td><td>4</td></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext2 in2 source. The source selected by 20.10 Ext2 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Notes:

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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source, 20.09 Ext2 in2 source and 20.10 Ext2 in3 source. The source selected by 20.10 Ext2 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>Any</td><td>1</td><td>Start forward</td></tr>
<tr><td>Any</td><td>0 -> 1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: Parameter 20.07 Ext2 start trigger type has no effect with this setting.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel (or PC connected to the panel connector).</td><td>11</td></tr>
<tr><td></td><td>Fieldbus A</td><td>The start and stop commands are taken from fieldbus adapter A.
Note: Set also 20.07 Ext2 start trigger type to Level.</td><td>12</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.
Note: Set also 20.07 Ext2 start trigger type to Level.</td><td>14</td></tr>
<tr><td>20.07</td><td>Ext2 start trigger type</td><td>Defines whether the start signal for external control location EXT2 is edge-triggered or level-triggered.
Note: This parameter is not effective if a pulse-type start signal is selected. See the descriptions of the selections of parameter 20.06 Ext2 commands.</td><td>Level</td></tr>
<tr><td></td><td>Edge</td><td>The start signal is edge-triggered.</td><td>0</td></tr>
<tr><td></td><td>Level</td><td>The start signal is level-triggered.</td><td>1</td></tr>
<tr><td>20.08</td><td>Ext2 in1 source</td><td>Selects source 1 for parameter 20.06 Ext2 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Not selected</td></tr>
<tr><td>20.09</td><td>Ext2 in2 source</td><td>Selects source 2 for parameter 20.06 Ext2 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Not selected</td></tr>
<tr><td>20.10</td><td>Ext2 in3 source</td><td>Selects source 3 for parameter 20.06 Ext2 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Not selected</td></tr>
<tr><td>20.11</td><td>Run enable stop mode</td><td>Selects the way the motor is stopped when the run enable signal switches off.
The source of the run enable signal is selected by parameter 20.12 Run enable 1 source.</td><td>Coast</td></tr>
<tr><td></td><td>Coast</td><td>Stop by switching off the output semiconductors of the drive. The motor coasts to a stop.
WARNING! If a mechanical brake is used, ensure it is safe to stop the drive by coasting.</td><td>0</td></tr>
<tr><td></td><td>Ramp</td><td>Stop along the active deceleration ramp. See parameter group 23 Speed reference ramp on page 282.</td><td>1</td></tr>
<tr><td></td><td>Torque limit</td><td>Stop according to torque limits (parameters 30.19 and 30.20).</td><td>2</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
20.12	*Run enable 1 source*	Selects the source of the external run enable signal. If the run enable signal is switched off, the drive will not start. If already running, the drive will stop according to the setting of parameter *20.11 Run enable stop mode*. 1 = Run enable signal on. **Note:** This parameter cannot be changed while the drive is running. See also parameter *20.19 Enable start command*.	*Selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	26
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	27
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	28
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	29
	FBA A	Control word bit 3 received through fieldbus interface A.	30
	EFB	Control word bit 3 received through the embedded fieldbus interface.	31
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
20.19	*Enable start command*	Selects the source for the start enable signal. 1 = Start enable. With the signal switched off, any drive start command is inhibited. (Switching the signal off while the drive is running will not stop the drive.) See also parameter *20.12 Run enable 1 source*.	*Selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19

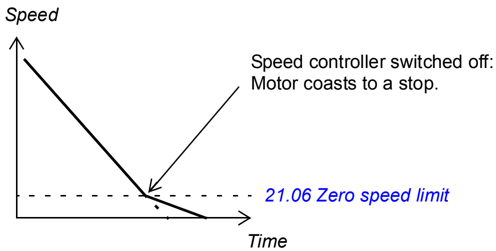
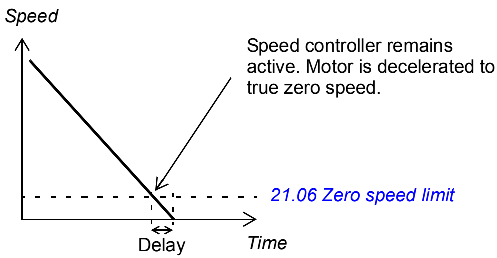
No.	Name/Value	Description	Def/FbEq16
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	26
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	27
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	28
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
20.21	*Direction*	Selects the direction of the motor.	*Request*
	Request	In external control the direction is selected by a direction command (parameter *20.01 Ext1 commands* or *20.06 Ext2 commands*). If no direction command is defined, the motor rotates in the direction of the reference; otherwise it rotates forward.	0
	Forward	Motor rotates forward.	1
	Reverse	Motor rotates reverse.	2
20.22	*Enable to rotate*	Selects source 1 for parameter *20.01 Ext1 commands*.	*Selected*
	Not selected	0 (always off).	0
	Selected	1 (always on).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
20.25	*Jogging enable*	Selects the source for a jog enable signal. (The sources for jogging activation signals are selected by parameters *20.26 Jogging 1 start source* and *20.27 Jogging 2 start source*.) 1 = Jogging is enabled. 0 = Jogging is disabled. **Notes:** • Jogging is supported in vector control mode only. • Jogging can be enabled only when no start command from an external control location is active. On the other hand, if jogging is already enabled, the drive cannot be started from an external control location (apart from inching commands through fieldbus). See section *Rush control* (page *191*).	*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

No.	Name/Value	Description	Def/FbEq16
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	26
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	27
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	28
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
20.26	*Jogging 1 start source*	If enabled by parameter *20.25 Jogging enable*, selects the source for the activation of jogging function 1. (Jogging function 1 can also be activated through fieldbus regardless of parameter *20.25*.) 1 = Jogging 1 active. **Notes:** • Jogging is supported in vector control mode only. • If both jogging 1 and 2 are activated, the one that was activated first has priority. • This parameter cannot be changed while the drive is running.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	26
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	27
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	28
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-

No.	Name/Value	Description	Def/FbEq16
20.27	*Jogging 2 start source*	If enabled by parameter *20.25 Jogging enable*, selects the source for the activation of jogging function 2. (Jogging function 2 can also be activated through fieldbus regardless of parameter *20.25*.) 1 = Jogging 2 active. For the selections, see parameter *20.26 Jogging 1 start source*. **Notes:** • Jogging is supported in vector control mode only. • If both jogging 1 and 2 are activated, the one that was activated first has priority. • This parameter cannot be changed while the drive is running.	*Not selected*
21 Start/stop mode		Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings.	
21.01	*Vector start mode*	Selects the motor start function for the vector motor control mode, ie. when *99.04 Motor control mode* is set to *Vector*. **Notes**: • The start function for the scalar motor control mode is selected by parameter *21.19 Scalar start mode*. • If parameter *99.04 Motor control mode* is set to *Scalar*, selections *Fast* and *Const time* are ignored. • Starting into a rotating motor is not possible when DC magnetizing is selected (*Fast* or *Const time*). • With permanent magnet motors, *Automatic* start mode must be used. • This parameter cannot be changed while the drive is running. See also section *DC magnetization* (page *199*).	*Automatic*
	Fast	The drive pre-magnetizes the motor before start. The pre-magnetizing time is determined automatically, being typically 200 ms to 2 s depending on motor size. This mode should be selected if a high break-away torque is required.	0
	Const time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. This mode should be selected if constant pre-magnetizing time is required (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **WARNING!** The drive will start after the set magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1
	Automatic	Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting into a rotating motor) and the automatic restart function (a stopped motor can be restarted immediately without waiting the motor flux to die away). The drive motor control program identifies the flux as well as the mechanical state of the motor and starts the motor instantly under all conditions. **Note:** If parameter *99.04 Motor control mode* is set to *Scalar*, no flying start or automatic restart is possible by default.	2

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>21.02</td><td>Magnetization time</td><td>Defines the pre-magnetization time when
• parameter 21.01 Vector start mode is set to Const time (in vector motor control mode), or
• parameter 21.19 Scalar start mode is set to Const time (in scalar motor control mode).
After the start command, the drive automatically premagnetizes the motor for the set time. To ensure full magnetizing, set this parameter to the same value as, or higher than, the rotor time constant. If not known, use the rule-of-thumb value given in the table below:
<table>
<tr><th>Motor rated power</th><th>Constant magnetizing time</th></tr>
<tr><td>< 1 kW</td><td>≥ 50 to 100 ms</td></tr>
<tr><td>1 to 10 kW</td><td>≥ 100 to 200 ms</td></tr>
<tr><td>10 to 200 kW</td><td>≥ 200 to 1000 ms</td></tr>
<tr><td>200 to 1000 kW</td><td>≥ 1000 to 2000 ms</td></tr>
</table>
Note: This parameter cannot be changed while the drive is running.</td><td>500 ms</td></tr>
<tr><td></td><td>0…10000 ms</td><td>Constant DC magnetizing time.</td><td>1 = 1 ms</td></tr>
<tr><td>21.03</td><td>Stop mode</td><td>Selects the way the motor is stopped when a stop command is received.
Additional braking is possible by selecting flux braking (see parameter 97.05 Flux braking).</td><td>Coast</td></tr>
<tr><td></td><td>Coast</td><td>Stop by switching off the output semiconductors of the drive. The motor coasts to a stop.
WARNING! If a mechanical brake is used, ensure it is safe to stop the drive by coasting.</td><td>0</td></tr>
<tr><td></td><td>Ramp</td><td>Stop along the active deceleration ramp. See parameter group 23 Speed reference ramp on page 282.</td><td>1</td></tr>
<tr><td></td><td>Torque limit</td><td>Stop according to torque limits (parameters 30.19 and 30.20).</td><td>2</td></tr>
<tr><td></td><td>Speed comp forward</td><td>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. See also section Switching frequency (page 201).
If the direction of rotation is reverse, the drive is stopped along a ramp.</td><td>3</td></tr>
<tr><td></td><td>Speed comp reverse</td><td>Speed compensation is used for constant distance braking if the direction of rotation is reverse. 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. See also section Switching frequency (page 201).
If the direction of rotation is forward, the drive is stopped along a ramp.</td><td>4</td></tr>
<tr><td></td><td>Speed comp bipolar</td><td>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. See also section Switching frequency (page 201).</td><td>5</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
21.04	*Emergency stop mode*	Selects the way the motor is stopped when an emergency stop command is received. The source of the emergency stop signal is selected by parameter *21.05 Emergency stop source*.	*Ramp stop (Off1)*
	Ramp stop (Off1)	With the drive running: • 1 = Normal operation. • 0 = Normal stop along the standard deceleration ramp defined for the particular reference type (see section *Reference ramping* [page *189*]). After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	0
	Coast stop (Off2)	With the drive running: • 1 = Normal operation. • 0 = Stop by coasting. The drive can be restarted by restoring the start interlock signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	1
	Eme ramp stop (Off3)	With the drive running: • 1 = Normal operation • 0 = Stop by ramping along emergency stop ramp defined by parameter *23.23 Emergency stop time*. After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed • 0 = Starting not allowed	2
	Stop torque	With the drive running: • 1 = Normal operation • 0 = Stop against the maximum torque limit (parameter *30.20 Maximum torque 1* or *30.24 Maximum torque 2*). The drive can be restarted by switching the start signal from 0 to 1. • With the drive stopped: • 1 = Starting allowed • 0 = Starting not allowed	3
21.05	*Emergency stop source*	Selects the source of the emergency stop signal. The stop mode is selected by parameter *21.04 Emergency stop mode*. 0 = Emergency stop active 1 = Normal operation **Note:** This parameter cannot be changed while the drive is running.	*Inactive (true)*
	Active (false)	0.	0
	Inactive (true)	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6

No.	Name/Value	Description	Def/FbEq16
	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 *226*).	-
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. Without zero speed delay: The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter *21.06 Zero speed limit*, inverter modulation is stopped and the motor coasts to a standstill.  With zero speed delay: The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter *21.06 Zero speed limit*, the zero speed delay function activates. During the delay the function keeps the speed controller live: the inverter modulates, motor is magnetized and the drive is ready for a quick restart. Zero speed delay can be used e.g. with the jogging function. 	0 ms
	0…30000 ms	Zero speed delay.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
21.08	*DC current control*	Activates/deactivates the DC hold and post-magnetization functions. See section *DC magnetization* (page *199*). **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.	00b

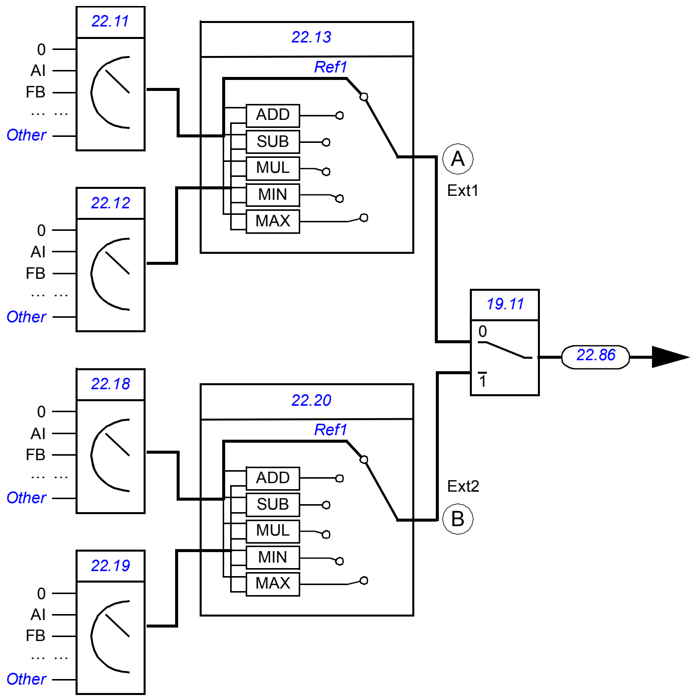
Bit	Value
0	1 = DC hold. See section *DC hold* (page *199*). **Note:** The DC hold function has no effect if the start signal is switched off.
1	1 = Post-magnetization. See section *Settings* (page *200*). **Note:** Post-magnetization is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*).
2…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	00b…11b	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 *199*).	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 *DC magnetization* (page *199*).	30.0%
	0.0…100.0%	DC hold current.	1 = 1%
21.11	*Post magnetization time*	Defines the length of time for which post-magnetization is active after stopping the motor. The magnetization current is defined by parameter *21.10 DC current reference*. See parameter *21.08 DC current control*.	0 s
	0…3000 s	Post-magnetization time.	1 = 1 s
21.14	*Pre-heating input source*	Selects the source for triggering pre-heating. The status of the pre-heating is shown as bit 2 of *06.20 Drive status word 3*. **Notes:** • The heating function requires that run enable, interlock and STO signals are active. • The heating function requires that the drive is not faulted. • Pre-heating uses DC hold to produce current.	*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
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	8
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	9

No.	Name/Value	Description	Def/FbEq16
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	10
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	11
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	12
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	13
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
21.16	*Pre-heating current*	Defines the DC current used to heat motor findings.	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 *211*). 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.	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*. **Notes**: • The start function for the vector motor control mode is selected by parameter *21.01 Vector start mode*. • With permanent magnet motors, *Automatic* start mode must be used. • This parameter cannot be changed while the drive is running. See also section *DC magnetization* (page *199*).	*Normal*
	Normal	Immediate start from zero speed.	0
	Const time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. This mode should be selected if constant pre-magnetizing time is required (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **Note:** This mode cannot be used to start into a rotating motor. **WARNING!** The drive will start after the set magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1
	Automatic	The drive automatically selects the correct output frequency to start a rotating motor. This is useful for flying starts: if the motor is already rotating, the drive will start smoothly at the current frequency. **Note:** Cannot be used in multimotor systems.	2
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 *199*).	5.00 Hz
	0.00…1000.00 Hz	DC hold frequency.	1 = 1 Hz

No.	Name/Value	Description	Def/FbEq16
21.22	*Start delay*	Defines the start delay. After the conditions for start have been fulfilled, the drive waits until the delay has elapsed and then starts the motor. During the delay, warning *AFE9 Start delay* is shown. Start delay can be used with all start modes.	0.00 s
	0.00…60.00 s	Start delay	1 = 1 s
21.30	*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. See also section *Switching frequency* (page *201*).	0.00 s
	0.00…1000.00 s	Time delay for speed compensation.	1 = 1 s
21.31	*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. See also section *Switching frequency* (page *201*).	10%
	0…100%	Speed threshold for speed compensation.	1 = 1%
22 Speed reference selection		Speed reference selection; motor potentiometer settings. See the control chain diagrams on pages *534*…*538*.	
22.01	*Speed ref unlimited*	Displays the output of the speed reference selection block. See the control chain diagram on page *537*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Value of the selected speed reference.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.11	*Ext1 speed ref1*	Selects Ext1 speed reference source 1. Two signal sources can be defined by this parameter and *22.12 Ext1 speed ref2*. A mathematical function (*22.13 Ext1 speed function*) applied to the two signals creates an Ext1 reference (A in the figure below). A digital source selected by *19.11 Ext1/Ext2 selection* can be used to switch between Ext1 reference and the corresponding Ext2 reference defined by parameters *22.18 Ext2 speed ref1*, *22.19 Ext2 speed ref2* and *22.20 Ext2 speed function* (B in the figure below).	*AI1 scaled*



	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *244*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *245*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *231*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *231*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *231*).	8
	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 DI6 is used as a frequency input).	17

No.	Name/Value	Description	Def/FbEq16
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
22.12	*Ext1 speed ref2*	Selects Ext1 speed reference source 2. For the selections, and a diagram of reference source selection, see parameter *22.11 Ext1 speed ref1*.	*Zero*
22.13	*Ext1 speed function*	Selects a mathematical function between the reference sources selected by parameters *22.11 Ext1 speed ref1* and *22.12 Ext1 speed ref2*. See diagram at *22.11 Ext1 speed ref1*.	*Ref1*
	Ref1	Signal selected by *22.11 Ext1 speed ref1* is used as speed reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as speed reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*22.11 Ext1 speed ref1*] - [*22.12 Ext1 speed ref2*]) of the reference sources is used as speed reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as speed reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as speed reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as speed reference 1.	5
22.18	*Ext2 speed ref1*	Selects Ext2 speed reference source 1. Two signal sources can be defined by this parameter and *22.19 Ext2 speed ref2*. A mathematical function (*22.20 Ext2 speed function*) applied to the two signals creates an Ext2 reference. See diagram at *28.11 Ext1 frequency ref1*.	*Zero*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *244*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *245*).	2
	Control panel	*03.01 Panel reference* (see page *231*).	3
	FB A ref1	*03.05 FB A reference 1* (see page *231*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *231*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *231*).	8
	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
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
22.19	*Ext2 speed ref2*	Selects Ext2 speed reference source 2. For the selections, and a diagram of reference source selection, see parameter *22.18 Ext2 speed ref1*.	*Zero*
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

No.	Name/Value	Description	Def/FbEq16
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as speed reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as speed reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as speed reference 1.	5
22.21	*Constant speed function*	Determines how constant speeds are selected, and whether the rotation direction signal is considered or not when applying a constant speed.	00b

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…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	00b…11b	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

No.	Name/Value	Description	Def/FbEq16
	Not selected	0 (always off).	0
	Selected	1 (always on).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19

No.	Name/Value	Description	Def/FbEq16
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	26
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	27
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	28
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
22.23	*Constant speed sel2*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 2. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.24 Constant speed sel3* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*.	*DI4*
22.24	*Constant speed sel3*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 3. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.23 Constant speed sel2* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*.	*Not selected*
22.26	*Constant speed 1*	Defines constant speed 1 (the speed the motor will turn when constant speed 1 is selected).	300.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 1.	See par. *46.01*
22.27	*Constant speed 2*	Defines constant speed 2.	0.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 2.	See par. *46.01*
22.28	*Constant speed 3*	Defines constant speed 3.	0.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 3.	See par. *46.01*
22.29	*Constant speed 4*	Defines constant speed 4.	0.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 4.	See par. *46.01*
22.30	*Constant speed 5*	Defines constant speed 5.	0.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 5.	See par. *46.01*
22.31	*Constant speed 6*	Defines constant speed 6.	0.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 6.	See par. *46.01*
22.32	*Constant speed 7*	Defines constant speed 7.	0.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 7.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.41	Speed ref safe	Defines a safe speed reference value that is used with supervision functions such as • 12.03 AI supervision function • 49.05 Communication loss action • 50.02 FBA A comm loss func.	0.00 rpm
	-30000.00… 30000.00 rpm	Safe speed reference.	See par. 46.01
22.42	Jogging 1 ref	Defines the speed reference for jogging function 1. For more information on jogging, see page 191.	0.00 rpm
	-30000.00… 30000.00 rpm	Speed reference for jogging function 1.	See par. 46.01
22.43	Jogging 2 ref	Defines the speed reference for jogging function 2. For more information on jogging, see page 191.	0.00 rpm
	-30000.00… 30000.00 rpm	Speed reference for jogging function 2.	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. See also section Critical speeds/frequencies (page 190).	00b

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	

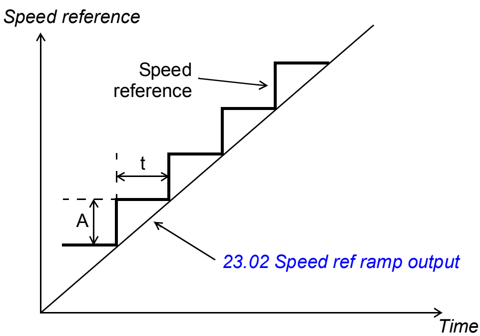
No.	Name/Value	Description	Def/FbEq16
	00b…11b	Critical speeds configuration word.	1 = 1
22.52	Critical speed 1 low	Defines the low limit for critical speed range 1. **Note:** This value must be less than or equal to the value of 22.53 Critical speed 1 high.	0.00 rpm
	-30000.00… 30000.00 rpm	Low limit for critical speed 1.	See par. 46.01
22.53	Critical speed 1 high	Defines the high limit for critical speed range 1. **Note:** This value must be greater than or equal to the value of 22.52 Critical speed 1 low.	0.00 rpm
	-30000.00… 30000.00 rpm	High limit for critical speed 1.	See par. 46.01
22.54	Critical speed 2 low	Defines the low limit for critical speed range 2. **Note:** This value must be less than or equal to the value of 22.55 Critical speed 2 high.	0.00 rpm
	-30000.00… 30000.00 rpm	Low limit for critical speed 2.	See par. 46.01
22.55	Critical speed 2 high	Defines the high limit for critical speed range 2. **Note:** This value must be greater than or equal to the value of 22.54 Critical speed 2 low.	0.00 rpm
	-30000.00… 30000.00 rpm	High limit for critical speed 2.	See par. 46.01

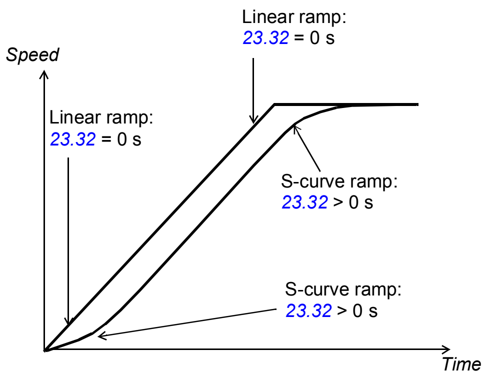
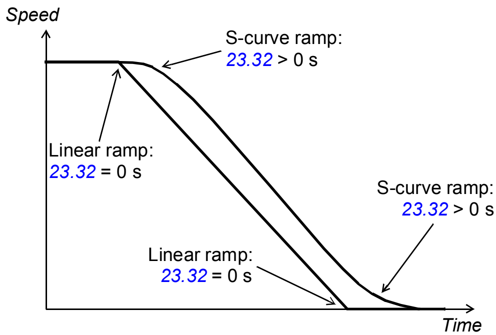
No.	Name/Value	Description	Def/FbEq16
22.56	*Critical speed 3 low*	Defines the low limit for critical speed range 3. **Note:** This value must be less than or equal to the value of *22.57 Critical speed 3 high*.	0.00 rpm
	-30000.00… 30000.00 rpm	Low limit for critical speed 3.	See par. *46.01*
22.57	*Critical speed 3 high*	Defines the high limit for critical speed range 3. **Note:** This value must be greater than or equal to the value of *22.56 Critical speed 3 low*.	0.00 rpm
	-30000.00… 30000.00 rpm	High limit for critical speed 3.	See par. *46.01*
22.71	*Motor potentiometer function*	Activates and selects the mode of the motor potentiometer. See section *Speed control performance figures* (page *195*).	*Disabled*
	Disabled	Motor potentiometer is disabled and its value set to 0.	0
	Enabled (init at power-up)	When enabled, the motor potentiometer first adopts the value defined by parameter *22.72 Motor potentiometer initial value*. The value can then be adjusted from the up and down sources defined by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*. After a power cycle, the motor potentiometer reverts to the predefined initial value (*22.72*).	1
	Enabled (resume at power-up)	As *Enabled (init at power-up)*, but the motor potentiometer value is retained over a power cycle.	2
	Enabled (init to actual)	Whenever another reference source is selected, the value of the motor potentiometer follows that reference. After the source of reference returns to the motor potentiometer, its value can again be changed by the up and down sources (defined by *22.73* and *22.74*).	3
22.72	*Motor potentiometer initial value*	Defines an initial value (starting point) for the motor potentiometer. See the selections of parameter *22.71 Motor potentiometer function*.	0.00
	-32768.00… 32767.00	Initial value for motor potentiometer.	1 = 1
22.73	*Motor potentiometer up source*	Selects the source of motor potentiometer up signal. 0 = No change 1 = Increase motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.)	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20

No.	Name/Value	Description	Def/FbEq16
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	26
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	27
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	28
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
22.74	*Motor potentiometer down source*	Selects the source of motor potentiometer down signal. 0 = No change 1 = Decrease motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.) For the selections, see parameter *22.73 Motor potentiometer up source*.	*Not selected*
22.75	*Motor potentiometer ramp time*	Defines the change rate of the motor potentiometer. This parameter specifies the time required for the motor potentiometer to change from minimum (*22.76*) to maximum (*22.77*). The same change rate applies in both directions.	10.0 s
	0.0…3600.0 s	Motor potentiometer change time.	10 = 1 s
22.76	*Motor potentiometer min value*	Defines the minimum value of the motor potentiometer. **Note:** If vector control mode is used, value of this parameter must be changed.	-50.00
	-32768.00… 32767.00	Motor potentiometer minimum.	1 = 1
22.77	*Motor potentiometer max value*	Defines the maximum value of the motor potentiometer. **Note:** If vector control mode is used, value of this parameter must be changed.	50.00
	-32768.00… 32767.00	Motor potentiometer maximum.	1 = 1
22.80	*Motor potentiometer ref act*	The output of the motor potentiometer function. (The motor potentiometer is configured using parameters *22.71*…*22.74*.) This parameter is read-only.	-
	-32768.00… 32767.00	Value of motor potentiometer.	1 = 1
22.86	*Speed reference act 6*	Displays the value of the speed reference (Ext1 or Ext2) that has been selected by *19.11 Ext1/Ext2 selection*. See diagram at *22.11 Ext1 speed ref1* or the control chain diagram on page *534*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference after additive 2.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.87	*Speed reference act 7*	Displays the value of speed reference before application of critical speeds. See the control chain diagram on page *537*. The value is received from *22.86 Speed reference act 6* unless overridden by • any constant speed • a jogging reference • *network control* reference • control panel reference • safe speed reference. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference before application of critical speeds.	See par. *46.01*
23 Speed reference ramp		Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive). See the control chain diagram on page *538*.	
23.01	*Speed ref ramp input*	Displays the used speed reference (in rpm) before it enters the ramping and shaping functions. See the control chain diagram on page *538*. 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 the control chain diagram on page *538*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference after ramping and shaping.	See par. *46.01*
23.11	*Ramp set selection*	Selects the source that switches between the two sets of acceleration/deceleration ramp times defined by parameters *23.12…23.15*. 0 = Acceleration time 1 and deceleration time 1 are active 1 = Acceleration time 2 and deceleration time 2 are active	*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
	FBA A	Control word bit 3 received through fieldbus interface A.	18
	EFB	Control word bit 3 received through the embedded fieldbus interface.	20
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-

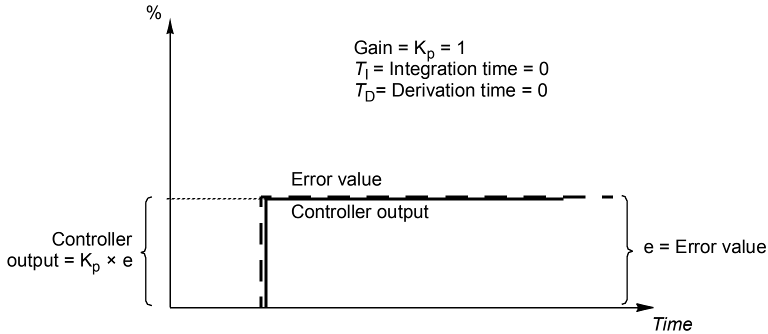
No.	Name/Value	Description	Def/FbEq16
23.12	*Acceleration time 1*	Defines acceleration time 1 as the time required for the speed to change from zero to the speed defined by parameter *46.01 Speed scaling* (**not** to parameter *30.12 Maximum speed*). If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	20.000 s
	0.000 …1800.000 s	Acceleration time 1.	10 = 1 s
23.13	*Deceleration time 1*	Defines deceleration time 1 as the time required for the speed to change from the speed defined by parameter *46.01 Speed scaling* (**not** from parameter *30.12 Maximum speed*) to zero. If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference. If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. If the deceleration rate is set too short, the drive will automatically prolong the deceleration in order not to exceed drive torque limits (or not to exceed a safe DC link voltage). If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control is on (parameter *30.30 Overvoltage control*). **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	20.000 s
	0.000 …1800.000 s	Deceleration time 1.	10 = 1 s
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
23.20	*Acc time jogging*	Defines the acceleration time for the jogging function ie. the time required for the speed to change from zero to the speed value defined by parameter *46.01 Speed scaling*. See section *Rush control* (page *191*).	60.000 s
	0.000 …1800.000 s	Acceleration time for jogging.	10 = 1 s
23.21	*Dec time jogging*	Defines the deceleration time for the jogging function ie. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* to zero. See section *Rush control* (page *191*).	60.000 s
	0.000 …1800.000 s	Deceleration time for jogging.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
23.23	*Emergency stop time*	Defines the time inside which the drive is stopped if an emergency stop Off3 is activated (ie. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling* to zero). Emergency stop mode and activation source are selected by parameters *21.04 Emergency stop mode* and *21.05 Emergency stop source* respectively. Emergency stop can also be activated through fieldbus. **Note:** • Emergency stop Off1 uses the standard deceleration ramp as defined by parameters *23.11*…*23.15*. • The same parameter value is also used in frequency control mode (ramp parameters *28.71*…*28.75*).	3.000 s
	0.000 …1800.000 s	Emergency stop Off3 deceleration time.	10 = 1 s
23.28	*Variable slope enable*	Activates the variable slope function, which controls the slope of the speed ramp during a speed reference change. This allows for a constantly variable ramp rate to be generated, instead of just the standard two ramps normally available. If the update interval of the signal from an external control system and the variable slope rate (*23.29 Variable slope rate*) are equal, speed reference (*23.02 Speed ref ramp output*) is a straight line.  t = update interval of signal from external control system A = speed reference change during t This function is only active in remote control.	*Off*
	Off	Variable slope disabled.	0
	On	Variable slope enabled (not available in local control).	1
23.29	*Variable slope rate*	Defines the rate of the speed reference change when variable slope is enabled by parameter *23.28 Variable slope enable*. For the best result, enter the reference update interval into this parameter.	50 ms
	2…30000 ms	Variable slope rate.	1 = 1 ms

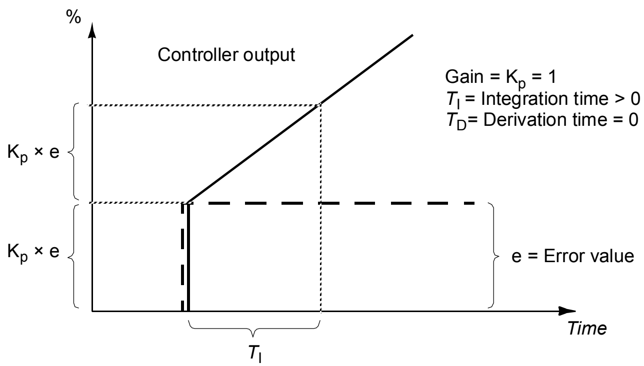
No.	Name/Value	Description	Def/FbEq16
23.32	*Shape time 1*	Defines the shape of the acceleration and deceleration ramps used with the set 1. 0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.001…1000.000 s: S-curve ramp. S-curve ramps are ideal for lifting applications. The S-curve consists of symmetrical curves at both ends of the ramp and a linear part in between. **Acceleration:**  **Deceleration:** 	0.100 s
	0.100…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s
23.33	*Shape time 2*	Defines the shape of the acceleration and deceleration ramps used with the set 2. See parameter *23.32 Shape time 1*.	0.100 s
	0.100…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s

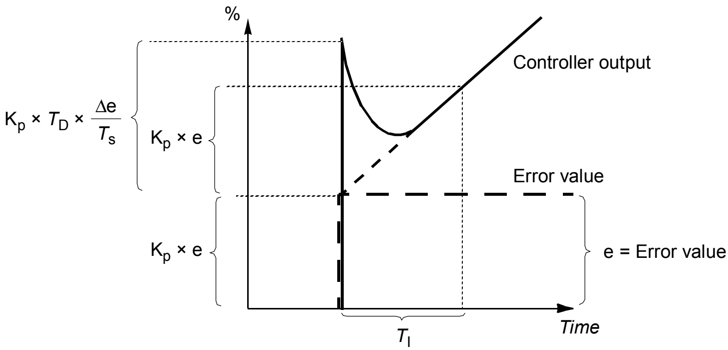
No.	Name/Value	Description	Def/FbEq16
24 Speed reference conditioning		Speed error calculation; speed error window control configuration; speed error step. See the control chain diagrams on pages *539* and *540*.	
24.01	*Used speed reference*	Displays the ramped and corrected speed reference (before speed error calculation). See the control chain diagram on page *539*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference used for speed error calculation.	See par. *46.01*
24.02	*Used speed feedback*	Displays the speed feedback used for speed error calculation. See the control chain diagram on page *539*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed feedback used for speed error calculation.	See par. *46.01*
24.03	*Speed error filtered*	Displays the filtered speed error. See the control chain diagram on page *539*. This parameter is read-only.	-
	-30000.0…30000.0 rpm	Filtered speed error.	See par. *46.01*
24.04	*Speed error inverted*	Displays the inverted (unfiltered) speed error. See the control chain diagram on page *539*. 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 the control chain diagram on page *539*.	0.00 rpm
	-10000.00… 10000.00 rpm	Speed reference correction.	See par. *46.01*
24.12	*Speed error filter time*	Defines the time constant of the speed error low-pass filter. If the used speed reference changes rapidly, the possible interferences in the speed measurement can be filtered with the speed error filter. Reducing the ripple with this filter may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control.	0 ms
	0…10000 ms	Speed error filtering time constant. 0 = filtering disabled.	1 = 1 ms
25 Speed control		Speed controller settings. See the control chain diagrams on pages *539* and *540*.	
25.01	*Torque reference speed control*	Displays the speed controller output that is transferred to the torque controller. See the control chain diagram on page *539*. This parameter is read-only.	-
	-1600.0…1600.0%	Limited speed controller output torque.	See par. *46.03*

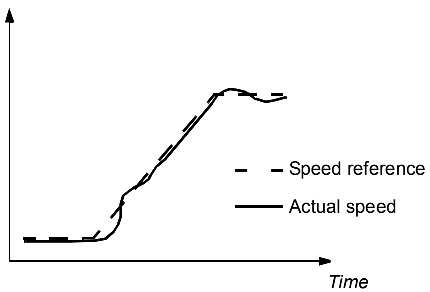
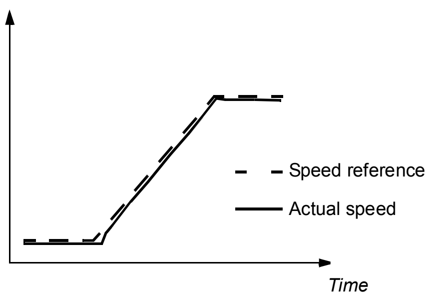
No.	Name/Value	Description	Def/FbEq16
25.02	*Speed proportional gain*	Defines the proportional gain (K_p) of the speed controller. Too high a gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant.	10.00



		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

No.	Name/Value	Description	Def/FbEq16
25.03	*Speed integration time*	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. This time constant must be set to the same order of magnitude as the time constant (time to respond) of the actual mechanical system being controlled, otherwise instability will result. Setting the integration time to zero disables the I-part of the controller. This is useful to do when tuning the proportional gain; adjust the proportional gain first, then return the integration time. Anti-windup (the integrator just integrates up to 100%) stops the integrator if the controller output is limited. The figure below shows the speed controller output after an error step when the error remains constant.	2.50 s
			
	0.00…1000.00 s	Integration time for speed controller.	10 = 1 s

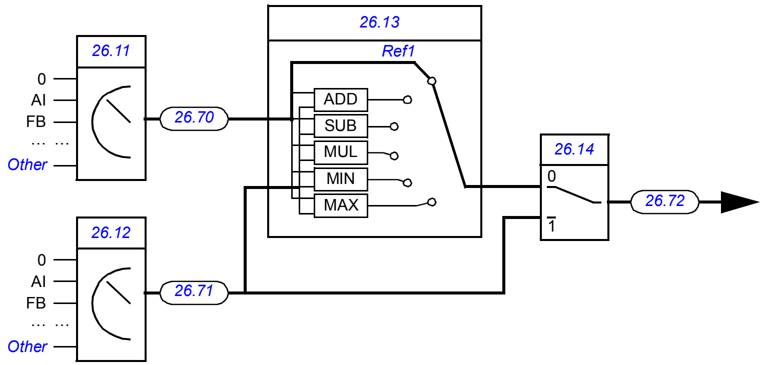
No.	Name/Value	Description	Def/FbEq16
25.04	*Speed derivation time*	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. For simple applications (especially those without a pulse encoder), derivative time is not normally required and should be left at zero. The speed error derivative must be filtered with a low pass filter to eliminate disturbances. The figure below shows the speed controller output after an error step when the error remains constant.  Gain = K_p = 1 T_I = Integration time > 0 T_D= Derivation time > 0 T_s= Sample time period = 250 µs Δe = Error value change between two samples	0.000 s
	0.000…10.000 s	Derivation time for speed controller.	1000 = 1 s
25.05	*Derivation filter time*	Defines the derivation filter time constant. See parameter *25.04 Speed derivation time*.	8 ms
	0…10000 ms	Derivation filter time constant.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
25.06	*Acc comp derivation time*	Defines the derivation time for acceleration(/deceleration) compensation. In order to compensate for a high inertia load during acceleration, a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described under parameter *25.04 Speed derivation time*. **Note:** As a general rule, set this parameter to the value between 50 and 100% of the sum of the mechanical time constants of the motor and the driven machine. The figure below shows the speed responses when a high inertia load is accelerated along a ramp. **No acceleration compensation:**  **Acceleration compensation:**  	0.00 s
	0.00…1000.00 s	Acceleration compensation derivation time.	10 = 1 s
25.07	*Acc comp filter time*	Defines the acceleration (or deceleration) compensation filter time constant. See parameters *25.04 Speed derivation time* and *25.06 Acc comp derivation time*.	8.0 ms
	0.0…1000.0 ms	Acceleration/deceleration compensation filter time.	1 = 1 ms
25.15	*Proportional gain em stop*	Defines the proportional gain for the speed controller when an emergency stop is active. See parameter *25.02 Speed proportional gain*.	10.00
	1.00…250.00	Proportional gain upon an emergency stop.	100 = 1

No.	Name/Value	Description	Def/FbEq16
25.53	*Torque prop reference*	Displays the output of the proportional (P) part of the speed controller. See the control chain diagram on page *539*. 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 the control chain diagram on page *539*. 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 the control chain diagram on page *539*. 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 the control chain diagram on page *539*. This parameter is read-only.	-
	-30000.0…30000.0%	Output of acceleration compensation function.	See par. *46.03*

26 Torque reference chain		Settings for the torque reference chain. See the control chain diagrams on pages *541* and *542*.	
26.01	*Torque reference to TC*	Displays the final torque reference given to the torque controller in percent. This reference is then acted upon by various final limiters, like power, torque, load etc. See the control chain diagrams on pages *542* and *543*. This parameter is read-only.	-
	-1600.0…1600.0%	Torque reference for torque control.	See par. *46.03*
26.02	*Torque reference used*	Displays the final torque reference (in percent of motor nominal torque) given to the torque controller, and comes after frequency, voltage and torque limitation. See the control chain diagram on page *543*. This parameter is read-only.	-
	-1600.0…1600.0%	Torque reference for torque control.	See par. *46.03*
26.08	*Minimum torque ref*	Defines the minimum torque reference. Allows for local limiting of the torque reference before it is passed on to the torque ramp controller. For absolute torque limiting, refer to parameter *30.19 Minimum torque 1*.	-300.0%
	-1000.0…0.0%	Minimum torque reference.	See par. *46.03*
26.09	*Maximum torque ref*	Defines the maximum torque reference. Allows for local limiting of the torque reference before it is passed on to the torque ramp controller. For absolute torque limiting, refer to parameter *30.20 Maximum torque 1*.	300.0%
	0.0…1000.0%	Maximum torque reference.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
26.11	*Torque ref1 source*	Selects torque reference source 1. Two signal sources can be defined by this parameter and *26.12 Torque ref2 source*. A digital source selected by *26.14 Torque ref1/2 selection* can be used to switch between the two sources, or a mathematical function (*26.13 Torque ref1 function*) applied to the two signals to create the reference.	*Zero*



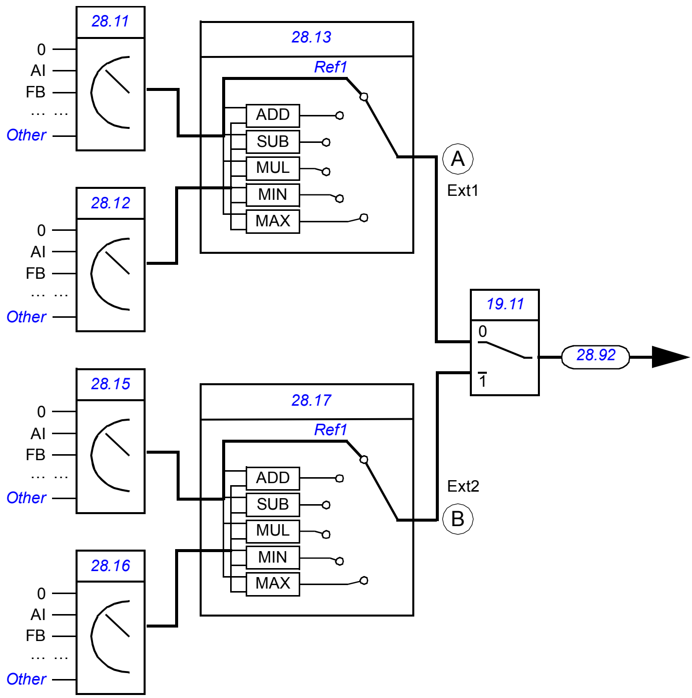
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *244*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *245*).	2
	Control panel	*03.01 Panel reference* (see page *231*).	3
	FB A ref1	*03.05 FB A reference 1* (see page *231*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *231*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *231*).	8
	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
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
26.12	*Torque ref2 source*	Selects torque reference source 2. For the selections, and a diagram of reference source selection, see parameter *26.11 Torque ref1 source*.	*Zero*
26.13	*Torque ref1 function*	Selects a mathematical function between the reference sources selected by parameters *26.11 Torque ref1 source* and *26.12 Torque ref2 source*. See diagram at *26.11 Torque ref1 source*.	*Ref1*
	Ref1	Signal selected by *26.11 Torque ref1 source* is used as torque reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as torque reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*26.11 Torque ref1 source*] - [*26.12 Torque ref2 source*]) of the reference sources is used as torque reference 1.	2

No.	Name/Value	Description	Def/FbEq16
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as torque reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as torque reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as torque reference 1.	5
26.14	*Torque ref1/2 selection*	Configures the selection between torque references 1 and 2. See diagram at *26.11 Torque ref1 source*. 0 = Torque reference 1 1 = Torque reference 2	*Torque reference 1*
	Torque reference 1	0.	0
	Torque reference 2	1.	1
	Follow Ext1/Ext2 selection	Torque reference 1 is used when external control location EXT1 is active. Torque reference 2 is used when external control location EXT2 is active. See also parameter *19.11 Ext1/Ext2 selection*.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
26.17	*Torque ref filter time*	Defines a low-pass filter time constant for the torque reference.	0.000 s
	0.000…30.000 s	Filter time constant for torque reference.	1000 = 1 s
26.18	*Torque ramp up time*	Defines the torque reference ramp-up time, ie. the time for the reference to increase from zero to nominal motor torque.	0.000 s
	0.000…60.000 s	Torque reference ramp-up time.	100 = 1 s
26.19	*Torque ramp down time*	Defines the torque reference ramp-down time, ie. the time for the reference to decrease from nominal motor torque to zero.	0.000 s
	0.000…60.000 s	Torque reference ramp-down time.	100 = 1 s
26.21	*Torque sel torque in*	Selects the source for *26.74 Torque ref ramp out*.	*Torque ref torq ctrl*
	Not selected	None.	0
	Torque ref torq ctrl	Torque reference from the torque chain.	1
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
26.22	*Torque sel speed in*	Selects the source for *25.01 Torque reference speed control*.	*Torque ref speed ctrl*
	Not selected	None.	0
	Torque ref speed ctrl	Torque reference from the speed chain.	1
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
	-1600.0…1600.0%	Value of torque reference source 1.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
26.70	*Torque reference act 1*	Displays the value of torque reference source 1 (selected by parameter *26.11 Torque ref1 source*). See the control chain diagram on page *541*. This parameter is read-only.	-
	-1600.0…1600.0%	Value of torque reference source 1.	See par. *46.03*
26.71	*Torque reference act 2*	Displays the value of torque reference source 2 (selected by parameter *26.12 Torque ref2 source*). See the control chain diagram on page *541*. This parameter is read-only.	-
	-1600.0…1600.0%	Value of torque reference source 2.	See par. *46.03*
26.72	*Torque reference act 3*	Displays the torque reference after the function applied by parameter *26.13 Torque ref1 function* (if any), and after selection (*26.14 Torque ref1/2 selection*). See the control chain diagram on page *541*. This parameter is read-only.	-
	-1600.0…1600.0%	Torque reference after selection.	See par. *46.03*
26.73	*Torque reference act 4*	Displays the torque reference after application of reference additive 1. See the control chain diagram on page *541*. This parameter is read-only.	-
	-1600.0…1600.0%	Torque reference after application of reference additive 1.	See par. *46.03*
26.74	*Torque ref ramp out*	Displays the torque reference after limiting and ramping. See the control chain diagram on page *541*. This parameter is read-only.	-
	-1600.0…1600.0%	Torque reference after limiting and ramping.	See par. *46.03*
26.75	*Torque reference act 5*	Displays the torque reference after control mode selection. See the control chain diagram on page *543*. This parameter is read-only.	-
	-1600.0…1600.0%	Torque reference after control mode selection.	See par. *46.03*

28 Frequency reference chain		Settings for the frequency reference chain. See the control chain diagrams on pages *544* and *535*.	
28.01	*Frequency ref ramp input*	Displays the used frequency reference before ramping. See the control chain diagram on page *544*. 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 the control chain diagram on page *544*. This parameter is read-only.	-
	-500.00…500.00 Hz	Final frequency reference.	See par. *46.02*

No.	Name/Value	Description	Def/FbEq16
28.11	*Ext1 frequency ref1*	Selects Ext1 frequency reference source 1. Two signal sources can be defined by this parameter and *28.12 Ext1 frequency ref2*. A mathematical function (*28.13 Ext1 frequency function*) applied to the two signals creates an Ext1 reference (A in the figure below). A digital source selected by *19.11 Ext1/Ext2 selection* can be used to switch between Ext1 reference and the corresponding Ext2 reference defined by parameters *28.15 Ext2 frequency ref1*, *28.16 Ext2 frequency ref2* and *28.17 Ext2 frequency function* (B in the figure below).	*AI1 scaled*



	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *244*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *245*).	2
	Control panel	*03.01 Panel reference* (see page *231*).	3
	FB A ref1	*03.05 FB A reference 1* (see page *231*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *231*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *231*).	8
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16

No.	Name/Value	Description	Def/FbEq16
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
28.12	*Ext1 frequency ref2*	Selects Ext1 frequency reference source 2. For the selections, and a diagram of reference source selection, see parameter *28.11 Ext1 frequency ref1*.	*Zero*
28.13	*Ext1 frequency function*	Selects a mathematical function between the reference sources selected by parameters *28.11 Ext1 frequency ref1* and *28.12 Ext1 frequency ref2*. See diagram at *28.11 Ext1 frequency ref1*.	*Ref1*
	Ref1	Signal selected by *28.11 Ext1 frequency ref1* is used as frequency reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as frequency reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*28.11 Ext1 frequency ref1*] - [*28.12 Ext1 frequency ref2*]) of the reference sources is used as frequency reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as frequency reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as frequency reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as frequency reference 1.	5
28.15	*Ext2 frequency ref1*	Selects Ext2 frequency reference source 1. Two signal sources can be defined by this parameter and *28.16 Ext2 frequency ref2*. A mathematical function (*28.17 Ext2 frequency function*) applied to the two signals creates an Ext2 reference. See diagram at *28.11 Ext1 frequency ref1*.	*AI1 scaled*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *244*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *245*).	2
	Control panel	*03.01 Panel reference* (see page *231*).	3
	FB A ref1	*03.05 FB A reference 1* (see page *231*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *231*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *231*).	8
	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
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
28.16	*Ext2 frequency ref2*	Selects Ext2 frequency reference source 2. For the selections, and a diagram of reference source selection, see parameter *28.15 Ext2 frequency ref1*.	*Zero*
28.17	*Ext2 frequency function*	Selects a mathematical function between the reference sources selected by parameters *28.15 Ext2 frequency ref1* and *28.16 Ext2 frequency ref2*. See diagram at *28.15 Ext2 frequency ref1*.	*Ref1*
	Ref1	Signal selected by *28.15 Ext2 frequency ref1* is used as frequency reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as frequency reference 1.	1

No.	Name/Value	Description	Def/FbEq16
	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.	00b

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.

No.	Name/Value	Description	Def/FbEq16
	00b…11b	Constant frequency configuration word.	1 = 1
28.22	*Constant frequency sel1*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 1. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.23 Constant frequency sel2* and *28.24 Constant frequency sel3* select three sources whose states activate constant frequencies as follows:	*Not selected*

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
	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

No.	Name/Value	Description	Def/FbEq16
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	26
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	27
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	28
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
28.23	*Constant frequency sel2*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 2. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.22 Constant frequency sel1* and *28.24 Constant frequency sel3* select three sources that are used to activate constant frequencies. See table at parameter *28.22 Constant frequency sel1*. For the selections, see parameter *28.22 Constant frequency sel1*.	*Not selected*
28.24	*Constant frequency sel3*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 3. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.22 Constant frequency sel1* and *28.23 Constant frequency sel2* select three sources that are used to activate constant frequencies. See table at parameter *28.22 Constant frequency sel1*. For the selections, see parameter *28.22 Constant frequency sel1*.	*Not selected*
28.26	*Constant frequency 1*	Defines constant frequency 1 (the frequency the motor will turn when constant frequency 1 is selected).	0.00 Hz
	-500.00…500.00 Hz	Constant frequency 1.	See par. *46.02*
28.27	*Constant frequency 2*	Defines constant frequency 2.	0.00 Hz
	-500.00…500.00 Hz	Constant frequency 2.	See par. *46.02*
28.28	*Constant frequency 3*	Defines constant frequency 3.	0.00 Hz
	-500.00…500.00 Hz	Constant frequency 3.	See par. *46.02*
28.29	*Constant frequency 4*	Defines constant frequency 4.	0.00 Hz
	-500.00…500.00 Hz	Constant frequency 4.	See par. *46.02*
28.30	*Constant frequency 5*	Defines constant frequency 5.	0.00 Hz
	-500.00…500.00 Hz	Constant frequency 5.	See par. *46.02*

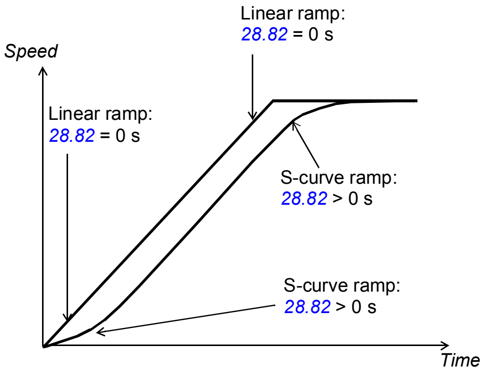
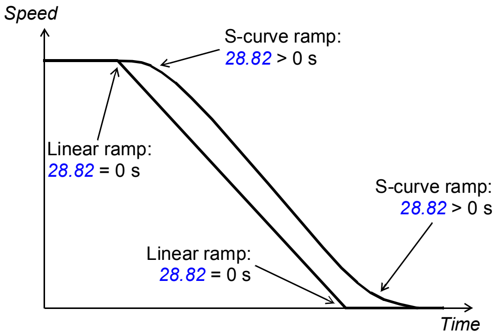
No.	Name/Value	Description	Def/FbEq16
28.31	*Constant frequency 6*	Defines constant frequency 6.	0.00 Hz
	-500.00…500.00 Hz	Constant frequency 6.	See par. *46.02*
28.32	*Constant frequency 7*	Defines constant frequency 7.	0.00 Hz
	-500.00…500.00 Hz	Constant frequency 7.	See par. *46.02*
28.41	*Frequency ref safe*	Defines a safe frequency reference value that is used with supervision functions such as • *12.03 AI supervision function* • *49.05 Communication loss action* • *50.02 FBA A comm loss func*.	0.00 Hz
	-500.00…500.00 Hz	Safe frequency reference.	See par. *46.02*
28.51	*Critical frequency function*	Enables/disables the critical frequencies function. Also determines whether the specified ranges are effective in both rotating directions or not. See also section *Critical speeds/frequencies* (page *190*).	00b

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
	00b…11b	Critical frequencies configuration word.	1 = 1
28.52	*Critical frequency 1 low*	Defines the low limit for critical frequency 1. **Note:** This value must be less than or equal to the value of *28.53 Critical frequency 1 high*.	0.00 Hz
	-500.00…500.00 Hz	Low limit for critical frequency 1.	See par. *46.02*
28.53	*Critical frequency 1 high*	Defines the high limit for critical frequency 1. **Note:** This value must be greater than or equal to the value of *28.52 Critical frequency 1 low*.	0.00 Hz
	-500.00…500.00 Hz	High limit for critical frequency 1.	See par. *46.02*
28.54	*Critical frequency 2 low*	Defines the low limit for critical frequency 2. **Note:** This value must be less than or equal to the value of *28.55 Critical frequency 2 high*.	0.00 Hz
	-500.00…500.00 Hz	Low limit for critical frequency 2.	See par. *46.02*
28.55	*Critical frequency 2 high*	Defines the high limit for critical frequency 2. **Note:** This value must be greater than or equal to the value of *28.54 Critical frequency 2 low*.	0.00 Hz
	-500.00…500.00 Hz	High limit for critical frequency 2.	See par. *46.02*

No.	Name/Value	Description	Def/FbEq16
28.56	*Critical frequency 3 low*	Defines the low limit for critical frequency 3. **Note:** This value must be less than or equal to the value of *28.57 Critical frequency 3 high*.	0.00 Hz
	-500.00…500.00 Hz	Low limit for critical frequency 3.	See par. *46.02*
28.57	*Critical frequency 3 high*	Defines the high limit for critical frequency 3. **Note:** This value must be greater than or equal to the value of *28.56 Critical frequency 3 low*.	0.00 Hz
	-500.00…500.00 Hz	High limit for critical frequency 3.	See par. *46.02*
28.71	*Freq ramp set selection*	Selects a source that switches between the two sets of acceleration/deceleration times defined by parameters *28.72*…*28.75*. 0 = Acceleration time 1 and deceleration time 1 are in force 1 = Acceleration time 2 and deceleration time 2 are in force	*Acc/Dec time 1*
	Acc/Dec time 1	0.	0
	Acc/Dec time 2	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	FBA A	Control word bit 3 received through fieldbus interface A.	18
	EFB	Control word bit 3 received through the embedded fieldbus interface.	20
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
28.72	*Freq acceleration time 1*	Defines acceleration time 1 as the time required for the frequency to change from zero to the frequency defined by parameter *46.02 Frequency scaling*. After this frequency has been reached, the acceleration continues with the same rate to the value defined by parameter *30.14 Maximum frequency*. If the reference increases faster than the set acceleration rate, the motor will follow the acceleration rate. If the reference increases slower than the set acceleration rate, the motor frequency will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	20.000 s
	0.000…1800.000 s	Acceleration time 1.	10 = 1 s
28.73	*Freq deceleration time 1*	Defines deceleration time 1 as the time required for the frequency to change from the frequency defined by parameter *46.02 Frequency scaling* (**not** from parameter *30.14 Maximum frequency*) to zero. If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control (*30.30 Overvoltage control*) is on. **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	20.000 s
	0.000…1800.000 s	Deceleration time 1.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
28.74	*Freq acceleration time 2*	Defines acceleration time 2. See parameter *28.72 Freq acceleration time 1*.	60.000 s
	0.000…1800.000 s	Acceleration time 2.	10 = 1 s
28.75	*Freq deceleration time 2*	Defines deceleration time 2. See parameter *28.73 Freq deceleration time 1*.	60.000 s
	0.000…1800.000 s	Deceleration time 2.	10 = 1 s
28.76	*Freq ramp in zero source*	Selects a source that forces the frequency reference to zero. 0 = Force frequency reference to zero 1 = Normal operation	*Inactive*
	Active	0.	0
	Inactive	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-

No.	Name/Value	Description	Def/FbEq16
28.82	*Shape time 1*	Defines the shape of the acceleration and deceleration ramps used with the set 1. 0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.001…1000.000 s: S-curve ramp. S-curve ramps are ideal for lifting applications. The S-curve consists of symmetrical curves at both ends of the ramp and a linear part in between. **Acceleration:**  **Deceleration:** 	0.100 s
	0.100…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s
28.83	*Shape time 2*	Defines the shape of the acceleration and deceleration ramps used with the set 2. See parameter *28.82 Shape time 1*.	0.100 s
	0.100…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
28.92	*Frequency ref act 3*	Displays the frequency reference after the function applied by parameter *28.13 Ext1 frequency function* (if any), and after selection (*19.11 Ext1/Ext2 selection*). See the control chain diagram on page *544*. 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 the control chain diagram on page *544*. This parameter is read-only.	-
	-500.00…500.00 Hz	Frequency reference 7.	See par. *46.02*
30 Limits		Drive operation limits.	
30.01	*Limit word 1*	Displays limit word 1. This parameter is read-only.	-

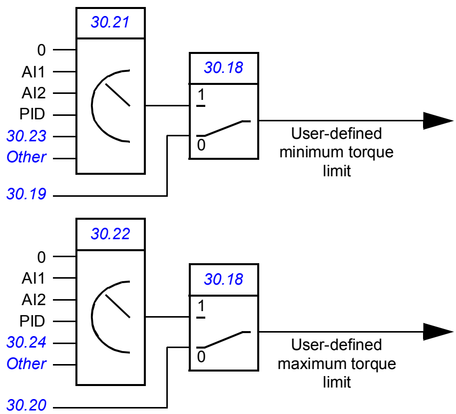
Bit	Name	Description
0	Torq lim	1 = Drive torque is being limited by the motor control (undervoltage control, current control, load angle control or pull-out control), or by the torque limits defined by parameters.
1…2	Reserved	
3	Torq ref max	1 = Torque reference is being limited by *26.09 Maximum torque ref*
4	Torq ref min	1 = Torque reference is being limited by *26.08 Minimum torque ref*
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	

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

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

Bit	Name	Description
0	Undervoltage	*1 = Intermediate DC circuit undervoltage
1	Overvoltage	*1 = Intermediate DC circuit overvoltage
2	Minimum torque	*1 = Torque is being limited by *30.19 Minimum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*
3	Maximum torque	*1 = Torque is being limited by *30.20 Maximum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*
4	Internal current	1 = An inverter current limit (identified by bits 8…11) is active
5	Load angle	(With permanent magnet motors and reluctance motors only) 1 = Load angle limit is active, ie. the motor cannot produce any more torque
6	Motor pullout	(With asynchronous motors only) Motor pull-out limit is active, ie. the motor cannot produce any more torque
7	Reserved	
8	Thermal	1 = Input current is being limited by the main circuit thermal limit
9	Max current	*1 = Maximum output current (I_{MAX}) is being limited
10	User current	*1 = Output current is being limited by *30.17 Maximum current*
11	Thermal IGBT	*1 = Output current is being limited by a calculated thermal current value
12…15	Reserved	
*Only one out of bits 0…3, and one out of bits 9…11 can be on simultaneously. The bit typically indicates the limit that is exceeded first.		

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Torque limitation status word.	1 = 1
30.11	*Minimum speed*	Defines the minimum allowed speed. **WARNING!** This value must not be higher than *30.12 Maximum speed*. **WARNING!** In frequency control mode, this limit is not effective. Make sure the frequency limits (*30.13* and *30.14*) are set appropriately if frequency control is used.	0.00 rpm
	-30000.00… 30000.00 rpm	Minimum allowed speed.	See par. *46.01*
30.12	*Maximum speed*	Defines the maximum allowed speed. **WARNING!** This value must not be lower than *30.11 Minimum speed*. **WARNING!** In frequency control mode, this limit is not effective. Make sure the frequency limits (*30.13* and *30.14*) are set appropriately if frequency control is used.	1500.00 rpm
	-30000.00… 30000.00 rpm	Maximum speed.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
30.13	*Minimum frequency*	Defines the minimum allowed frequency. **WARNING!** This value must not be higher than *30.14 Maximum frequency*. **WARNING!** This limit is effective in frequency control mode only.	0.00 Hz
	-500.00…500.00 Hz	Minimum frequency.	See par. *46.02*
30.14	*Maximum frequency*	Defines the maximum allowed frequency. **WARNING!** This value must not be lower than *30.13 Minimum frequency*. **WARNING!** This limit is effective in frequency control mode only.	50.00 Hz
	-500.00…500.00 Hz	Maximum frequency.	See par. *46.02*
30.17	*Maximum current*	Defines the maximum allowed motor current.	0.00 A
	0.00…30000.00 A	Maximum motor current.	1 = 1 A
30.18	*Torq lim sel*	Selects a source that switches between two different predefined minimum torque limit sets. 0 = minimum torque limit defined by *30.19* and maximum torque limit defined by *30.20* are active 1 = minimum torque limit selected by *30.21* and maximum torque limit defined by *30.22* are active The user can define two sets of torque limits, and switch between the sets using a binary source such as a digital input. The first set of limits is defined by parameters *30.19* and *30.20*. The second set has selector parameters for both the minimum (*30.21*) and maximum (*30.22*) limits that allows the use of a selectable analog source (such as an analog input).  **Note:** In addition to the user-defined limits, torque may be limited for other reasons (such as power limitation). Refer to the block diagram on page *543*.	*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

No.	Name/Value	Description	Def/FbEq16
	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
	FBA A	Control word bit 3 received through fieldbus interface A.	24
	EFB	Control word bit 3 received through the embedded fieldbus interface.	25
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
30.19	*Minimum torque 1*	Defines a minimum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter *30.18 Torq lim sel*. The limit is effective when • the source selected by *30.18 Torq lim sel* is 0, or • *30.18* is set to *Torque limit set 1*.	-300.0%
	-1600.0…0.0%	Minimum torque limit 1.	See par. *46.03*
30.20	*Maximum torque 1*	Defines a maximum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter *30.18 Torq lim sel*. The limit is effective when • the source selected by *30.18 Torq lim sel* is 0, or • *30.18* is set to *Torque limit set 1*.	300.0%
	0.0…1600.0%	Maximum torque 1.	See par. *46.03*
30.21	*Min torque 2 source*	Defines the source of the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.18 Torq lim sel* is 1, or • *30.18* is set to *Torque limit set 2*. See diagram at *30.18 Torq lim sel*. **Note:** Any positive values received from the selected source are inverted.	*Minimum torque 2*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *244*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *245*).	2
	Control panel	*03.01 Panel reference* (see page *231*).	3
	FB A ref1	*03.05 FB A reference 1* (see page *231*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *231*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *231*).	8
	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 *226*).	-

No.	Name/Value	Description	Def/FbEq16
30.22	*Max torque 2 source*	Defines the source of the maximum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.18 Torq lim sel* is 1, or • *30.18* is set to *Torque limit set 2*. See diagram at *30.18 Torq lim sel*. **Note:** Any negative values received from the selected source are inverted.	*Maximum torque 2*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *244*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *245*).	2
	Control panel	*03.01 Panel reference* (see page *231*).	3
	FB A ref1	*03.05 FB A reference 1* (see page *231*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *231*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *231*).	8
	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 *226*).	-
30.23	*Minimum torque 2*	Defines the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by *30.18 Torq lim sel* is 1, or • *30.18* is set to *Torque limit set 2* and • *30.21 Min torque 2 source* is set to *Minimum torque 2*. See diagram at *30.18 Torq lim sel*.	-300.0%
	-1600.0…0.0%	Minimum torque limit 2.	See par. *46.03*
30.24	*Maximum torque 2*	Defines the maximum torque limit for the drive (in percent of nominal motor torque) when The limit is effective when • the source selected by *30.18 Torq lim sel* is 1, or • *30.18* is set to *Torque limit set 2* and • *30.22 Max torque 2 source* is set to *Maximum torque 2*. See diagram at *30.18 Torq lim sel*.	300.0%
	0.0…1600.0%	Maximum torque limit 2.	See par. *46.03*
30.26	*Power motoring limit*	Defines the maximum allowed power fed by the inverter to the motor in percent of nominal motor power.	300.00%
	0.00…600.00%	Maximum motoring power.	1 = 1%
30.27	*Power generating limit*	Defines the maximum allowed power fed by the motor to the inverter in percent of nominal motor power.	-300.00%
	-600.00…0.00%	Maximum generating power.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
30.30	*Overvoltage control*	Enables the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque. **Note:** If the drive is equipped with a brake chopper and resistor, or a regenerative supply unit, the controller must be disabled.	*Enable*
	Disable	Overvoltage control disabled.	0
	Enable	Overvoltage control enabled.	1
30.31	*Undervoltage control*	Enables the undervoltage control of the intermediate DC link. If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor torque in order to keep the voltage above the lower limit. By decreasing the motor torque, the inertia of the load will cause regeneration back to the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to a stop. This will act as a power-loss ride-through functionality in systems with high inertia, such as a centrifuge or a fan.	*Enable*
	Disable	Undervoltage control disabled.	0
	Enable	Undervoltage control enabled.	1

31 Fault functions		Configuration of external events; selection of behavior of the drive upon fault situations.	
31.01	*External event 1 source*	Defines the source of external event 1. See also parameter *31.02 External event 1 type*. 0 = Trigger event 1 = Normal operation	*Inactive (true)*
	Active (false)	0.	0
	Inactive (true)	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
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	The external event generates a fault.	0
	Warning	The external event generates a warning.	1

No.	Name/Value	Description	Def/FbEq16
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	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	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	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
31.11	*Fault reset selection*	Selects the source of an external fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists. 0 -> 1 = Reset **Note:** A fault reset from the fieldbus interface is always observed regardless of this parameter.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	26
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	27
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	28

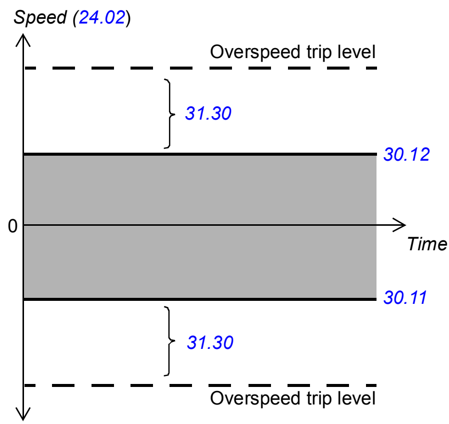
No.	Name/Value	Description	Def/FbEq16
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
31.12	*Autoreset selection*	Selects faults that are automatically reset. The parameter is a 16-bit word with each bit corresponding to a fault type. Whenever a bit is set to 1, the corresponding fault is automatically reset. **Note:** The autoreset function is only available in external control; see section *Local control vs. external control* (page *180*). The bits of this binary number correspond to the following faults:	0000h

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. Faults are listed in chapter *Fault tracing* (page *433*). **Note:** The fault codes are in hexadecimal. The selected code must be converted to decimal for this parameter.	0
	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 the time the automatic reset function will attempt to reset the drive. During this time, it will perform the number of automatic resets defined by *31.14 Number of trials*.	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
31.19	*Motor phase loss*	Selects how the drive reacts when a motor phase loss is detected.	*Fault*
	No action	No action taken.	0
	Fault	The drive trips on fault *3381 Output phase loss*.	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>31.20</td><td>Earth fault</td><td>Selects how the drive reacts when an earth (ground) fault or current unbalance is detected in the motor or the motor cable.</td><td>Fault</td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Warning</td><td>The drive generates an A2B3 Earth leakage warning.</td><td>1</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 2330 Earth leakage.</td><td>2</td></tr>
<tr><td>31.21</td><td>Supply phase loss</td><td>Selects how the drive reacts when a supply phase loss is detected.</td><td>Fault</td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 3130 Input phase loss.</td><td>1</td></tr>
<tr><td>31.22</td><td>STO indication run/stop</td><td>Selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.
The tables at each selection below show the indications generated with that particular setting.
Notes:
This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.
The loss of only one STO signal always generates a fault as it is interpreted as a malfunction.
For more information on the STO, see chapter The Safe torque off function on page 555.</td><td>Fault/Fault</td></tr>
<tr><td></td><td>Fault/Fault</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>0</td></tr>
<tr><td></td><td>Fault/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1</td><td>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2</td><td>Warning A5A0 Safe torque off and fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>1</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Fault/Event</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Event B5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1</td><td>Event B5A0 Safe torque off and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2</td><td>Event B5A0 Safe torque off and fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>2</td></tr>
<tr><td></td><td>Warning/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Warning A5A0 Safe torque off and fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>3</td></tr>
<tr><td>31.23</td><td>Cross connection</td><td>Selects how the drive reacts to incorrect input power and motor cable connection (ie. input power cable is connected to drive motor connection).</td><td>Fault</td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 3181 Cross connection.</td><td>1</td></tr>
<tr><td>31.24</td><td>Stall function</td><td>Selects how the drive reacts to a motor stall condition.
A stall condition is defined as follows:
• The drive exceeds the stall current limit (31.25 Stall current limit), and
• the output frequency is below the level set by parameter 31.27 Stall frequency limit or the motor speed is below the level set by parameter 31.26 Stall speed limit, and
• the conditions above have been true longer than the time set by parameter 31.28 Stall time.</td><td>No action</td></tr>
<tr><td></td><td>No action</td><td>None (stall supervision disabled).</td><td>0</td></tr>
<tr><td></td><td>Warning</td><td>The drive generates an A780 Motor stall warning.</td><td>1</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 7121 Motor stall.</td><td>2</td></tr>
<tr><td>31.25</td><td>Stall current limit</td><td>Stall current limit in percent of the nominal current of the motor. See parameter 31.24 Stall function.</td><td>200.0%</td></tr>
<tr><td></td><td>0.0…1600.0%</td><td>Stall current limit.</td><td>-</td></tr>
<tr><td>31.26</td><td>Stall speed limit</td><td>Stall speed limit in rpm. See parameter 31.24 Stall function.</td><td>150.00 rpm</td></tr>
<tr><td></td><td>0.00…10000.00 rpm</td><td>Stall speed limit.</td><td>See par. 46.01</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
31.27	*Stall frequency limit*	Stall frequency limit. See parameter *31.24 Stall function*. **Note:** Setting the limit below 10 Hz is not recommended.	15.00 Hz
	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.	-
31.30	*Overspeed trip margin*	Defines, together with *30.11 Minimum speed* and *30.12 Maximum speed*, the maximum allowed speed of the motor (overspeed protection). If the speed (*24.02 Used speed feedback*) exceeds the speed limit defined by parameter *30.11* or *30.12* by more than the value of this parameter, the drive trips on the *7310 Overspeed* fault. **WARNING!** This function only supervises the speed in vector motor control mode. The function is not effective in scalar motor control mode. **Example:** If the maximum speed is 1420 rpm and speed trip margin is 300 rpm, the drive trips at 1720 rpm. 	500.00 rpm
	0.00…10000.0 rpm	Overspeed trip margin.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
31.32	*Emergency ramp supervision*	Parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*, together with the derivative of *24.02 Used speed feedback*, provide a supervision function for emergency stop modes Off1 and Off3. The supervision is based on either • observing the time within which the motor stops, or • comparing the actual and expected deceleration rates. If this parameter is set to 0%, the maximum stop time is directly set in parameter *31.33*. Otherwise, *31.32* defines the maximum allowed deviation from the expected deceleration rate, which is calculated from parameters *23.11*…*23.15* (Off1) or *23.23 Emergency stop time* (Off3). If the actual deceleration rate (*24.02*) deviates too much from the expected rate, the drive trips on *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to 0% and *31.33* is set to 0 s, the emergency stop ramp supervision is disabled. See also parameter *21.04 Emergency stop mode*.	0%
	0…300%	Maximum deviation from expected deceleration rate.	1 = 1%
31.33	*Emergency ramp supervision delay*	If parameter *31.32 Emergency ramp supervision* is set to 0%, this parameter defines the maximum time an emergency stop (mode Off1 or Off3) is allowed to take. If the motor has not stopped when the time elapses, the drive trips on *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to a value other than 0%, this parameter defines a delay between the receipt of the emergency stop command and the activation of the supervision. It is recommended to specify a short delay to allow the speed change rate to stabilize.	0 s
	0…100 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
32 Supervision		Configuration of signal supervision functions 1…3. Three values can be chosen to be monitored; a warning or fault is generated whenever predefined limits are exceeded. See also section *Signal supervision* (page *220*).	
32.01	*Supervision status*	Signal supervision status word. Indicates whether the values monitored by the signal supervision functions are within or outside their respective limits. **Note:** This word is independent of the drive actions defined by parameters *32.06*, *32.16*, *32.26*, *32.36*, *32.46* and *32.56*.	000b

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
	000…111b	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
32.06	*Supervision 1 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 1 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	A warning (*A8B0 Signal supervision*) is generated.	1
	Fault	The drive trips on *80B0 Signal supervision*.	2

No.	Name/Value	Description	Def/FbEq16
32.07	*Supervision 1 signal*	Selects the signal to be monitored by signal supervision function 1.	*Zero*
	Zero	None.	0
	Speed	*01.01 Motor speed used* (page *229*).	1
	Frequency	*01.06 Output frequency* (page *229*).	3
	Current	*01.07 Motor current* (page *229*).	4
	Torque	*01.10 Motor torque* (page *229*).	6
	DC voltage	*01.11 DC voltage* (page *229*).	7
	Output power	*01.14 Output power* (page *230*).	8
	AI1	*12.11 AI1 actual value* (page *244*).	9
	AI2	*12.21 AI2 actual value* (page *245*).	10
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *282*).	18
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *282*).	19
	Speed ref used	*24.01 Used speed reference* (page *286*).	20
	Torque ref used	*26.02 Torque reference used* (page *291*).	21
	Freq ref used	*28.02 Frequency ref ramp output* (page *294*).	22
	Inverter temperature	*05.11 Inverter temperature* (page *233*).	23
	Process PID output	*40.01 Process PID output actual* (page *341*).	24
	Feedback act value	*40.02 Process PID feedback actual* (page *342*).	25
	Setpoint act value	*40.03 Process PID setpoint actual* (page *342*).	26
	Deviation act value	*40.04 Process PID deviation actual* (page *342*).	27
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
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
	-21474830.00… 21474830.00	Low limit.	-
32.10	*Supervision 1 high*	Defines the upper limit for signal supervision 1.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.11	*Supervision 1 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 1.	0.00
	0.00…100000.00	Hysteresis.	-
32.15	*Supervision 2 function*	Selects the mode of signal supervision function 2. Determines how the monitored signal (see parameter *32.17*) is compared to its 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

No.	Name/Value	Description	Def/FbEq16
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
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	A warning (*A8B0 Signal supervision*) is generated.	1
	Fault	The drive trips on *80B0 Signal supervision*.	2
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*.	*Zero*
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
	-21474830.00… 21474830.00	Low limit.	-
32.20	*Supervision 2 high*	Defines the upper limit for signal supervision 2.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.21	*Supervision 2 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 2.	0.00
	0.00…100000.00	Hysteresis.	-
32.25	*Supervision 3 function*	Selects the mode of signal supervision function 3. Determines how the monitored signal (see parameter *32.27*) is compared to its lower and upper limits (*32.29* and *32.30* respectively). The action to be taken when the condition is fulfilled is selected by *32.26*.	*Disabled*
	Disabled	Signal supervision 3 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5

No.	Name/Value	Description	Def/FbEq16
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
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	A warning (*A8B0 Signal supervision*) is generated.	1
	Fault	The drive trips on *80B0 Signal supervision*.	2
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*.	*Zero*
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
	-21474830.00… 21474830.00	Low limit.	-
32.30	*Supervision 3 high*	Defines the upper limit for signal supervision 3.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.31	*Supervision 3 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 3.	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

No.	Name/Value	Description	Def/FbEq16
32.36	*Supervision 4 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 4 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	A warning (*A8B0 Signal supervision*) is generated.	1
	Fault	The drive trips on *80B0 Signal supervision*.	2
32.37	*Supervision 4 signal*	Selects the signal to be monitored by signal supervision function 4. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.38	*Supervision 4 filter time*	Defines a filter time constant for the signal monitored by signal supervision 4.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.39	*Supervision 4 low*	Defines the lower limit for signal supervision 4.	0.00
	-21474830.00… 21474830.00	Low limit.	-
32.40	*Supervision 4 high*	Defines the upper limit for signal supervision 4.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.41	*Supervision 4 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 4.	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
32.46	*Supervision 5 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 5 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	A warning (*A8B0 Signal supervision*) is generated.	1

No.	Name/Value	Description	Def/FbEq16
	Fault	The drive trips on *80B0 Signal supervision*.	2
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
	-21474830.00… 21474830.00	Low limit.	-
32.50	*Supervision 5 high*	Defines the upper limit for signal supervision 5.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.51	*Supervision 5 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 5.	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
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	A warning (*A8B0 Signal supervision*) is generated.	1
	Fault	The drive trips on *80B0 Signal supervision*.	2
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*

No.	Name/Value	Description	Def/FbEq16
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
	-21474830.00… 21474830.00	Low limit.	-
32.60	*Supervision 6 high*	Defines the upper limit for signal supervision 6.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.61	*Supervision 6 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 6.	0.00
	0.00…100000.00	Hysteresis.	-

34 Timed functions		Configuration of the timed functions. See also section *Timed functions* (page *209*).	
34.01	*Combined timer 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	Combined timer 1	1 = Active.
1	Combined timer 2	1 = Active.
2	Combined timer 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

No.	Name/Value	Description	Def/FbEq16
34.04	*Season/exception day status*	Status of seasons 1…3, exception weekday and exception holiday. Only one season can be active at a time. A day can be a workday and a holiday at the same time. This parameter is read-only.	-

Bit	Name	Description
0	Status of season 1	1 = Active.
1	Status of season 2	1 = Active.
2	Status of season 3	1 = Active.
3	Status of season 4	1 = Active.
4…9	Reserved	
10	Status of exception weekday	1 = Active.
11	Status of exception holiday	1 = Active.
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status of the seasons and exception weekday and holiday.	1 = 1
34.10	*Timed functions enable*	Selects the source for the timed functions enable signal. 0 = Disabled. 1 = Enabled.	*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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-

No.	Name/Value	Description	Def/FbEq16
34.11	*Timer 1 configuration*	Defines when timer 1 is active.	0000011110000000

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	1 = Timer is active on exception days.
12	Holidays	0 = Timer is inactive on exception days configured as "Holiday". 1 = Timer is active on exception days configured as "Holiday".
13	Workdays	0 = Timer is inactive on exception days configured as "Workday". 1 = Timer is active on exception days configured as "Workday".
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Configuration of timer 1.	1 = 1
34.12	*Timer 1 start time*	Defines the daily start time of timer 1. The time can be changed in second steps. The timer can be started at an other time than the start time. E.g. if the timer's duration is more than one day and the active session starts during the time, the timer is started at 00:00 and stopped when there is no duration left.	00:00:00
	00:00:00…23:59:59	Daily start time of the timer.	1 = 1
34.13	*Timer 1 duration*	Defines the duration of timer 1. The duration can be changed in minute steps. The duration can extend over the change of the day but if an exception day becomes active, the period is interrupted at midnight. In the same way the period started on an exception day stays active only until the end of the day, even if the duration is longer. The timer will continue after a break if there is duration left.	00 00:00
	00 00:00…07 00:00	Timer duration.	1 = 1
34.14	*Timer 2 configuration*	See *34.11 Timer 1 configuration*.	0000011110000000
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*.	0000011110000000
34.18	*Timer 3 start time*	See *34.12 Timer 1 start time*.	00:00:00

No.	Name/Value	Description	Def/FbEq16
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*.	0000011110000000
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*.	0000011110000000
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*.	0000011110000000
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*.	0000011110000000
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*.	0000011110000000
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*.	0000011110000000
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*.	0000011110000000
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*.	0000011110000000
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*.	0000011110000000
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.

No.	Name/Value	Description	Def/FbEq16
	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.	-
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).	111111111111 111

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
	0…60	Length of exception period 1.	1 = 1
34.74	*Exception 2 start*	See *34.72 Exception 1 start*.	01.01.

No.	Name/Value	Description	Def/FbEq16
34.75	*Exception 2 length*	See *34.73 Exception 1 length*.	0
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
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
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	*Combined timer 1*	Defines which timers are connected to combined timer 1. 0 = Not connected. 1 = Connected. See *34.01 Combined timer status*.	0000000000 00000

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.
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Timers connected to combined timer 1.	1 = 1
34.101	*Combined timer 2*	Defines which timers are connected to combined timer 2. See *34.01 Combined timer status*.	0000000000 00000
34.102	*Combined timer 3*	Defines which timers are connected to combined timer 3. See *34.01 Combined timer status*.	0000000000 00000

No.	Name/Value	Description	Def/FbEq16
34.110	*Extra time function*	Defines which combined timers (that is, timers that are connected to the combined timers) are activated with the extra time function.	000

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Combined timers including the extra timer.	1 = 1
34.111	*Extra time activation source*	Selects the source of extra time activation signal. 0 = Disabled. 1 = Enabled.	*Off*
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
34.112	*Extra time duration*	Defines the time inside which the extra time is deactivated after extra time activation signal is switched off. **Example:** If parameter *34.111 Extra time activation source* is set to *DI1* and *34.112 Extra 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…00 00:00	Extra time duration.	1 = 1

35 Motor thermal protection		Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration. See also section *Motor thermal protection* (page *214*).	
35.01	*Motor estimated temperature*	Displays the motor temperature as estimated by the internal motor thermal protection model (see parameters *35.50*…*35.55*). The unit is selected by parameter *96.16 Unit selection*. This parameter is read-only.	-
	-60…1000 °C or -76…1832 °F	Estimated motor temperature.	1 = 1°
35.02	*Measured temperature 1*	Displays the temperature received through the source defined by parameter *35.11 Temperature 1 source*. The unit is selected by parameter *96.16 Unit selection*. This parameter is read-only.	-
	-10…1000 °C or 14…1832 °F	Measured temperature 1.	1 = 1 unit

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*. This parameter is read-only.	-
	-10…1000 °C or 14…1832 °F	Measured temperature 2.	1 = 1 unit
35.11	*Temperature 1 source*	Selects the source from which measured temperature 1 is read. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Estimated temperature*
	Disabled	None. Temperature monitoring function 1 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1
	KTY84 StdIO / Extension I/O module	KTY84 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	2
	PT100 x1 StdIO	Pt100 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	5
	PT100 x2 StdIO	As selection *PT100 x1 StdIO*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6

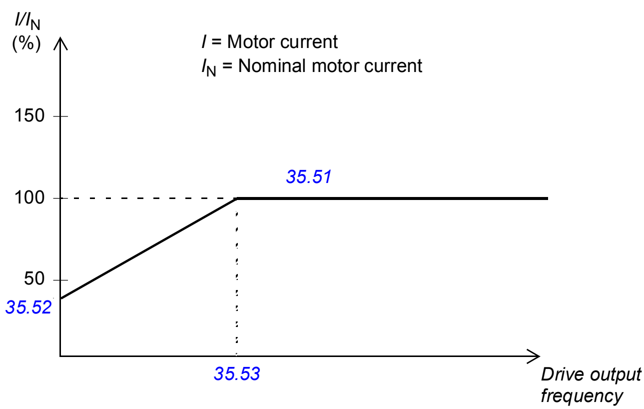
No.	Name/Value	Description	Def/FbEq16
	PT100 x3 StdIO	As selection *PT100 x1 StdIO*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7
	Direct AI temperature	The temperature is taken from the source selected by parameter *35.14 Temperature 1 AI source*. The value of the source is assumed to be degrees Celsius.	11
	KTY83 StdIO / Extension module	KTY83 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	12
	PT1000 x1 StdIO	Pt1000 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	13
	PT1000 x2 StdIO	As selection *PT1000 x1 StdIO*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	PT1000 x3 StdIO	As selection *PT1000 x1 StdIO*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15

No.	Name/Value	Description	Def/FbEq16
	NI1000	Ni1000 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	16
	PTC extension module	PTC is connected to the CMOD-02 multifunction extension module, which is installed in drive slot 2. See section *CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)* on page *576*.	17
35.14	*Temperature 1 AI source*	Selects the input for parameter *35.11 Temperature 1 source* selections *KTY84 StdIO / Extension I/O module*, *PT100 x1 StdIO*, *PT100 x2 StdIO*, *PT100 x3 StdIO*, *Direct AI temperature*, *KTY83 StdIO / Extension module*, *PT1000 x1 StdIO*, *PT1000 x2 StdIO*, *PT1000 x3 StdIO* and *NI1000*.	*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 *226*).	-
35.21	*Temperature 2 source*	Selects the source from which measured temperature 2 is read. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Disabled*
	Disabled	None. Temperature monitoring function 2 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1

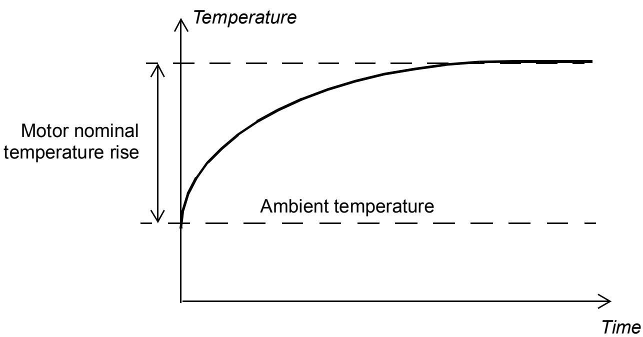
No.	Name/Value	Description	Def/FbEq16
	KTY84 StdIO / Extension I/O module	KTY84 sensor connected to the analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	2
	PT100 x1 StdIO	Pt100 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	5
	PT100 x2 StdIO	As selection *PT100 x1 StdIO*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	PT100 x3 StdIO	As selection *PT100 x1 StdIO*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7
	Direct AI 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

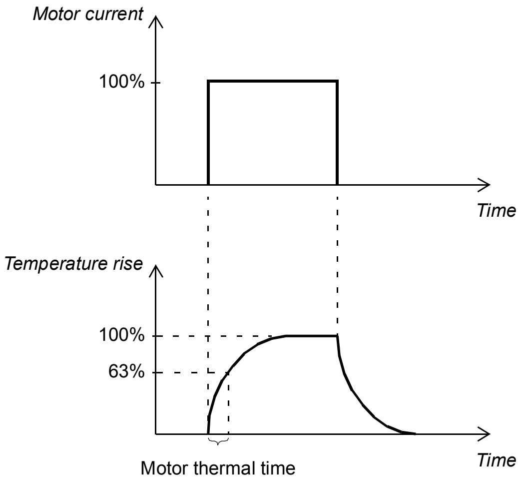
No.	Name/Value	Description	Def/FbEq16
	KTY83 StdIO / Extension module	KTY83 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	12
	PT1000 x1 StdIO	Pt1000 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	13
	PT1000 x2 StdIO	As selection *PT1000 x1 StdIO*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	PT1000 x3 StdIO	As selection *PT1000 x1 StdIO*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15
	NI1000	Ni1000 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	16

No.	Name/Value	Description	Def/FbEq16
	PTC extension module	PTC is connected to the CMOD-02 multifunction extension module, which is installed in drive slot 2. See section *CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)* on page *576*.	17
35.24	*Temperature 2 AI source*	Selects the input for parameter *35.21 Temperature 2 source* selections *KTY84 StdIO / Extension I/O module*, *PT100 x1 StdIO*, *PT100 x2 StdIO*, *PT100 x3 StdIO*, *Direct AI temperature*, *KTY83 StdIO / Extension module*, *PT1000 x1 StdIO*, *PT1000 x2 StdIO*, *PT1000 x3 StdIO* and *Ni1000*.	*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 *226*).	-
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 -75 … 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*.	100%



	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. See parameter *35.51 Motor load curve*.	100%
	50…150%	Zero speed load for the motor load curve.	1 = 1%
35.53	*Break point*	Defines the motor load curve together with parameters *35.51 Motor load curve* and *35.52 Zero speed load*. Defines the break point frequency of the load curve ie. the point at which the motor load curve begins to decrease from the value of parameter *35.51 Motor load curve* towards the value of parameter *35.52 Zero speed load*. See parameter *35.51 Motor load curve*.	45.00 Hz
	1.00…500.00 Hz	Break point for the motor load curve.	See par. *46.02*
35.54	*Motor nominal temperature rise*	Defines the temperature rise of the motor above ambient when the motor is loaded with nominal current. See the motor manufacturer's recommendations. The unit is selected by parameter *96.16 Unit selection*.  	80 °C or 176 °F
	0…300 °C or 32…572 °F	Temperature rise.	1 = 1°

No.	Name/Value	Description	Def/FbEq16
35.55	*Motor thermal time const*	Defines the thermal time constant for use with the motor thermal protection model, defined as the time to reach 63% of the nominal motor temperature. See the motor manufacturer's recommendations.  	256 s
	100…10000 s	Motor thermal time constant.	1 = 1 s

36 Load analyzer		Peak value and amplitude logger settings. See also section *Load analyzer* (page *220*).	
36.01	*PVL signal source*	Selects the signal to be monitored by the peak value logger. The signal is filtered using the filtering time specified by parameter *36.02 PVL filter time*. The peak value is stored, along with other pre-selected signals at the time, into parameters *36.10*…*36.15*. The peak value logger can be reset using parameter *36.09 Reset loggers*. The date and time of the last reset are stored into parameters *36.16* and *36.17* respectively.	*Output power*
	Not selected	None (peak value logger disabled).	0
	Motor speed used	*01.01 Motor speed used* (page *229*).	1
	Output frequency	*01.06 Output frequency* (page *229*).	3
	Motor current	*01.07 Motor current* (page *229*).	4
	Motor torque	*01.10 Motor torque* (page *229*).	6
	DC voltage	*01.11 DC voltage* (page *229*).	7
	Output power	*01.14 Output power* (page *230*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *282*).	10
	Speed ref ramped	*23.02 Speed ref ramp output* (page *282*).	11
	Speed ref used	*24.01 Used speed reference* (page *286*).	12
	Torque ref used	*26.02 Torque reference used* (page *291*).	13
	Freq ref used	*28.02 Frequency ref ramp output* (page *294*).	14

No.	Name/Value	Description	Def/FbEq16
	Process PID out	*40.01 Process PID output actual* (page *341*).	16
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
36.02	*PVL filter time*	Peak value logger filtering time. See parameter *36.01 PVL signal source*.	2.00 s
	0.00…120.00 s	Peak value logger filtering time.	100 = 1 s
36.06	*AL2 signal source*	Selects the signal to be monitored by amplitude logger 2. The signal is sampled at 200 ms intervals. The results are displayed by parameters *36.40*…*36.49*. Each parameter represents an amplitude range, and shows what portion of the samples fall within that range. The signal value corresponding to 100% is defined by parameter *36.07 AL2 signal scaling*. Amplitude logger 2 can be reset using parameter *36.09 Reset loggers*. The date and time of the last reset are stored into parameters *36.50* and *36.51* respectively. For the selections, see parameter *36.01 PVL signal source*.	*Motor torque*
36.07	*AL2 signal scaling*	Defines the signal value that corresponds to 100% amplitude.	100.00
	0.00…32767.00	Signal value corresponding to 100%.	1 = 1
36.09	*Reset loggers*	Resets the peak value logger and/or amplitude logger 2. (Amplitude logger 1 cannot be reset.)	*Done*
	Done	Reset completed or not requested (normal operation).	0
	All	Reset both the peak value logger and amplitude logger 2.	1
	PVL	Reset the peak value logger.	2
	AL2	Reset amplitude logger 2.	3
36.10	*PVL peak value*	Peak value recorded by the peak value logger.	0.00
	-32768.00… 32767.00	Peak value.	1 = 1
36.11	*PVL peak date*	The date on which the peak value was recorded.	01.01.1980
	-	Peak occurrence date.	-
36.12	*PVL peak time*	The time at which the peak value was recorded.	00:00:00
	-	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… 30000 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.	00:00:00
	-	Last reset time of the peak value logger.	-

No.	Name/Value	Description	Def/FbEq16
36.20	*AL1 0 to 10%*	Percentage of samples recorded by amplitude logger 1 that fall between 0 and 10%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 0 and 10%.	1 = 1%
36.21	*AL1 10 to 20%*	Percentage of samples recorded by amplitude logger 1 that fall between 10 and 20%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 10 and 20%.	1 = 1%
36.22	*AL1 20 to 30%*	Percentage of samples recorded by amplitude logger 1 that fall between 20 and 30%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 20 and 30%.	1 = 1%
36.23	*AL1 30 to 40%*	Percentage of samples recorded by amplitude logger 1 that fall between 30 and 40%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 30 and 40%.	1 = 1%
36.24	*AL1 40 to 50%*	Percentage of samples recorded by amplitude logger 1 that fall between 40 and 50%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 40 and 50%.	1 = 1%
36.25	*AL1 50 to 60%*	Percentage of samples recorded by amplitude logger 1 that fall between 50 and 60%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 50 and 60%.	1 = 1%
36.26	*AL1 60 to 70%*	Percentage of samples recorded by amplitude logger 1 that fall between 60 and 70%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 60 and 70%.	1 = 1%
36.27	*AL1 70 to 80%*	Percentage of samples recorded by amplitude logger 1 that fall between 70 and 80%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 70 and 80%.	1 = 1%
36.28	*AL1 80 to 90%*	Percentage of samples recorded by amplitude logger 1 that fall between 80 and 90%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 80 and 90%.	1 = 1%
36.29	*AL1 over 90%*	Percentage of samples recorded by amplitude logger 1 that exceed 90%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples over 90%.	1 = 1%
36.40	*AL2 0 to 10%*	Percentage of samples recorded by amplitude logger 2 that fall between 0 and 10%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 0 and 10%.	1 = 1%
36.41	*AL2 10 to 20%*	Percentage of samples recorded by amplitude logger 2 that fall between 10 and 20%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 10 and 20%.	1 = 1%
36.42	*AL2 20 to 30%*	Percentage of samples recorded by amplitude logger 2 that fall between 20 and 30%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 20 and 30%.	1 = 1%
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%

No.	Name/Value	Description	Def/FbEq16
36.45	*AL2 50 to 60%*	Percentage of samples recorded by amplitude logger 2 that fall between 50 and 60%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 50 and 60%.	1 = 1%
36.46	*AL2 60 to 70%*	Percentage of samples recorded by amplitude logger 2 that fall between 60 and 70%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 60 and 70%.	1 = 1%
36.47	*AL2 70 to 80%*	Percentage of samples recorded by amplitude logger 2 that fall between 70 and 80%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 70 and 80%.	1 = 1%
36.48	*AL2 80 to 90%*	Percentage of samples recorded by amplitude logger 2 that fall between 80 and 90%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 80 and 90%.	1 = 1%
36.49	*AL2 over 90%*	Percentage of samples recorded by amplitude logger 2 that exceed 90%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples over 90%.	1 = 1%
36.50	*AL2 reset date*	The date on which amplitude logger 2 was last reset.	01.01.1980
	-	Last reset date of amplitude logger 2.	-
36.51	*AL2 reset time*	The time at which amplitude logger 2 was last reset.	00:00:00
	-	Last reset time of amplitude logger 2.	-

37 User load curve		Settings for user load curve. See also section *User load curve* (page *196*).	
37.01	*ULC output status word*	Displays the status of the monitored signal.	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…15	Reserved	

	0000h…FFFFh	Status of the monitored signal.	1 = 1
37.02	*ULC supervision signal*	Selects the signal to be supervised.	*Motor torque*
	Not selected	No signal selected. ULC disabled.	0
	Motor speed %	*01.03 Motor speed %* (page *229*).	1
	Motor current %	*01.08 Motor current % of motor nom* (page *229*).	2
	Motor torque	*01.10 Motor torque* (page *229*).	3
	Ouput power % of motor nom	*01.15 Output power % of motor nom* (page *230*).	4
	Ouput power % of drive nom	*01.16 Output power % of drive nom* (page *230*).	5
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
37.03	*ULC overload actions*	Selects an action taken if the signal stays over the overload curve for a defined time.	*Disabled*
	Disabled	No warnings or fault generated.	0

No.	Name/Value	Description	Def/FbEq16
	Warning	The drive generates an *A8C1 ULC overload warning* if the signal has been continuously over the overload curve for a time defined by parameter *37.41 ULC overload timer*.	1
	Fault	The drive generates an *8002 ULC overload fault* if the signal has been continuously over the overload curve for a time defined by parameter *37.41 ULC overload timer*.	2
	Warning/Fault	The drive generates an *A8C1 ULC overload warning* if the signal has been continuously over the overload curve for half of the time defined by parameter *37.41 ULC overload timer*. The drive generates an *8002 ULC overload fault* if the signal has been continuously over the overload curve for a time defined by parameter *37.41 ULC overload timer*.	3
37.04	*ULC underload actions*	Selects an action taken if the signal stays under the underload curve for a defined time.	*Disabled*
	Disabled	No warnings or fault generated.	0
	Warning	The drive generates an *A8C4 ULC underload warning* if the signal has been continuously under the underload curve for a time defined by parameter *37.42 ULC underload timer*.	1
	Fault	The drive generates an *8001 ULC underload fault* if the signal has been continuously under the underload curve for a time defined by parameter *37.42 ULC underload timer*.	2
	Warning/Fault	The drive generates an *A8C4 ULC underload warning* if the signal has been continuously under the underload curve for half of the time defined by parameter *37.42 ULC underload timer*. The drive generates an *8001 ULC underload fault* if the signal has been continuously under the underload curve for a time defined by parameter *37.42 ULC underload timer*.	3
37.11	*ULC speed table point 1*	Defines the first of the five speed points on the X-axis of the user load curve. The values of the parameters must satisfy: -30000.0 rpm ≤ *37.11 ULC speed table point 1* < *37.12 ULC speed table point 2* < *37.13 ULC speed table point 3* < *37.14 ULC speed table point 4* < *37.15 ULC speed table point 5* ≤ 30000.0 rpm. Speed points are used if parameter *99.04 Motor control mode* is set to *Vector* or if *99.04 Motor control mode* is set to *Scalar* and the reference unit is rpm.	150.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.12	*ULC speed table point 2*	Defines the second speed point. See parameter *37.11 ULC speed table point 1*.	750.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.13	*ULC speed table point 3*	Defines the third speed point. See parameter *37.11 ULC speed table point 1*.	1290.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.14	*ULC speed table point 4*	Defines the fourth speed point. See parameter *37.11 ULC speed table point 1*.	1500.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
37.15	*ULC speed table point 5*	Defines the fifth speed point. See parameter *37.11 ULC speed table point 1*.	1800.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.16	*ULC frequency table point 1*	Defines the first of the five frequency points on the X-axis of the user load curve. The values of the parameters must satisfy: -500.0 Hz ≤ *37.16 ULC frequency table point 1* < *37.17 ULC frequency table point 2* < *37.18 ULC frequency table point 3* < *37.19 ULC frequency table point 4* < *37.20 ULC frequency table point 5* ≤ 500.0 Hz. Frequency points are used if parameter *99.04 Motor control mode* is set to *Scalar* and the reference unit is Hz.	5.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.17	*ULC frequency table point 2*	Defines the second frequency point. See parameter *37.16 ULC frequency table point 1*.	25.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.18	*ULC frequency table point 3*	Defines the third frequency point. See parameter *37.16 ULC frequency table point 1*.	43.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.19	*ULC frequency table point 4*	Defines the fourth frequency point. See parameter *37.16 ULC frequency table point 1*.	50.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.20	*ULC frequency table point 5*	Defines the fifth frequency point. See parameter *37.16 ULC frequency table point 1*.	60.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.21	*ULC underload point 1*	Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (*37.11 ULC speed table point 1*…*37.15 ULC speed table point 5* or *37.15 ULC speed table point 5*…*37.20 ULC frequency table point 5*) define the underload (lower) curve. The following conditions must be fulfilled: • *37.21 ULC underload point 1* <= *37.31 ULC overload point 1* • *37.22 ULC underload point 2* <= *37.32 ULC overload point 2* • *37.23 ULC underload point 3* <= *37.33 ULC overload point 3* • *37.24 ULC underload point 4* <= *37.34 ULC overload point 4* • *37.25 ULC underload point 5* <= *37.35 ULC overload point 5*	10.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.22	*ULC underload point 2*	Defines the second underload point. See parameter *37.21 ULC underload point 1*.	15.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.23	*ULC underload point 3*	Defines the third underload point. See parameter *37.21 ULC underload point 1*	25.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.24	*ULC underload point 4*	Defines the fourth underload point. See parameter *37.21 ULC underload point 1*	30.0%
	-1600.0…1600.0%	Underload point.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
37.25	*ULC underload point 5*	Defines the fifth underload point. See parameter *37.21 ULC underload point 1*	30.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.31	*ULC overload point 1*	Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (*37.11 ULC speed table point 1*…*37.15 ULC speed table point 5* or *37.15 ULC speed table point 5*…*37.20 ULC frequency table point 5*) define the overload (higher) curve. At each of the five points the value of the underload curve point must be equal to or smaller than the value of the overload curve point. See parameter *37.21 ULC underload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.32	*ULC overload point 2*	Defines the second overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.33	*ULC overload point 3*	Defines the third overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.34	*ULC overload point 4*	Defines the fourth overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.35	*ULC overload point 5*	Defines the fifth overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.41	*ULC overload timer*	Defines the time period for which time the monitored signal must remain continuously below the overload curve.	20.0 s
	0.0…10000.0 s	Time.	1 = 1 s
37.42	*ULC underload timer*	Defines the time period for which time the monitored signal must remain continuously above the underload curve.	20.0 s
	0.0…10000.0 s	Time.	1 = 1 s

40 Process PID set 1		Parameter values for process PID control. The drive output can be controlled by the process PID. When the process PID control is enabled, the drive controls the process feedback to the reference value. Two different parameter sets can be defined for the process PID. One parameter set is in use at a time. The first set is made up of parameters *40.07*…*40.50*, the second set is defined by the parameters in group *41 Process PID set 2*. The binary source that defines which set is used is selected by parameter *40.57 PID set1/set2 selection*. See also the control chain diagrams on pages *544* and *545*.	
40.01	*Process PID output actual*	Displays the output of the process PID controller. See the control chain diagram on page *545*. This parameter is read-only.	-
	-32768.00…32767.00	Process PID controller output.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
40.02	*Process PID feedback actual*	Displays the value of process feedback after source selection, mathematical function (parameter *40.10 Set 1 feedback function*), and filtering. See the control chain diagram on page *544*. This parameter is read-only..	-
	-32768.00…32767.00	Process feedback.	1 = 1 unit
40.03	*Process PID setpoint actual*	Displays the value of process PID setpoint after source selection, mathematical function (*40.18 Set 1 setpoint function*), limitation and ramping. See the control chain diagram on page *545*. This parameter is read-only.	-
	-32768.00…32767.00	Setpoint for process PID controller.	1 = 1 unit
40.04	*Process PID deviation actual*	Displays the process PID deviation. By default, this value equals setpoint - feedback, but deviation can be inverted by parameter *40.31 Set 1 deviation inversion*. See the control chain diagram on page *545*. This parameter is read-only.	-
	-32768.00…32767.00	PID deviation.	1 = 1 unit
40.06	*Process PID status word*	Displays status information on process PID control. This parameter is read-only.	-

Bit	Name	Value
0	PID active	1 = Process PID control active.
1	Setpoint frozen	1 = Process PID setpoint frozen.
2	Output frozen	1 = Process PID controller output frozen.
3	PID sleep mode	1 = Sleep mode active.
4	Sleep boost	1 = Sleep boost active.
5	Reserved	
6	Tracking mode	1 = Tracking function active.
7	Output limit high	1 = PID output is being limited by par. *40.37*.
8	Output limit low	1 = PID output is being limited by par. *40.36*.
9	Reserved	
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*…*40.16*)
13…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Process PID control status word.	1 = 1
40.07	*Process PID operation mode*	Activates/deactivates process PID control. **Note:** Process PID control is only available in external control; see section *Local control vs. external control* (page *180*).	*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

No.	Name/Value	Description	Def/FbEq16
40.08	*Set 1 feedback 1 source*	Selects the primary source of process feedback. See the control chain diagram on page *544*.	*AI1 scaled*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *244*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *245*).	2
	Freq in scaled	*11.39 Freq in 1 scaled value* (see page *241*).	3
	EFB ref	Embedded fieldbus reference	4
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
40.09	*Set 1 feedback 2 source*	Selects the second source of process feedback. The second source is used only if the setpoint function requires two inputs. For the selections, see parameter *40.08 Set 1 feedback 1 source*.	*Not selected*
40.10	*Set 1 feedback function*	Defines how process feedback is calculated from the two feedback sources selected by parameters *40.08 Set 1 feedback 1 source* and *40.09 Set 1 feedback 2 source*.	*In1*
	In1	Source 1.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3
	In1/In2	Source 1 divided by source 2.	4
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6
	AVE(In1,In2)	Average of the two sources.	7
	sqrt(In1)	Square root of source 1.	8
	sqrt(In1-In2)	Square root of (source 1 - source 2).	9
	sqrt(In1+In2)	Square root of (source 1 + source 2).	10
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
40.11	*Set 1 feedback filter time*	Defines the filter time constant for process feedback.	0.000 s
	0.000…30.000 s	Feedback filter time.	1 = 1 s
40.16	*Set 1 setpoint 1 source*	Selects the primary source of process PID setpoint. See the control chain diagram on page *544*.	*AI1 scaled*
	Not selected	None.	0
	Internal setpoint	Internal setpoint. See parameter *40.19 Set 1 internal setpoint sel1*.	2
	Control panel	*03.01 Panel reference* (see page *231*).	1
	AI1 scaled	*12.12 AI1 scaled value* (see page *244*).	3
	AI2 scaled	*12.22 AI2 scaled value* (see page *245*).	4
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	8
	Freq in scaled	*11.39 Freq in 1 scaled value* (see page *241*).	10
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-

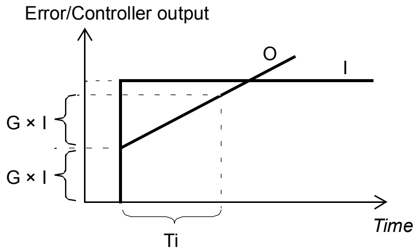
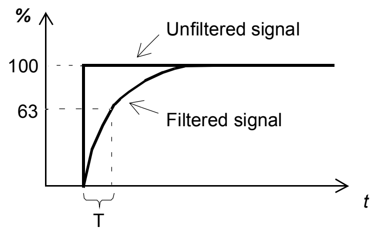
No.	Name/Value	Description	Def/FbEq16
40.17	*Set 1 setpoint 2 source*	Selects the second source of process setpoint. The second source is used only if the setpoint function requires two inputs. For the selections, see parameter *40.16 Set 1 setpoint 1 source*.	*Not selected*
40.18	*Set 1 setpoint function*	Selects a function between the setpoint sources selected by parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source*.	*In1*
	In1	Source 1.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3
	In1/In2	Source 1 divided by source 2.	4
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6
	AVE(In1,In2)	Average of the two sources.	7
	sqrt(In1)	Square root of source 1.	8
	sqrt(In1-In2)	Square root of (source 1 - source 2).	9
	sqrt(In1+In2)	Square root of (source 1 + source 2).	10
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
40.19	*Set 1 internal setpoint sel1*	Selects together with *40.20 Set 1 internal setpoint sel2* the internal setpoint out of the presets defined by parameters *40.21*…*40.23*. **Note:** Parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source* must be set to *Internal setpoint*.	*Not selected*

Source defined by par. *40.19*	Source defined by par. *40.20*	Setpoint preset active
0	0	Setpoint source
1	0	1 (par. ***40.21***)
0	1	2 (par. ***40.22***)
1	1	3 (par. ***40.23***)

No.	Name/Value	Description	Def/FbEq16
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	21

No.	Name/Value	Description	Def/FbEq16
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
40.20	*Set 1 internal setpoint sel2*	Selects together with *40.19 Set 1 internal setpoint sel1* the internal setpoint used out of the three internal setpoints defined by parameters *40.21*…*40.23*. See table at *40.19 Set 1 internal setpoint sel1*.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
40.21	*Set 1 internal setpoint 1*	Internal process setpoint 1. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00
	-32768.00… 32767.00	Internal process setpoint 1.	1 = 1 unit
40.22	*Set 1 internal setpoint 2*	Internal process setpoint 2. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00
	-32768.00… 32767.00	Internal process setpoint 2.	1 = 1 unit
40.23	*Set 1 internal setpoint 3*	Internal process setpoint 3. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00
	-32768.00… 32767.00	Internal process setpoint 3.	1 = 1 unit
40.26	*Set 1 setpoint min*	Defines a minimum limit for the process PID controller setpoint.	0.00
	-32768.00… 32767.00	Minimum limit for process PID controller setpoint.	1 = 1
40.27	*Set 1 setpoint max*	Defines a maximum limit for the process PID controller setpoint.	32767.00
	-32768.00… 32767.00	Maximum limit for process PID controller setpoint.	1 = 1
40.28	*Set 1 setpoint increase time*	Defines the minimum time it takes for the setpoint to increase from 0% to 100%.	0.0 s
	0.0…1800.0 s	Setpoint increase time.	1 = 1

No.	Name/Value	Description	Def/FbEq16
40.29	*Set 1 setpoint decrease time*	Defines the minimum time it takes for the setpoint to decrease from 100% to 0%.	0.0 s
	0.0…1800.0 s	Setpoint decrease time.	1 = 1
40.30	*Set 1 setpoint freeze enable*	Freezes, or defines a source that can be used to freeze, the setpoint of the process PID controller. This feature is useful when the reference is based on a process feedback connected to an analog input, and the sensor must be serviced without stopping the process. 1 = Process PID controller setpoint frozen See also parameter *40.38 Set 1 output freeze enable*.	*Not selected*
	Not selected	Process PID controller setpoint not frozen.	0
	Selected	Process PID controller setpoint frozen.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
40.31	*Set 1 deviation inversion*	Inverts the input of the process PID controller. 0 = Deviation not inverted (Deviation = Setpoint - Feedback) 1 = Deviation inverted (Deviation = Feedback - Setpoint) See also section *Sleep and boost functions for process PID control* (page *204*).	*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 *226*).	-
40.32	*Set 1 gain*	Defines the gain for the process PID controller. See parameter *40.33 Set 1 integration time*.	1.00
	0.10…100.00	Gain for PID controller.	100 = 1

No.	Name/Value	Description	Def/FbEq16
40.33	*Set 1 integration time*	Defines the integration time for the process PID controller. This time needs to be set to the same order of magnitude as the reaction time of the process being controlled, otherwise instability will result.  I = controller input (error) O = controller output G = gain Ti = integration time **Note:** Setting this value to 0 disables the “I” part, turning the PID controller into a PD controller.	60.0 s
	0.0…9999.0 s	Integration time.	1 = 1 s
40.34	*Set 1 derivation time*	Defines the derivation time of the process PID controller. The derivative component at the controller output is calculated on basis of two consecutive error values (E_{K-1} and E_K) according to the following formula: PID DERIV TIME × (E_K - E_{K-1})/T_S, in which T_S = 2 ms sample time E = Error = Process reference - process feedback.	0.000 s
	0.000…10.000 s	Derivation time.	1000 = 1 s
40.35	*Set 1 derivation filter time*	Defines the time constant of the 1-pole filter used to smooth the derivative component of the process PID controller.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.0 s
	0.0…10.0 s	Filter time constant.	10 = 1 s

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.	-32768.0
	-32768.0… 32767.0	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.	32767.0
	-32768.0… 32767.0	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
	Timed function 1	Bit 0 of 34.01 Combined timer status (see page 321).	18
	Timed function 2	Bit 1 of 34.01 Combined timer status (see page 321).	19
	Timed function 3	Bit 2 of 34.01 Combined timer status (see page 321).	20
	Supervision 1	Bit 0 of 32.01 Supervision status (see page 315).	21
	Supervision 2	Bit 1 of 32.01 Supervision status (see page 315).	22
	Supervision 3	Bit 2 of 32.01 Supervision status (see page 315).	23
	Other [bit]	Source selection (see Terms and abbreviations on page 226).	-
40.43	Set 1 sleep level	Defines the start limit for the sleep function. If the value is 0.0, set 1 sleep mode is disabled. The sleep function compares the motor speed to the value of this parameter. If the motor speed 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…32767.0	Sleep start level.	1 = 1
40.44	Set 1 sleep delay	Defines a delay before the sleep function actually becomes enabled, to prevent nuisance sleeping. The delay timer starts when the sleep mode is enabled by parameter 40.43 Set 1 sleep level, and resets when the sleep mode is disabled.	60.0 s
	0.0…3600.0 s	Sleep start delay.	1 = 1 s
40.45	Set 1 sleep boost time	Defines a boost time for the sleep boost step. See parameter 40.46 Set 1 sleep boost step.	0.0 s
	0.0…3600.0 s	Sleep boost time.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
40.46	*Set 1 sleep boost step*	When the drive is entering sleep mode, the process setpoint is increased by this percentage for the time defined by parameter *40.45 Set 1 sleep boost time*. If active, sleep boost is aborted when the drive wakes up.	0.0
	0.0…32767.0	Sleep boost step.	1 = 1 unit
40.47	*Set 1 wake-up deviation*	Defines the wake-up level as deviation between process setpoint and feedback. When the deviation exceeds the value of this parameter, and remains there for the duration of the wake-up delay (*40.48 Set 1 wake-up delay*), the drive wakes up. See also parameter *40.31 Set 1 deviation inversion*.	0.00
	-32768.00 … 32767.00 rpm, % or Hz	Wake-up level (as deviation between process setpoint and feedback).	1 = 1%
40.48	*Set 1 wake-up delay*	Defines a wake-up delay for the sleep function to prevent nuisance wake-ups. See parameter *40.47 Set 1 wake-up deviation*. The delay timer starts when the deviation exceeds the wake-up level (*40.47 Set 1 wake-up deviation*), and resets if the deviation falls below the wake-up level.	0.50 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 *205*). 1 = Tracking mode enabled	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	23
	Supervision 4	N/A	24
	Supervision 5	N/A	25
	Supervision 6	N/A	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
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

No.	Name/Value	Description	Def/FbEq16
	AI1 scaled	*12.12 AI1 scaled value* (see page *244*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *245*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *231*).	3
	FB A ref2	*03.06 FB A reference 2* (see page *231*).	4
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
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. 0 = Process PID parameter set 1 in use 1 = Process PID parameter set 2 in use	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	23
	Supervision 4	N/A	24
	Supervision 5	N/A	25
	Supervision 6	N/A	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
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 it's 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 it's 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
40.59	*Set 1 decrease prevention*	Prevention of PID integration term decrease for PID set 1.	*No*
	No	Decrease prevention not in use.	0

No.	Name/Value	Description	Def/FbEq16
	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 it's 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 it's 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
40.62	*PID internal setpoint actual*	Displays the value of the internal setpoint. See the control chain diagram on page *545*. This parameter is read-only.	-
	-32768.00…32767.00	Process PID internal setpoint.	1 = 1 unit
41 Process PID set 2		A second set of parameter values for process PID control. The selection between this set and first set (parameter group *40 Process PID set 1*) is made by parameter *40.57 PID set1/set2 selection*. See also parameters *40.01*…*40.06*, and the control chain diagrams on pages *544* and *545*.	
41.07	*Set 2 PID operation mode*	See parameter *40.07 Process PID operation mode*.	*Off*
41.08	*Set 2 feedback 1 source*	See parameter *40.08 Set 1 feedback 1 source*.	*AI1 scaled*
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
41.16	*Set 2 setpoint 1 source*	See parameter *40.16 Set 1 setpoint 1 source*.	*AI2 scaled*
41.17	*Set 2 setpoint 2 source*	See parameter *40.17 Set 1 setpoint 2 source*.	*Not selected*
41.18	*Set 2 setpoint function*	See parameter *40.18 Set 1 setpoint function*.	*In1*
41.19	*Set 2 internal setpoint sel1*	See parameter *40.19 Set 1 internal setpoint sel1*.	*Not selected*
41.20	*Set 2 internal setpoint sel2*	See parameter *40.20 Set 1 internal setpoint sel2*.	*Not selected*
41.21	*Set 2 internal setpoint 1*	See parameter *40.21 Set 1 internal setpoint 1*.	0.00
41.22	*Set 2 internal setpoint 2*	See parameter *40.22 Set 1 internal setpoint 2*.	0.00
41.23	*Set 2 internal setpoint 3*	See parameter *40.23 Set 1 internal setpoint 3*.	0.00
41.26	*Set 2 setpoint min*	See parameter *40.26 Set 1 setpoint min*.	0.00
41.27	*Set 2 setpoint max*	See parameter *40.27 Set 1 setpoint max*.	32767.00

No.	Name/Value	Description	Def/FbEq16
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*.	-32768.0
41.37	*Set 2 output max*	See parameter *40.37 Set 1 output max*.	32767.0
41.38	*Set 2 output freeze enable*	See parameter *40.38 Set 1 output freeze enable*.	*Not selected*
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
41.47	*Set 2 wake-up deviation*	See parameter *40.47 Set 1 wake-up deviation*.	0.00%
41.48	*Set 2 wake-up delay*	See parameter *40.48 Set 1 wake-up delay*.	0.50 s
41.49	*Set 2 tracking mode*	See parameter *40.49 Set 1 tracking mode*.	*Not selected*
41.50	*Set 2 tracking ref selection*	See parameter *40.50 Set 1 tracking ref selection*.	*Not selected*
41.58	*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*
41.62	*PID internal setpoint actual*	See parameter *40.62 PID internal setpoint actual*.	-

No.	Name/Value	Description	Def/FbEq16
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 temperature the resistor would reach if the maximum continuous braking power (*43.09 Brake resistor Pmax cont*) is applied to the resistor for 100% rated time. The thermal time constant (*43.08 Brake resistor thermal tc*) defines the rated time to achieve 63% temperature. 100% would be reached when 100% time has elapsed. This parameter is read-only.	-
	0.0…120.0%	Estimated brake resistor temperature.	1 = 1%
43.06	*Brake chopper enable*	Enables brake chopper control. **Note:** Before enabling brake chopper control, ensure that • a brake resistor is connected • overvoltage control is switched off (parameter *30.30 Overvoltage control*) • the supply voltage range (parameter *95.01 Supply voltage*) has been selected correctly.	*Disabled*
	Disabled	Brake chopper control disabled.	0
	Enabled with thermal model	Brake chopper control enabled with resistor overload protection.	1
	Enabled without thermal model	Brake chopper control enabled without resistor overload protection. This setting can be used, for example, if the resistor is equipped with a thermal circuit breaker that is wired to stop the drive if the resistor overheats.	2
43.07	*Brake chopper runtime enable*	Selects the source for quick brake chopper on/off control. 0 = Brake chopper IGBT pulses are cut off 1 = Normal brake chopper IGBT modulation. This parameter can be used to program the chopper control to function only when the supply is missing from a drive with a regenerative supply unit.	*On*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
43.08	*Brake resistor thermal tc*	Defines the thermal time constant of the brake resistor for overload protection.	0 s
	0…10000 s	Brake resistor thermal time constant.	1 = 1 s
43.09	*Brake resistor Pmax cont*	Defines the maximum continuous braking power of the resistor (in kW) which will raise the resistor temperature to the maximum allowed value. The value is used in the overload protection.	0.00 kW
	0.00… 10000.00 kW	Maximum continuous braking power.	1 = 1 kW
43.10	*Brake resistance*	Defines the resistance value of the brake resistor. The value is used for brake chopper protection.	0.0 ohm
	0.0…1000.0 ohm	Brake resistor resistance value.	1 = 1 ohm

No.	Name/Value	Description	Def/FbEq16
43.11	*Brake resistor fault limit*	Selects the fault limit for the brake resistor temperature protection function. When the limit is exceeded, the drive trips on fault *7183 BR excess temperature*. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*.	105%
	0…150%	Brake resistor temperature fault limit.	1 = 1%
43.12	*Brake resistor warning limit*	Selects the warning limit for the brake resistor temperature protection function. When the limit is exceeded, the drive generates a *A793 BR excess temperature* warning. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*.	95%
	0…150%	Brake resistor temperature warning limit.	1 = 1%
44 Mechanical brake control		Configuration of mechanical brake control. See also section *Mechanical brake control* (page *206*).	
44.01	*Brake control status*	Displays the mechanical brake control status word. This parameter is read-only.	-

Bit	Name	Information
0	Open command	Close/open command to brake actuator (0 = close, 1 = open). Connect this bit to desired output.
1	Opening torque request	1 = Opening torque requested from drive logic
2	Hold stopped request	1 = Hold requested from drive logic
3	Ramp to stopped	1 = Ramping down to zero speed requested from drive logic
4	Enabled	1 = Brake control is enabled
5	Closed	1 = Brake control logic in *BRAKE CLOSED* state
6	Opening	1 = Brake control logic in *BRAKE OPENING* state
7	Open	1 = Brake control logic in *BRAKE OPEN* state
8	Closing	1 = Brake control logic in *BRAKE CLOSING* state
9…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Mechanical brake control status word.	1 = 1
44.06	*Brake control enable*	Activates/deactivates (or selects a source that activates/deactivates) the mechanical brake control logic. 0 = Brake control inactive 1 = Brake control active	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Combined timer status* (see page *321*).	18

No.	Name/Value	Description	Def/FbEq16
	Timed function 2	Bit 1 of *34.01 Combined timer status* (see page *321*).	19
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	26
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	27
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	28
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
44.08	*Brake open delay*	Defines the brake open delay, ie. the delay between the internal open brake command and the release of motor speed control. The delay timer starts when the drive has magnetized the motor. Simultaneously with the timer start, the brake control logic energizes the brake control output and the brake starts to open. Set this parameter to the value of mechanical opening delay specified by the brake manufacturer.	0.00 s
	0.00…5.00 s	Brake open delay.	100 = 1 s
44.13	*Brake close delay*	Specifies a delay between a close command (that is, when the brake control output is de-energized) and when the drive stops modulating. This is to keep the motor live and under control until the brake actually closes. Set this parameter equal to the value specified by the brake manufacturer as the mechanical make-up time of the brake.	0.00 s
	0.00…60.00 s	Brake close delay.	100 = 1 s
44.14	*Brake close level*	Defines the brake close speed as an absolute value. After motor speed has decelerated to this level, a close command is given.	10.0 rpm
	0.0…1000.0 rpm	Brake close speed.	See par. *46.01*

45 Energy efficiency		Settings for the energy saving calculators. See also section *Energy saving calculators* (page *220*).	
45.01	*Saved GW hours*	Energy saved in GWh compared to direct-on-line motor connection. This parameter is incremented when *45.02 Saved MW hours* rolls over. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…65535 GWh	Energy savings in GWh.	1 = 1 GWh
45.02	*Saved MW hours*	Energy saved in MWh compared to direct-on-line motor connection. This parameter is incremented when *45.03 Saved kW hours* rolls over. When this parameter rolls over, parameter *45.01 Saved GW hours* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…999 MWh	Energy savings in MWh.	1 = 1 MWh

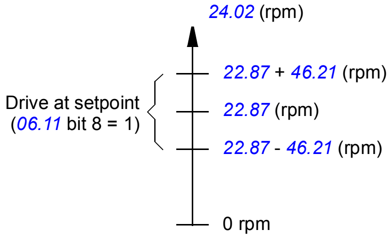
No.	Name/Value	Description	Def/FbEq16
45.03	*Saved kW hours*	Energy saved in kWh compared to direct-on-line motor connection. If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat, but the calculation still records savings made by controlling the speed. If the chopper is disabled, then regenerated energy from the motor is also recorded here. When this parameter rolls over, parameter *45.02 Saved MW hours* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…999.9 kWh	Energy savings in kWh.	10 = 1 kWh
45.04	*Saved energy*	Energy saved in kWh compared to direct-on-line motor connection. If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…214748364.7 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. The currency is defined by parameter *45.17 Tariff currency unit*. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…4294967295 thousands	Monetary savings in thousands of units.	1 = 1 unit
45.06	*Saved money*	Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*). When this parameter rolls over, parameter *45.05 Saved money x1000* is incremented. The currency is defined by parameter *45.17 Tariff currency unit*. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.00…999.99 units	Monetary savings.	1 = 1 unit
45.07	*Saved amount*	Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*). The currency is defined by parameter *45.17 Tariff currency unit*. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.00… 21474836.47 units	Monetary savings.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
45.08	*CO2 reduction in kilotons*	Reduction in CO_2 emissions in metric kilotons compared to direct-on-line motor connection. This value is incremented when parameter *45.09 CO2 reduction in tons* rolls over. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…65535 metric kilotons	Reduction in CO_2 emissions in metric kilotons.	1 = 1 metric kiloton
45.09	*CO2 reduction in tons*	Reduction in CO_2 emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh). When this parameter rolls over, parameter *45.08 CO2 reduction in kilotons* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…999.9 metric tons	Reduction in CO_2 emissions in metric tons.	1 = 1 metric ton
45.10	*Total saved CO2*	Reduction in CO_2 emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh). This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…214748364.7 metric tons	Reduction in CO_2 emissions in metric tons.	1 = 1 metric ton
45.11	*Energy optimizer*	Enables/disables the energy optimization function. The function optimizes the motor flux so that total energy consumption and motor noise level are reduced when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1…20% depending on load torque and speed. **Note:** With a permanent magnet motor, energy optimization is always enabled regardless of this parameter.	*Disable*
	Disable	Energy optimization disabled.	0
	Enable	Energy optimization enabled.	1
45.12	*Energy tariff 1*	Defines energy tariff 1 (price of energy per kWh). Depending on the setting of parameter *45.14 Tariff selection*, either this value or *45.13 Energy tariff 2* is used for reference when monetary savings are calculated. The currency is defined by parameter *45.17 Tariff currency unit*. **Note:** Tariffs are read only at the instant of selection, and are not applied retroactively.	0.100 units
	0.000… 4294967.295 units	Energy tariff 1.	-
45.13	*Energy tariff 2*	Defines energy tariff 2 (price of energy per kWh). See parameter *45.12 Energy tariff 1*.	0.200 units
	0.000… 4294967.295 units	Energy tariff 2.	-

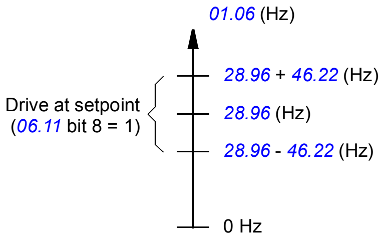
No.	Name/Value	Description	Def/FbEq16
45.14	*Tariff selection*	Selects (or defines a source that selects) which pre-defined energy tariff is used. 0 = *45.12 Energy tariff 1* 1 = *45.13 Energy tariff 2*	*Energy tariff 1*
	Energy tariff 1	0.	0
	Energy tariff 2	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
45.17	*Tariff currency unit*	Specifies the currency used for the savings calculations.	*EUR*
	Local currency	The currency is determined by the language selection (see parameter *96.01 Language*).	100
	EUR	Euro.	101
	USD	US dollar.	102
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
	0.000…65.535 tn/MWh	Factor for conversion of saved energy into CO_2 emissions.	1 = 1 tn/MWh
45.19	*Comparison power*	Actual power that the motor absorbs when connected direct-on-line and operating the application. The value is used for reference when energy savings are calculated. **Note:** The accuracy of the energy savings calculation is directly dependent on the accuracy of this value. If nothing is entered here, then the nominal motor power is used by the calculation, but that may inflate the energy savings reported as many motors do not absorb nameplate power.	0.00 kW
	0.00…100000.00 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

No.	Name/Value	Description	Def/FbEq16
46 Monitoring/scaling settings		Speed supervision settings; actual signal filtering; general scaling settings.	
46.01	*Speed scaling*	Defines the maximum speed value used to define the acceleration ramp rate and the initial speed value used to define the deceleration ramp rate (see parameter group *23 Speed reference ramp*). The speed acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.12 Maximum speed*). Also defines the 16-bit scaling of speed-related parameters. The value of this parameter corresponds to 20000 in eg. fieldbus communication.	1500.00 rpm
	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 in eg. fieldbus communication.	50.00 Hz
	0.10…1000.00 Hz	Acceleration/deceleration terminal/initial frequency.	10 = 1 Hz
46.03	*Torque scaling*	Defines the 16-bit scaling of torque parameters. The value of this parameter (in percent of nominal motor torque) corresponds to 10000 in eg. fieldbus communication.	100.0%
	0.1…1000.0%	Torque corresponding to 10000 on fieldbus.	10 = 1%
46.04	*Power scaling*	Defines the output power value that corresponds to 10000 in eg. fieldbus communication. The unit is selected by parameter *96.16 Unit selection*.	1000.0 kW or hp
	0.1…30000.0 kW or 0.1…40214.5 hp	Power corresponding to 10000 on fieldbus.	1 = 1 unit
46.05	*Current scaling*	Defines the 16-bit scaling of current parameters. The value of this parameter corresponds to 10000 in fieldbus communication.	10000 A
	0…30000 A		
46.11	*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

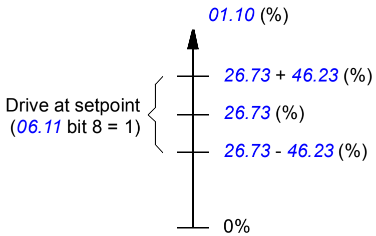
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>46.21</td><td>At speed hysteresis</td><td>Defines the “at setpoint” limits for speed control of the drive. When the difference between reference (22.87 Speed reference act 7) and the speed (24.02 Used speed 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.



</td><td>50.00 rpm</td></tr>
<tr><td></td><td>0.00…30000.00 rpm</td><td>Limit for “at setpoint” indication in speed control.</td><td>See par. 46.01</td></tr>
<tr><td>46.22</td><td>At frequency hysteresis</td><td>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.



</td><td>2.00 Hz</td></tr>
<tr><td></td><td>0.00…1000.00 Hz</td><td>Limit for “at setpoint” indication in frequency control.</td><td>See par. 46.02</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
46.23	*At torque hysteresis*	Defines the “at setpoint” limits for torque control of the drive. When the absolute difference between reference (*26.73 Torque reference act 4*) and actual torque (*01.10 Motor torque*) is smaller than *46.23 At torque hysteresis*, the drive is considered to be “at setpoint”. This is indicated by bit 8 of *06.11 Main status word*. 	5.0%
	0.0…300.0%	Limit for “at setpoint” indication in torque control.	See par. *46.03*
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.	0.00 rpm
	0.00…30000.00 rpm	“Above limit” indication trigger level for speed control.	See par. *46.01*
46.32	*Above frequency limit*	Defines the trigger level for “above limit” indication in frequency control. When actual frequency exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	0.00 Hz
	0.00…1000.00 Hz	“Above limit” indication trigger level for frequency control.	See par. *46.02*
46.33	*Above torque limit*	Defines the trigger level for “above limit” indication in torque control. When actual torque exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	0.0%
	0.0…1600.0%	“Above limit” indication trigger level for torque control.	See par. *46.03*
46.41	*kWh pulse scaling*	Defines the trigger level for the “kWh pulse” on for 50 ms. The output of the pulse is bit 9 of *05.22 Diagnostic word 3*.	1.000 kWh
	0.001… 1000.000 kWh	“kWh pulse” on trigger level.	1 = 1 kWh

47 Data storage		Data storage parameters that can be written to and read from using other parameters’ source and target settings. Note that there are different storage parameters for different data types. See also section *Data storage parameters* (page *223*).	
47.01	*Data storage 1 real32*	Data storage parameter 1.	0.000
	-2147483.008… 2147483.008	32-bit data.	-
47.02	*Data storage 2 real32*	Data storage parameter 2.	0.000
	-2147483.008… 2147483.008	32-bit data.	-

No.	Name/Value	Description	Def/FbEq16
47.03	*Data storage 3 real32*	Data storage parameter 3.	0.000
	-2147483.008… 2147483.008	32-bit data.	-
47.04	*Data storage 4 real32*	Data storage parameter 4.	0.000
	-2147483.008… 2147483.008	32-bit data.	-
47.11	*Data storage 1 int32*	Data storage parameter 9.	0
	-2147483648… 2147483647	32-bit data.	-
47.12	*Data storage 2 int32*	Data storage parameter 10.	0
	-2147483648… 2147483647	32-bit data.	-
47.13	*Data storage 3 int32*	Data storage parameter 11.	0
	-2147483648… 2147483647	32-bit data.	-
47.14	*Data storage 4 int32*	Data storage parameter 12.	0
	-2147483648… 2147483647	32-bit data.	-
47.21	*Data storage 1 int16*	Data storage parameter 17.	0
	-32768…32767	16-bit data.	1 = 1
47.22	*Data storage 2 int16*	Data storage parameter 18.	0
	-32768…32767	16-bit data.	1 = 1
47.23	*Data storage 3 int16*	Data storage parameter 19.	0
	-32768…32767	16-bit data.	1 = 1
47.24	*Data storage 4 int16*	Data storage parameter 20.	0
	-32768…32767	16-bit data.	1 = 1

49 Panel port communication		Communication settings for the control panel port on the drive.	
49.01	*Node ID number*	Defines the node ID of the drive. All devices connected to the network must have a unique node ID. **Note:** For networked drives, it is advisable to reserve ID 1 for spare/replacement drives.	1
	1…32	Node ID.	1 = 1
49.03	*Baud rate*	Defines the transfer rate of the link.	*115.2 kbps*
	9.6 kbps	9.6 kbit/s.	0
	38.4 kbps	38.4 kbit/s.	1
	57.6 kbps	57.6 kbit/s.	2

No.	Name/Value	Description	Def/FbEq16
	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
	0.1…3000.0 s	Panel/PC tool communication timeout.	10 = 1 s
49.05	*Communication loss action*	Selects how the drive reacts to a control panel (or PC tool) communication break.	*Fault*
	No action	No action taken.	0
	Fault	Drive trips on *7081 Control panel loss Programmable fault: 49.05 Communication loss action*.	1
	Last speed	Drive generates an *A7EE Panel loss* warning and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7EE Panel loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
49.06	*Refresh settings*	Applies the settings of parameters *49.01*…*49.05*. **Note:** Refreshing may cause a communication break, so reconnecting the drive may be required.	*Done*
	Done	Refresh done or not requested.	0
	Configure	Refresh parameters *49.01*…*49.05*. The value reverts automatically to *Done*.	1

50 Fieldbus adapter (FBA)		Fieldbus communication configuration. See also chapter *Fieldbus control through a fieldbus adapter* (page *467*).	
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
	Option slot 1	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 1.	1
50.02	*FBA A comm loss func*	Selects how the drive reacts upon a fieldbus communication break. The time delay is defined by parameter *50.03 FBA A comm loss t out*.	*No action*
	No action	No action taken.	0
	Fault	Communication break detection active. Upon a communication break, the drive trips on a *7510 FBA A communication* fault and coasts to a stop.	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Last speed</td><td>Communication break detection active. Upon a communication break, the drive generates a warning (A7C1 FBA A communication) and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering.
WARNING! Make sure that it is safe to continue operation in case of a communication break.</td><td>2</td></tr>
<tr><td></td><td>Speed ref safe</td><td>Communication break detection active. Upon a communication break, the drive generates a warning (A7C1 FBA A communication) and sets the speed to the value defined by parameter 22.41 Speed ref safe (or 28.41 Frequency ref safe when frequency reference is being used).
WARNING! Make sure that it is safe to continue operation in case of a communication break.</td><td>3</td></tr>
<tr><td>50.03</td><td>FBA A comm loss t out</td><td>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.</td><td>0.3 s</td></tr>
<tr><td></td><td>0.3…6553.5 s</td><td>Time delay.</td><td>1 = 1 s</td></tr>
<tr><td>50.04</td><td>FBA A ref1 type</td><td>Selects the type and scaling of reference 1 received from fieldbus adapter A. The scaling of the reference is defined by parameters 46.01…46.04, depending on which reference type is selected by this parameter.</td><td>Speed or frequency</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows:
<table>
<tr><th>Operation mode
(see par. 19.01)</th><th>Reference 1 type</th></tr>
<tr><td>Speed control</td><td>Speed</td></tr>
<tr><td>Torque control</td><td>Speed</td></tr>
<tr><td>Frequency control</td><td>Frequency</td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>The scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>The scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>50.05</td><td>FBA A ref2 type</td><td>Selects the type and scaling of reference 2 received from fieldbus adapter A. The scaling of the reference is defined by parameters 46.01…46.04, depending on which reference type is selected by this parameter.</td><td>Speed or frequency</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows:
<table>
<tr><th>Operation mode
(see par. 19.01)</th><th>Reference 2 type</th></tr>
<tr><td>Speed control</td><td>Torque</td></tr>
<tr><td>Torque control</td><td>Torque</td></tr>
<tr><td>Frequency control</td><td>Torque</td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>The scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Speed</td><td>The scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>50.06</td><td>FBA A SW sel</td><td>Selects the source of the Status word to be sent to the fieldbus network through fieldbus adapter A.</td><td>Auto</td></tr>
<tr><td></td><td>Auto</td><td>Source of the Status word is chosen automatically.</td><td>0</td></tr>
<tr><td></td><td>Transparent mode</td><td>The source selected by parameter 50.09 FBA A SW transparent source is transmitted as the Status word to the fieldbus network through fieldbus adapter A.</td><td>1</td></tr>
<tr><td>50.07</td><td>FBA A actual 1 type</td><td>Selects the type and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter A. The scaling of the value is defined by parameters 46.01…46.04, depending on which actual value type is selected by this parameter.</td><td>Speed or frequency</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows:
<table>
<tr><th>Operation mode
(see par. 19.01)</th><th>Actual value 1 type</th></tr>
<tr><td>Speed control</td><td>Speed</td></tr>
<tr><td>Torque control</td><td>Speed</td></tr>
<tr><td>Frequency control</td><td>Frequency</td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>The scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>The scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>50.08</td><td>FBA A actual 2 type</td><td>Selects the type and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter A. The scaling of the value is defined by parameters 46.01…46.04, depending on which actual value type is selected by this parameter.</td><td>Speed or frequency</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows:
<table>
<tr><th>Operation mode
(see par. 19.01)</th><th>Actual value 2 type</th></tr>
<tr><td>Speed control</td><td>Torque</td></tr>
<tr><td>Torque control</td><td>Torque</td></tr>
<tr><td>Frequency control</td><td>Torque</td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>The scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>The scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>50.09</td><td>FBA A SW transparent source</td><td>Selects the source of the fieldbus status word when parameter 50.06 FBA A SW sel is set to Transparent mode.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>No source selected.</td><td>-</td></tr>
<tr><td></td><td>Other</td><td>Source selection (see Terms and abbreviations on page 226).</td><td>-</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
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 *226*).	-
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 *226*).	-
50.12	*FBA A debug enable*	Enables the display of raw (unmodified) data received from and sent to fieldbus adapter A in parameters *50.13*…*50.18*. This functionality should only be used for debugging.	*Disable*
	Disable	Display of raw data from fieldbus adapter A disabled.	0
	Enable	Display of raw data from fieldbus adapter A enabled.	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 enable*. 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 enable*. 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 enable*. This parameter is read-only.	-
	-2147483648… 2147483647	Raw REF2 sent by master to fieldbus adapter A.	-
50.16	*FBA A status word*	Displays the raw (unmodified) status word sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug enable*. This parameter is read-only.	-
	00000000h… FFFFFFFFh	Status word sent by fieldbus adapter A to master.	-
50.17	*FBA A actual value 1*	Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug enable*. This parameter is read-only.	-
	-2147483648… 2147483647	Raw ACT1 sent by fieldbus adapter A to master.	-

No.	Name/Value	Description	Def/FbEq16
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 enable*. This parameter is read-only.	-
	-2147483648… 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. **0** = Module is not found or is not properly connected, or is disabled by parameter *50.01 FBA A enable*; **0** = None; **1** = PROFIBUS-DP; **32** = CANopen; **37** = DeviceNet; **128 =** Ethernet; **132** = PROFInet IO; **135** = EtherCAT; **136** = ETH Pwrlink; **485** = RS-485 comm; **101** = ControlNet; 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…65535	Fieldbus adapter configuration parameter.	1 = 1
…	…	…	…
51.26	*FBA A Par26*	See parameter *51.02 FBA A Par2*.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
51.27	*FBA A par refresh*	Validates any changed fieldbus adapter module configuration settings. After refreshing, the value reverts automatically to *Done*. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Refreshing done.	0
	Configure	Refreshing.	1
51.28	*FBA A par table ver*	Displays the parameter table revision of the fieldbus adapter module mapping file (stored in the memory of the drive). In format axyz, where ax = major table revision number; yz = minor table revision number. This parameter is read-only.	-
		Parameter table revision of adapter module.	-
51.29	*FBA A drive type code*	Displays the drive type code in the fieldbus adapter module mapping file (stored in the memory of the drive). This parameter is read-only.	-
	0…65535	Drive type code stored in the mapping file.	1 = 1
51.30	*FBA A mapping file ver*	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. This parameter is read-only.	-
	0…65535	Mapping file revision.	1 = 1
51.31	*D2FBA A comm status*	Displays the status of the fieldbus adapter module communication.	*Not configured*
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2

No.	Name/Value	Description	Def/FbEq16
	Configuration error	Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times.	3
	Off-line	Fieldbus communication is off-line.	4
	On-line	Fieldbus communication is on-line, or fieldbus adapter has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Adapter is performing a hardware reset.	6
51.32	*FBA A comm SW ver*	Displays the common program revision of the adapter module in format axyz, where a = major revision number, xy = minor revision number, z = correction number or letter. Example: 190A = revision 1.90A.	
		Common program revision of adapter module.	-
51.33	*FBA A appl SW ver*	Displays the application program revision of the adapter module in format axyz, where a = major revision number, xy = minor revision number, z = correction number or letter. Example: 190A = revision 1.90A.	
		Application program version of adapter module.	-

52 FBA A data in		Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
52.01	*FBA A data in1*	Parameters *52.01*…*52.12* select data to be transferred from the drive to the fieldbus controller through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	SW 32bit	Status Word (32 bits)	14
	Act1 32bit	Actual value ACT1 (32 bits)	15
	Act2 32bit	Actual value ACT2 (32 bits)	16
	SW2 16bit	Status Word 2 (16 bits)	24

No.	Name/Value	Description	Def/FbEq16
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
…	…	…	…
52.12	*FBA A data in12*	See parameter *52.01 FBA A data in1*.	*None*
53 FBA A data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
53.01	*FBA A data out1*	Parameters *53.01*…*53.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
…	…	…	…
53.12	*FBA A data out12*	See parameter *53.01 FBA A data out1*.	*None*
58 Embedded fieldbus		Configuration of the embedded fieldbus (EFB) interface. See also chapter *Fieldbus control through the embedded fieldbus interface (EFB)* (page *441*).	
58.01	*Protocol enable*	Enables/disables the embedded fieldbus interface and selects the protocol to use.	*None*
	None	None (communication disabled).	0
	Modbus RTU	Embedded fieldbus interface is enabled and uses the Modbus RTU protocol.	1
58.02	*Protocol ID*	Displays the protocol ID and revision. This parameter is read-only.	-
		Protocol ID and revision.	1 = 1
58.03	*Node address*	Defines the node address of the drive on the fieldbus link. Values 1…247 are allowable. Two devices with the same address are not allowed on-line. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	1
	0…255	Node address (values 1…247 are allowed).	1 = 1
58.04	*Baud rate*	Selects the transfer rate of the fieldbus link. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*19.2 kbps*
	Autodetect	When using autodetect, the parity setting of the bus must be known and configured in parameter *58.05 Parity*. The bus is monitored for a period of time and the detected baud rate is written to the parameter.	0

No.	Name/Value	Description	Def/FbEq16
	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*	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*.	*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*…*58.35*) and takes changed EFB configuration settings in use. Reverts automatically to *Enabled*.	1
	Silent mode	Activates silent mode (no messages are transmitted). Silent mode can be terminated by activating the *Refresh settings* selection of this parameter.	2

No.	Name/Value	Description	Def/FbEq16
58.07	*Communication diagnostics*	Displays the status of the EFB communication. This parameter is read-only. Note that the name is only visible when the error is present (bit value is 1).	-

Bit	Name	Description
0	Init failed	1 = EFB initialization failed
1	Addr config err	1 = Node address not allowed by protocol
2	Silent mode	1 = Drive not allowed to transmit
		0 = Drive allowed to transmit
3	Autodetect	1 = Autodetect in progress: EFB is trying to determine the baud rate
4	Wiring error	1 = Errors detected (A/B wires possibly swapped)
5	Parity error	1 = Error detected: check parameters *58.04* and *58.05*
6	Baud rate error	1 = Error detected: check parameters *58.05* and *58.04*
7	No bus activity	1 = 0 bytes received during last 5 seconds
8	No packets	1 = 0 packets (addressed to any device) detected during last 5 seconds
9	Noise or addressing error	1 = Errors detected (interference, or another device with the same address on line)
10	Comm loss	1 = 0 packets addressed to the drive received within timeout (*58.16*)
11	CW/Ref loss	1 = No control word or references received within timeout (*58.16*)
12	Not active	Reserved
13…14	Reserved	
15	Internal error	1 = Problem with calls to drive control program

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	EFB communication status.	1 = 1
58.08	*Received packets*	Displays a count of valid packets addressed to the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of received packets addressed to the drive.	1 = 1
58.09	*Transmitted packets*	Displays a count of valid packets transmitted by the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of transmitted packets.	1 = 1
58.10	*All packets*	Displays a count of valid packets addressed to any device on the bus. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of all received packets.	1 = 1
58.11	*UART errors*	Displays a count of character errors received by the drive. An increasing count indicates a configuration problem on the bus. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of UART errors.	1 = 1

No.	Name/Value	Description	Def/FbEq16
58.12	*CRC errors*	Displays a count of packets with a CRC error received by the drive. An increasing count indicates interference on the bus. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of CRC errors.	1 = 1
58.14	*Communication loss action*	Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*. See also parameters *58.15 Communication loss mode* and *58.16 Communication loss time*.	*No*
	No	No action taken (monitoring disabled).	0
	Fault	Drive trips on *6681 EFB comm loss*. This occurs only if control is expected from the EFB.	1
	Last speed	Drive generates an *A7CE EFB comm loss* warning and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. This occurs only if control is expected from the EFB. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7CE EFB comm loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). This occurs only if control is expected from the EFB. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on *6681 EFB comm loss*. This occurs even though no control is expected from the EFB.	4
58.15	*Communication loss mode*	Defines which message types reset the timeout counter for detecting an EFB communication loss. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*. See also parameters *58.14 Communication loss action* and *58.16 Communication loss time*.	*None*
	None	None.	0
	Any message	Any message addressed to the drive resets the timeout.	1
	Cw / Ref1 / Ref2	A write of the control word or a reference resets the timeout.	2
58.16	*Communication loss time*	Sets a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified by parameter *58.14 Communication loss action* is taken. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*. See also parameter *58.15 Communication loss mode*.	30.0 s
	0.0…6000.0 s	EFB communication timeout.	1 = 1

No.	Name/Value	Description	Def/FbEq16
58.17	*Transmit delay*	Defines a minimum response delay in addition to any fixed delay imposed by the protocol. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	0 ms
	0…65535 ms	Minimum response delay.	1 = 1
58.18	*Internal 1*	Displays the raw (unmodified) control word for debugging purposes. This parameter is read-only.	-
	0000h…FFFFh	Control word.	1 = 1
58.19	*Internal 2*	Displays the raw (unmodified) status word for debugging purposes. This parameter is read-only.	-
	0000h…FFFFh	Status word.	1 = 1
58.25	*Control profile*	Defines the communication profile used by the protocol. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*ABB Drives*
	ABB Drives	ABB Drives control profile (with a 16-bit control word)	0
	DCU Profile	DCU control profile (16 or 32-bit control word)	5
58.26	*EFB ref1 type*	Selects the type of reference 1.	*Speed or frequency*
	Speed or frequency	Type and scaling is chosen automatically according to the currently active operation mode as follows. <table><tr><th>Operation mode (see par. *19.01*)</th><th>Reference 1 type</th></tr><tr><td>Speed control</td><td>*Speed*</td></tr><tr><td>Torque control</td><td>*Speed*</td></tr><tr><td>Frequency control</td><td>*Frequency*</td></tr></table>	0
	Transparent	No scaling is applied.	1
	General	Generic reference without a specific unit.	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*	Selects the type of reference 2. For the selections, see parameter *58.26 EFB ref1 type*.	*Speed or frequency*
58.28	*EFB act1 type*	Selects the type of actual value 1. For the selections, see parameter *58.26 EFB ref1 type*.	*Speed or frequency*
58.29	*EFB act2 type*	Selects the type of actual value 2. For the selections, see parameter *58.26 EFB ref1 type*.	*Speed or frequency*
58.31	*EFB act1 transparent source*	Selects the source of actual value 1 when in transparent mode.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-

No.	Name/Value	Description	Def/FbEq16
58.32	*EFB act2 transparent source*	Selects the source of actual value 1 when in transparent mode.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
58.33	*Addressing mode*	Defines the mapping between parameters and holding registers in the 100…65535 Modbus register range. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*Mode 0*
	Mode 0	16-bit values (groups 1…99, indexes 1…99): Register address = 400000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 2200 + 80 = 402280. 32-bit values (groups 1…99, indexes 1…99): Register address = 420000 + 200 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 420000 + 4400 + 160 = 424560.	0
	Mode 1	16-bit values (groups 1…255, indexes 1…255): Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712.	1
	Mode 2	32-bit values (groups 1…127, indexes 1…255): Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 11264 + 160 = 411424.	2
	Mode 3	32-bit values (groups 1…255, indexes 1…127): Register address = 400000 + 256 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 160 = 405792.	3
	Mode 4	32-bit values (groups 128…254, indexes 1…255): Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 122.80 would be mapped to register 400000 + 62464 + 160 = 462624.	4
	Mode 5	32-bit values (groups 1…255, indexes 128…254): Register address = 400000 + 256 × parameter group + 2 × parameter index. For example, parameter 22.180 would be mapped to register 400000 + 5632 + 360 = 405992.	5
58.34	*Word order*	Selects in which order 16-bit registers of 32-bit parameters are transferred. For each register, the first byte contains the high order byte and the second byte contains the low order byte. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*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

No.	Name/Value	Description	Def/FbEq16
58.35	*Return app error*	Specifies whether an exception is returned or not when writes fail at the application. In some systems, application layer errors (such as writing a register to a value out of the acceptable range of the parameter) should not return an exception.	*No*
	No	Application layer errors do not return an exception. This conforms to the Modbus protocol specification.	0
	Yes	Application layer errors return a 04 Slave Device Failure exception.	1
58.101	*Data I/O 1*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus I/O parameter 1. 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.	*CW 16bit*
	None	None	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	SW 32bit	Status Word (32 bits)	14
	Act1 32bit	Actual value ACT1 (32 bits)	15
	Act2 32bit	Actual value ACT2 (32 bits)	16
	CW2 16bit	Control Word 2 (16 bits)	21
	SW2 16bit	Status Word 2 (16 bits)	24
	Other	Source selection (see *Terms and abbreviations* on page *226*).	-
58.102	*Data I/O 2*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400002. For the selections, see parameter *58.101 Data I/O 1*.	*Ref1 16bit*
58.103	*Data I/O 3*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400003. For the selections, see parameter *58.101 Data I/O 1*.	*Ref2 16bit*
58.104	*Data I/O 4*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400004. For the selections, see parameter *58.101 Data I/O 1*.	*SW 16bit*
58.105	*Data I/O 5*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400005. For the selections, see parameter *58.101 Data I/O 1*.	*None*

No.	Name/Value	Description	Def/FbEq16
58.106	*Data I/O 6*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400006. For the selections, see parameter *58.101 Data I/O 1*.	*None*
58.107	*Data I/O 7*	Parameter selector for Modbus register address 400007. For the selections, see parameter *58.101 Data I/O 1*.	*None*
…	…	…	…
58.130	*Data I/O 30*	Parameter selector for Modbus register address 400030. For the selections, see parameter *58.101 Data I/O 1*.	*None*
58.131	*Data I/O 31*	Parameter selector for Modbus register address 400031. For the selections, see parameter *58.101 Data I/O 1*.	*CW 32bit*
58.132	*Data I/O 32*	Parameter selector for Modbus register address 400032. For the selections, see parameter *58.101 Data I/O 1*.	*None*
58.133	*Data I/O 33*	Parameter selector for Modbus register address 400033. For the selections, see parameter *58.101 Data I/O 1*.	*SW 32bit*
58.134	*Data I/O 34*	Parameter selector for Modbus register address 400034. For the selections, see parameter *58.101 Data I/O 1*.	*None*
…	…	…	…
58.140	*Data I/O 40*	Parameter selector for Modbus register address 400040. For the selections, see parameter *58.101 Data I/O 1*.	*None*

71 External PID1		Configuration of external PID.	
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. *40.37*.
8	Output limit low	1 = PID output is being limited by par. *40.36*.
9	Deadband active	1 = Deadband is active.
10…11	Reserved	
12	Internal setpoint active	1 = Internal setpoint active (see par. *40.16*…*40.16*)
13…15	Reserved	

	0000h…FFFFh	Process PID control status word.	1 = 1
71.07	*PID operation mode*	See parameter *40.07 Process PID operation mode*.	*Off*

No.	Name/Value	Description	Def/FbEq16
71.08	*Feedback 1 source*	See parameter *40.08 Set 1 feedback 1 source*.	*Not selected*
71.11	*Feedback filter time*	See parameter *40.11 Set 1 feedback filter time*.	0.000 s
71.14	*Set 1 setpoint scaling*	TBA	1500.00
71.15	*Set 1 output scaling*	TBA	1500.00
71.16	*Setpoint 1 source*	See parameter *40.16 Set 1 setpoint 1 source*.	*AI2 scaled*
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*.	32767.00
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*.	-32768.0
71.37	*Output max*	See parameter *40.37 Set 1 output max*.	32767.0
71.38	*Output freeze enable*	See parameter *40.38 Set 1 output freeze enable*.	*Not selected*
71.39	*Deadband range*	If the PID feedback is within dead band area defined by this parameter for the time period defined by parameter *71.40 Deadband delay*, the PID output is frozen.	0.0
71.40	*Deadband delay*	Defines the deadband delay for the deadband function. See parameter *71.39 Deadband range*.	0.0 s
71.58	*Increase prevention*	See parameter *40.58 Set 1 increase prevention*.	TBA
71.59	*Decrease prevention*	See parameter *40.59 Set 1 decrease prevention*.	TBA
71.62	*Internal setpoint actual*	See parameter *40.62 PID internal setpoint actual*.	-

No.	Name/Value	Description	Def/FbEq16
95 HW configuration		Various hardware-related settings.	
95.01	Supply voltage	Selects the supply voltage range. This parameter is used by the drive to determine the nominal voltage of the supply network. The parameter also affects the current ratings and the DC voltage control functions (trip and brake chopper activation limits) of the drive. **WARNING!** An incorrect setting may cause the motor to rush uncontrollably, or the brake chopper or resistor to overload. **Note:** The selections shown depend on the hardware of the drive. If only one voltage range is valid for the drive in question, it is selected by default.	Automatic / not selected
	Automatic / not selected	No voltage range selected. The drive will not start modulating before a range is selected, unless parameter 95.02 Adaptive voltage limits is set to Enable, in which case the drive estimates the supply voltage itself.	0
	200…240 V	200…240 V, available for ACS580-01-xxxx-2 drives	1
	380…415 V	380…415 V, available for ACS580-01-xxxx-4 drives	2
	440…480 V	440…480 V, available for ACS580-01-xxxx-4 drives	3
	575…600 V	575…600 V, available for ACS580-01-xxxx-6 drives	5
95.02	Adaptive voltage limits	Enables adaptive voltage limits. Adaptive voltage limits can be used if, for example, an IGBT supply unit is used to raise the DC voltage level. If the communication between the inverter and IGBT supply unit is active, the voltage limits are related to the DC voltage reference from the IGBT supply unit. Otherwise the limits are calculated based on the measured DC voltage at the end of the pre-charging sequence. This function is also useful if the AC supply voltage to the drive is high, as the warning levels are raised accordingly.	Enable
	Disable	Adaptive voltage limits disabled.	0
	Enable	Adaptive voltage limits enabled.	1
95.03	Estimated AC supply voltage	AC supply voltage estimated by calculating using DC voltage.	-
	0.0…1000.0 V	Voltage.	10 = 1 V
95.04	Control board supply	Specifies how the control board of the drive is powered.	Internal 24V
	Internal 24V	The drive control board is powered from the drive power unit it is connected to.	0
	External 24V	The drive control board is powered from an external power supply.	1

No.	Name/Value	Description	Def/FbEq16
95.20	*HW options word 1*	Specifies hardware-related options that require differentiated parameter defaults. This parameter is not affected by a parameter restore.	-

Bit	Name	Value
0	Supply ferquency 60 Hz	0 = 50 Hz. 1 = 60 Hz.
1…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Hardware options configuration word.	1 = 1
96 System		Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection.	
96.01	*Language*	Selects the language of the parameter interface and other displayed information when viewed on the control panel. **Notes:** • Not all languages listed below are necessarily supported. • This parameter does not affect the languages visible in the Drive composer PC tool. (Those are specified under **View – Settings – Drive default language**.)	-
	Not selected	None.	0
	English	English.	1033
	Deutsch	German.	1031
	Italiano	Italian.	1040
	Español	Spanish.	3082
	Nederlands	Dutch.	1043
	Français	French.	1036
	Suomi	Finnish.	1035
	Svenska	Swedish.	1053
	Russki	Russian.	1049
	Polski	Polish.	1045
	Türkçe	Turkish.	1055
	Chinese (Simplified, PRC)	Simplified Chinese.	2052
96.02	*Pass code*	Pass codes can be entered into this parameter to activate further access levels (for example additional parameters). Code 358 allows you to change the value of *96.50 Parameter lock* once.	0
	0…99999999	Pass code.	-
96.04	*Macro select*	Selects the control macro. See chapter *Control macros* (page *161*) for more information. After a selection is made, the parameter reverts automatically to *Done*.	*Done*
	Done	Macro selection complete; normal operation.	0
	ABB standard	Factory macro (see page *162*).	1
	Hand/Auto	Hand/Auto macro (see page *170*).	2

No.	Name/Value	Description	Def/FbEq16
	Hand/PID	Hand/PID macro (see page 172).	3
	3-wire	3-wire macro see page 164).	11
	Alternate	Alternate macro see page 166).	12
	Motor potentiometer	Motor potentiometer macro (see page 168).	13
	PID	PID macro (see page 174).	14
96.05	*Macro active*	Shows which control macro is currently selected. See chapter *Control macros* (page 161) for more information. To change the macro, use parameter *96.04 Macro select*.	*ABB standard*
	ABB standard	Factory macro (see page 162).	1
	Hand/Auto	Hand/Auto macro (see page 170).	2
	Hand/PID	Hand/PID macro (see page 172).	3
	3-wire	3-wire macro see page 164).	11
	Alternate	Alternate macro see page 166).	12
	Motor potentiometer	Motor potentiometer macro (see page 168).	13
	PID	PID macro (see page 174).	14
96.06	*Parameter restore*	Restores the original settings of the control program, ie. parameter default values. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Restoring is completed.	0
	Restore defaults	All editable parameter values are restored to default values, except • motor data and ID run results • I/O extension module settings • end user texts, such as customized warnings and faults (external faults and changed), and the drive name • control panel/PC communication settings • fieldbus adapter settings • control macro selection and the parameter defaults implemented by it • parameter *95.20 HW options word 1* and the differentiated defaults implemented by it.	8
	Clear all	All editable parameter values are restored to default values, except • end user texts, such as customized warnings and faults (external faults and changed), and the drive name • control panel/PC communication settingsfieldbus adapter settings. • control macro selection and the parameter defaults implemented by it • parameter *95.20 HW options word 1* and the differentiated defaults implemented by it. PC tool communication is interrupted during the restoring.	62

No.	Name/Value	Description	Def/FbEq16
96.07	*Parameter save manually*	Saves the valid parameter values to the permanent memory on the drive control unit to ensure that operation can continue after cycling the power. Save the parameters with this parameter • to store values sent from the fieldbus • when using external +24 V DC power supply to the control unit: to save parameter changes before you power down the control unit. The supply has a very short hold-up time when powered off. **Note:** A new parameter value is saved automatically when changed from the PC tool or control panel but not when altered through a fieldbus adapter connection.	*Done*
	Done	Save completed.	0
	Save	Save in progress.	1
96.08	*Control board boot*	Changing the value of this parameter to 1 reboots the control unit (without requiring a power off/on cycle of the complete drive module). The value reverts to 0 automatically.	0
	0…1	1 = Reboot the control unit.	1 = 1
96.10	*User set status*	Shows the status of the user parameter sets. This parameter is read-only. See also section *User parameter sets* (page *223*).	-
	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
	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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>96.11</td><td>User set save/load</td><td>Enables the saving and restoring of up to four custom sets of parameter settings.
The set that was in use before powering down the drive is in use after the next power-up.
Notes:
Some hardware configuration settings, such as I/O extension module, fieldbus and encoder configuration parameters (groups 14…16, 47, 50…58 and 92…93) are not included in user parameter sets.
Parameter changes made after loading a set are not automatically stored – they must be saved using this parameter.
This parameter cannot be changed while the drive is running</td><td>No action</td></tr>
<tr><td></td><td>No action</td><td>Load or save operation complete; normal operation.</td><td>0</td></tr>
<tr><td></td><td>User set I/O mode</td><td>Load user parameter set using parameters 96.12 User set I/O mode in1 and 96.13 User set I/O mode in2.</td><td>1</td></tr>
<tr><td></td><td>Load set 1</td><td>Load user parameter set 1.</td><td>2</td></tr>
<tr><td></td><td>Load set 2</td><td>Load user parameter set 2.</td><td>3</td></tr>
<tr><td></td><td>Load set 3</td><td>Load user parameter set 3.</td><td>4</td></tr>
<tr><td></td><td>Load set 4</td><td>Load user parameter set 4.</td><td>5</td></tr>
<tr><td></td><td>Save to set 1</td><td>Save user parameter set 1.</td><td>18</td></tr>
<tr><td></td><td>Save to set 2</td><td>Save user parameter set 2.</td><td>19</td></tr>
<tr><td></td><td>Save to set 3</td><td>Save user parameter set 3.</td><td>20</td></tr>
<tr><td></td><td>Save to set 4</td><td>Save user parameter set 4.</td><td>21</td></tr>
<tr><td>96.12</td><td>User set I/O mode in1</td><td>When parameter 96.11 User set save/load is set to User set I/O mode, selects the user parameter set together with parameter 96.13 User set I/O mode in2 as follows:
<table>
<tr><th>Status of source defined by par. 96.12</th><th>Status of source defined by par. 96.13</th><th>User parameter set selected</th></tr>
<tr><td>0</td><td>0</td><td>Set 1</td></tr>
<tr><td>1</td><td>0</td><td>Set 2</td></tr>
<tr><td>0</td><td>1</td><td>Set 3</td></tr>
<tr><td>1</td><td>1</td><td>Set 4</td></tr>
</table></td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of 34.01 Combined timer status (see page 321).</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of 34.01 Combined timer status (see page 321).</td><td>19</td></tr>
</table>

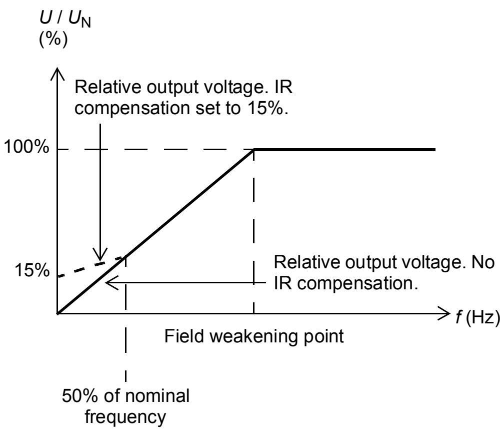
No.	Name/Value	Description	Def/FbEq16
	Timed function 3	Bit 2 of *34.01 Combined timer status* (see page *321*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *315*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *315*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *315*).	26
	Supervision 4	Bit 3 of *32.01 Supervision status* (see page *315*).	27
	Supervision 5	Bit 4 of *32.01 Supervision status* (see page *315*).	28
	Supervision 6	Bit 5 of *32.01 Supervision status* (see page *315*).	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *226*).	-
96.13	*User set I/O mode in2*	See parameter *96.12 User set I/O mode in1*.	*Not selected*
96.16	*Unit selection*	Selects the unit of parameters indicating power, temperature and torque.	00000b

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
96.50	*Parameter lock*	Selects the state of the parameter lock. The lock prevents parameter changing.**Note:** The parameter lock can be opened only after entering the correct pass code in parameter *96.02 Pass code*.	
	OPEN	Parameter values can be changed.	0
	LOCKED	Parameter values cannot be changed from the control panel or PC.	65535

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 does not heat too much. See section *Switching frequency* on page *201*. Higher switching frequency results in lower acoustic noise. In multimotor systems, do not change the switching frequency from the default value.	*4 kHz*
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
	12 kHz	12 kHz.	12
97.02	*Minimum switching frequency*	Lowest switching frequency that is allowed.	*2 kHz*
	1.5 kHz	1.5 kHz.	1
	2 kHz	2 kHz.	2
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
	12 kHz	12 kHz.	12
97.03	*Slip gain*	Defines the slip gain which is used to improve the estimated motor slip. 100% means full slip gain; 0% means no slip gain. The default value is 100%. Other values can be used if a static speed error is detected despite having the setting at full slip gain. **Example** (with nominal load and nominal slip of 40 rpm): A 1000 rpm constant speed reference is given to the drive. Despite having full slip gain (= 100%), a manual tachometer measurement from the motor axis gives a speed value of 998 rpm. The static speed error is 1000 rpm - 998 rpm = 2 rpm. To compensate the error, the slip gain should be increased to 105% (2 rpm / 40 rpm = 5%).	100%
	0…200%	Slip gain.	1 = 1%
97.04	*Voltage reserve*	Defines the minimum allowed voltage reserve. When the voltage reserve has decreased to the set value, the drive enters the field weakening area. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. If the intermediate circuit DC voltage U_{dc} = 550 V and the voltage reserve is 5%, the RMS value of the maximum output voltage in steady-state operation is 0.95 × 550 V / sqrt(2) = 369 V The dynamic performance of the motor control in the field weakening area can be improved by increasing the voltage reserve value, but the drive enters the field weakening area earlier.	-2%
	-4…50%	Voltage reserve.	1 = 1%
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

No.	Name/Value	Description	Def/FbEq16
	Moderate	Flux level is limited during the braking. Deceleration time is longer compared to full braking.	1
	Full	Maximum braking power. Almost all available current is used to convert the mechanical braking energy to thermal energy in the motor.	2
97.10	*Signal injection*	Enables the anti-cogging function: a high-frequency alternating signal is injected to the motor in the low speed region to improve the stability of torque control. This removes the “cogging” that can sometimes be seen as the rotor passes the motor magnetic poles. Anti-cogging can be enabled with different amplitude levels. **Notes:** • This is an expert level parameter and should not be adjusted without appropriate skill. • Use as low a level as possible that gives satisfactory performance. • Signal injection cannot be applied to asynchronous motors.	*Disabled*
	Disabled	Anti-cogging disabled.	0
	Enabled (5%)	Anti-cogging enabled with amplitude level of 5%.	1
	Enabled (10%)	Anti-cogging enabled with amplitude level of 10%.	2
	Enabled (15%)	Anti-cogging enabled with amplitude level of 15%.	3
	Enabled (20%)	Anti-cogging enabled with amplitude level of 20%.	4
97.11	*TR tuning*	Rotor time constant tuning. This parameter can be used to improve torque accuracy in closed-loop control of an induction motor. Normally, the motor identification run provides sufficient torque accuracy, but manual fine-tuning can be applied in exceptionally demanding applications to achieve optimal performance. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	100%
	25…400%	Rotor time constant tuning.	1 = 1%

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.  See also section *IR compensation for scalar motor control* on page *196*.	3.50%
	0.00…50.00%	Voltage boost at zero speed in percent of nominal motor voltage.	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.	*Squared*
	Linear	Linear ratio for constant torque applications.	0
	Squared	Squared ratio for centrifugal pump and fan applications. With squared U/f ratio the noise level is lower for most operating frequencies. Not recommended for permanent magnet motors.	1
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

No.	Name/Value	Description	Def/FbEq16
	Motor parameters	The values of parameters *98.02*… *98.12* are used as the motor model.	1
98.02	*Rs user*	Defines the stator resistance R_S of the motor model. With a star-connected motor, R_S is the resistance of one winding. With a delta-connected motor, R_S is one-third of the resistance of one winding.	0.00000 p.u.
	0.00000…0.50000 p.u.	Stator resistance in per unit.	-
98.03	*Rr user*	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000…0.50000 p.u.	Rotor resistance in per unit.	-
98.04	*Lm user*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000… 10.00000 p.u.	Main inductance in per unit.	-
98.05	*SigmaL user*	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000…1.00000 p.u.	Leakage inductance in per unit.	-
98.06	*Ld user*	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u	Direct axis inductance in per unit.	-
98.07	*Lq user*	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u	Quadrature axis inductance in per unit.	-
98.08	*PM flux user*	Defines the permanent magnet flux. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 2.00000 p.u	Permanent magnet flux in per unit.	-
98.09	*Rs user SI*	Defines the stator resistance R_S of the motor model.	0.00000 ohm
	0.00000… 100.00000 ohm	Stator resistance.	-
98.10	*Rr user SI*	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 ohm
	0.00000… 100.00000 ohm	Rotor resistance.	-
98.11	*Lm user SI*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00…100000.00 mH	Main inductance.	1 = 10000 mH

No.	Name/Value	Description	Def/FbEq16
98.12	*SigmaL user SI*	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00…100000.00 mH	Leakage inductance.	1 = 10000 mH
98.13	*Ld user SI*	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00 …100000.00 mH	Direct axis inductance.	1 = 10000 mH
98.14	*Lq user SI*	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00 …100000.00 mH	Quadrature axis inductance.	1 = 10000 mH

99 Motor data		Motor configuration settings.	
99.03	*Motor type*	Selects the motor type. **Note:** This parameter cannot be changed while the drive is running.	*Asynchro-nous 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.	1
99.04	*Motor control mode*	Selects the motor control mode.	*Scalar*
	Vector	Vector control. Vector control has better accuracy than scalar control but cannot be used in all situations (see selection *Scalar* below). Requires motor identification run (ID run). See parameter *99.13 ID run requested*. **Note:** In vector control the drive performs a standstill ID run at the first start if ID run has not been previously performed. A restart is required to get the drive operational. **Note:** To achieve a better motor control performance, you can perform a normal ID run without load. See also section *Operating modes of the drive* (page *183*).	0
	Scalar	Scalar control. Suitable for most applications, if top performance is not required. Motor identification run is not required. **Note:** Scalar control must be used in the following situations: • with multimotor applications 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification (ID run) • if the nominal current of the motor is less than 1/6 of the nominal output current of the drive • if the drive is used with no motor connected (for example, for test purposes). **Note:** Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the inverter. See also section *Speed control performance figures* (page *195*), and section *Operating modes of the drive* (page *183*).	1

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. **Notes:** • Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the drive. • This parameter cannot be changed while the drive is running.	0.0 A
	0.0…6400.0 A	Nominal current of the motor. The allowable range is 1/6…2 × I_N of the drive (0…2 × I_N with scalar control mode).	1 = 1 A
99.07	*Motor nominal voltage*	Defines the nominal motor voltage supplied to the motor. This setting must match the value on the rating plate of the motor. **Notes:** • With permanent magnet motors, the nominal voltage is the BackEMF voltage at nominal speed of the motor. If the voltage is given as voltage per rpm, e.g. 60 V per 1000 rpm, the voltage for a nominal speed of 3000 rpm is 3 × 60 V = 180 V. Note that the nominal voltage is not equal to the equivalent DC motor voltage (EDCM) specified by some motor manufacturers. The nominal voltage can be calculated by dividing the EDCM voltage by 1.7 (or square root of 3). • The stress on the motor insulation is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than that of the drive and the supply. • This parameter cannot be changed while the drive is running.	0.0 V
	0.0…800.0	Nominal voltage of the motor.	10 = 1 V
99.08	*Motor nominal frequency*	Defines the nominal motor frequency. This setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	50.0 Hz
	0.0…500.0 Hz	Nominal frequency of the motor.	10 = 1 Hz
99.09	*Motor nominal speed*	Defines the nominal motor speed. The setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	0 rpm
	0…30000 rpm	Nominal speed of the motor.	1 = 1 rpm
99.10	*Motor nominal power*	Defines the nominal motor power. The setting must match the value on the rating plate of the motor. If multiple motors are connected to the drive, enter the total power of the motors. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running.	0.00 kW or hp
	-10000.00… 10000.00 kW or -13404.83… 13404.83 hp	Nominal power of the motor.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
99.11	*Motor nominal cos phi*	Defines the cosphi of the motor for a more accurate motor model. (Not applicable to permanent magnet motors.) Not obligatory; if set, should match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	0.00
	0.00…1.00	Cosphi of the motor.	100 = 1
99.12	*Motor nominal torque*	Defines the nominal motor shaft torque for a more accurate motor model. Not obligatory. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running.	0.000 N·m or lb·ft
	0.000… N·m or lb·ft	Nominal motor torque.	1 = 100 unit
99.13	*ID run requested*	Selects the type of the motor identification routine (ID run) performed at the next start of the drive. During the ID run, the drive will identify the characteristics of the motor for optimum motor control. If no ID run has been performed yet (or if default parameter values have been restored using parameter *96.06 Parameter restore*), this parameter is automatically set to *Standstill*, signifying that an ID run must be performed. After the ID run, the drive stops and this parameter is automatically set to *None*. **Notes:** • For the *Advanced* ID run, the machinery must always be de-coupled from the motor. • With a permanent magnet or synchronous reluctance motor, a *Normal*, *Reduced* or *Standstill* ID run requires that the motor shaft is NOT locked and the load torque is less than 10%. • With scalar control mode (*99.04 Motor control mode* = *Scalar*), only the *Current measurement calibration* ID run mode is possible. • Once the ID run is activated, it can be cancelled by stopping the drive. • The ID run must be performed every time any of the motor parameters (*99.04*, *99.06*…*99.12*) have been changed. • Ensure that the Safe Torque Off and emergency stop circuits (if any) are closed during the ID run. • Mechanical brake (if present) is not opened by the logic for the ID run. • This parameter cannot be changed while the drive is running.	*None*
	None	No motor ID run is requested. This mode can be selected only if the ID run (*Normal*/*Reduced*/*Standstill*/*Advanced*) has already been performed once.	0

No.	Name/Value	Description	Def/FbEq16
	Normal	Normal ID run. Guarantees good control accuracy for all cases. The ID run takes about 90 seconds. This mode should be selected whenever it is possible. **Notes:** • If the load torque will be higher than 20% of motor nominal torque, or if the machinery is not able to withstand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run. • Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. ⚠ **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	1
	Reduced	Reduced ID run. This mode should be selected instead of the *Normal* or *Advanced* ID Run if • mechanical losses are higher than 20% (ie. the motor cannot be de-coupled from the driven equipment), or if • flux reduction is not allowed while the motor is running (ie. in case of a motor with an integrated brake supplied from the motor terminals). With this ID run mode, the resultant motor control in the field weakening area or at high torques is not necessarily as accurate as motor control following a Normal ID run. Reduced ID run is completed faster than the Normal ID Run (< 90 seconds). **Note:** Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. ⚠ **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	2
	Standstill	Standstill ID run. The motor is injected with DC current. With an AC induction (asynchronous) motor, the motor shaft is not rotated. With a permanent magnet motor, the shaft can rotate up to half a revolution. **Note:** This mode should be selected only if the *Normal*, *Reduced* or *Advanced* ID run is not possible due to the restrictions caused by the connected mechanics (e.g. with lift or crane applications).	3
	Current measurement calibration	Current offset and gain measurement calibration is set to calibrate the control loops. The calibration will be performed at next start. Only for frames R5…R9.	5

No.	Name/Value	Description	Def/FbEq16
	Advanced	Advanced ID run. Guarantees the best possible control accuracy. The ID run can take a couple of minutes. This mode should be selected when top performance is needed across the whole operating area. **Note:** The driven machinery must be de-coupled from the motor because of high torque and speed transients that are applied. **WARNING!** The motor may run at up to the maximum (positive) and minimum (negative) allowed speed during the ID run. Several accelerations and decelerations are done. The maximum torque, current and speed allowed by the limit parameters may be utilized. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	6
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
	Current measurement calibration	*Current measurement calibration*.	5
	Advanced	*Advanced* ID run.	6
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. **Notes:** • 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

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 *225*).

Terms and abbreviations

Term	Definition
Actual signal	Signal measured or calculated by the drive. Usually can only be monitored but not adjusted; some counter-type signals can however be reset.
Analog src	Analog source: the parameter can be set to the value of another parameter by choosing “Other”, and selecting the source parameter from a list. In addition to the “Other” selection, the parameter may offer other pre-selected settings.
Binary src	Binary source: the value of the parameter can be taken from a specific bit in another parameter value (“Other”). Sometimes the value can be fixed to 0 (false) or 1 (true). In addition, the parameter may offer other pre-selected settings.
Data	Data parameter
FbEq32	32-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 32-bit value is selected for transmission to an external system. The corresponding 16-bit scalings are listed in chapter *Parameters* (page *225*).

Term	Definition
List	Selection list.
No.	Parameter number.
PB	Packed Boolean (bit list).
Real	Real number.
Type	Parameter type. See *Analog src*, *Binary src*, *List*, *PB*, *Real*.

Fieldbus addresses

Refer to the *User's manual* of the fieldbus adapter.

Parameter groups 1…9

No.	Name	Type	Range	Unit	FbEq32
01 Actual values					
01.01	Motor speed used	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
01.02	Motor speed estimated	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
01.03	Motor speed %	*Real*	-1000.00…1000.00	%	100 = 1%
01.06	Output frequency	*Real*	-500.00…500.00	Hz	100 = 1 Hz
01.07	Motor current	*Real*	0.00…30000.00	A	100 = 1 A
01.08	Motor current % of motor nom	*Real*	0.0…1000.0	%	10 = 1%
01.09	Motor current % of drive nom	*Real*	0.0…1000.0	%	10 = 1%
01.10	Motor torque	*Real*	-1600.0…1600.0	%	10 = 1%
01.11	DC voltage	*Real*	0.00…2000.00	V	100 = 1 V
01.13	Output voltage	*Real*	0…2000	V	1 = 1 V
01.14	Output power	*Real*	-32768.00…32767.00	kW 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…999	MWh	1 = 1 MWh
01.20	Inverter kWh counter	*Real*	0…999	kWh	1 = 1 kWh
01.24	Flux actual %	*Real*	0…200	%	1 = 1%
01.30	Nominal torque scale	*Real*	0.000…	N·m or lb·ft	1000 = 1 unit
01.31	Ambient temperature	*Real*	-32768…32767	°C or °F	10 = 1°
01.50	Current hour kWh	*Real*	-21474836.48… 21474836.47	kWh	100 = 1 kWh
01.51	Previous hour kWh	*Real*	-21474836.48… 21474836.47	kWh	100 = 1 kWh
01.52	Current day kWh	*Real*	-21474836.48… 21474836.47	kWh	100 = 1 kWh
01.53	Previous day kWh	*Real*	-21474836.48… 21474836.47	kWh	100 = 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 % mot nom		0.00…300.00	%	100 = 1%
01.67	Abs output power % drive nom		0.00…300.00	%	100 = 1%
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
03.05	FB A reference 1	*Real*	-100000.00…100000.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
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
04.04	Active fault 4	*Data*	0000h…FFFFh	-	1 = 1
04.05	Active fault 5	*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
04.09	Active warning 4	*Data*	0000h…FFFFh	-	1 = 1
04.10	Active warning 5	*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
04.14	4th latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.15	5th 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
04.19	4th latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.20	5th latest warning	*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
05.04	Fan on-time counter	*Real*	0…65535	d	1 = 1 d
05.10	Control board temperature	*Real*	-32768.00…32767.00	°C or °F	10 = 1 °C
05.11	Inverter temperature	*Real*	-40.0…160.0	%	10 = 1%
05.22	Diagnostic word 3	*PB*	0000h…FFFFh	-	
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

No.	Name	Type	Range	Unit	FbEq32
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%

Parameter groups 10…99

No.	Name	Type	Range	Unit	FbEq32
10 Standard DI, RO					
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
10.21	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
10.101	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					
11.25	DI6 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*	1…16000	Hz	1 = 1 Hz
11.43	Freq in 1 max	*Real*	1…16000	Hz	1 = 1 Hz
11.44	Freq in 1 at scaled min	*Real*	-32768.000…32767.000	-	1000 = 1
11.45	Freq in 1 at scaled max	*Real*	-32768.000…32767.000	-	1000 = 1
12 Standard AI					
12.02	AI force selection	*PB*	0000h…FFFFh	-	1 = 1
12.03	AI supervision function	*List*	0…4	-	1 = 1
12.04	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
12.11	AI1 actual value	*Real*	4.000…20.000 mA or 0.000…10.000 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*	4.000…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

No.	Name	Type	Range	Unit	FbEq32
12.17	AI1 min	*Real*	4.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.18	AI1 max	*Real*	4.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.19	AI1 scaled at AI1 min	*Real*	-32768.000…32767.000	-	1000 = 1
12.20	AI1 scaled at AI1 max	*Real*	-32768.000…32767.000	-	1000 = 1
12.21	AI2 actual value	*Real*	4.000…20.000 mA or 0.000…10.000 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*	4.000…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*	4.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.28	AI2 max	*Real*	4.000…20.000 mA or 0.000…10.000 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
13 Standard AO					
13.02	AO force selection	*PB*	0000h…FFFFh	-	1 = 1
13.11	AO1 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
13.12	AO1 source	*Analog src*	-	-	1 = 1
13.13	AO1 forced value	*Real*	0.000…32767.000	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	mA	1000 = 1 mA
13.20	AO1 out at AO1 src max	*Real*	0.000…22.000	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
15 I/O extension module					
15.01	Extension module type	*List*	0…3	-	1 = 1
15.02	Detected extension module	*List*	0…3	-	1 = 1
15.03	DI status	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
15.04	RO/DO status	*PB*	0000h…FFFFh	-	1 = 1
15.05	RO/DO force selection	*PB*	0000h…FFFFh	-	1 = 1
15.06	RO/DO forced data	*PB*	0000h…FFFFh	-	1 = 1
15.07	RO4 source	*Binary src*	-	-	1 = 1
15.08	RO4 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.09	RO4 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.10	RO5 source	*Binary src*	-	-	1 = 1
15.11	RO5 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.12	RO5 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.22	DO1 configuration	*List*	0…1	-	1 = 1
15.23	DO1 source	*Binary src*	-	-	1 = 1
15.24	DO1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.25	DO1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.32	Freq out 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz
15.33	Freq out 1 source	*Analog src*	-	-	1 = 1
15.34	Freq out 1 src min	*Real*	-32768.0…32767.0	-	1000 = 1
15.35	Freq out 1 src max	*Real*	-32768.0…32767.0	-	1000 = 1
15.36	Freq out 1 at src min	*Real*	0…16000	Hz	1 = 1 Hz
15.37	Freq out 1 at src max	*Real*	0…16000	Hz	1 = 1 Hz
19 Operation mode					
19.01	Actual operation mode	*List*	1…6, 10…11, 20	-	1 = 1
19.11	Ext1/Ext2 selection	*Binary src*	-	-	1 = 1
19.12	Ext1 control mode	*List*	1…5	-	1 = 1
19.14	Ext2 control mode	*List*	1…5	-	1 = 1
19.16	Local control mode	*List*	0…1	-	1 = 1
19.17	Local control disable	*List*	0…1	-	1 = 1
20 Start/stop/direction					
20.01	Ext1 commands	*List*	0…6, 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

No.	Name	Type	Range	Unit	FbEq32
20.09	Ext2 in2 source	*Binary src*	-	-	1 = 1
20.10	Ext2 in3 source	*Binary src*	-	-	1 = 1
20.11	Run enable stop mode	*List*	0…2	-	1 = 1
20.12	Run enable 1 source	*Binary src*	-	-	1 = 1
20.19	Enable start command	*Binary src*	-	-	1 = 1
20.21	Direction	*List*	0…2	-	1 = 1
20.22	Enable to rotate	*Binary src*	-	-	1 = 1
20.25	Jogging enable	*Binary src*	-	-	1 = 1
20.26	Jogging 1 start source	*Binary src*	-	-	1 = 1
20.27	Jogging 2 start source	*Binary src*	-	-	1 = 1
21 Start/stop mode					
21.01	Vector start mode	*List*	0…2	-	1 = 1
21.02	Magnetization time	*Real*	0…10000	ms	1 = 1 ms
21.03	Stop mode	*List*	0…5	-	1 = 1
21.04	Emergency stop mode	*List*	0…3	-	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*	00b…11b	-	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
21.16	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…2	-	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
21.30	Speed comp stop delay	*Real*	0.00…1000.00	s	100 = 1 s
21.31	Speed comp stop threshold	*Real*	0…100	%	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

No.	Name	Type	Range	Unit	FbEq32
22.12	Ext1 speed ref2	*Analog src*	-	-	1 = 1
22.13	Ext1 speed function	*List*	0…5	-	1 = 1
22.18	Ext2 speed ref1	*Analog src*	-	-	1 = 1
22.19	Ext2 speed ref2	*Analog src*	-	-	1 = 1
22.20	Ext2 speed function	*List*	0…5	-	1 = 1
22.21	Constant speed function	*PB*	00b…11b	-	1 = 1
22.22	Constant speed sel1	*Binary src*	-	-	1 = 1
22.23	Constant speed sel2	*Binary src*	-	-	1 = 1
22.24	Constant speed sel3	*Binary src*	-	-	1 = 1
22.26	Constant speed 1	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.27	Constant speed 2	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.28	Constant speed 3	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.29	Constant speed 4	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.30	Constant speed 5	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.31	Constant speed 6	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.32	Constant speed 7	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.41	Speed ref safe	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.42	Jogging 1 ref	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.43	Jogging 2 ref	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.51	Critical speed function	*PB*	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

No.	Name	Type	Range	Unit	FbEq32
22.86	Speed reference act 6	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.87	Speed reference act 7	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
23 Speed reference ramp					
23.01	Speed ref ramp input	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
23.02	Speed ref ramp output	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
23.11	Ramp set selection	*Binary src*	-	-	1 = 1
23.12	Acceleration time 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.13	Deceleration time 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.14	Acceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.15	Deceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.20	Acc time jogging	*Real*	0.000 …1800.000	s	1000 = 1 s
23.21	Dec time jogging	*Real*	0.000 …1800.000	s	1000 = 1 s
23.23	Emergency stop time	*Real*	0.000 …1800.000	s	1000 = 1 s
23.28	Variable slope enable	*List*	0…1	-	1 = 1
23.29	Variable slope rate	*Real*	2…30000	ms	1 = 1 ms
23.32	Shape time 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.33	Shape time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
24 Speed reference conditioning					
24.01	Used speed reference	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
24.02	Used speed feedback	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
24.03	Speed error filtered	*Real*	-30000.0…30000.0	rpm	100 = 1 rpm
24.04	Speed error inverted	*Real*	-30000.0…30000.0	rpm	100 = 1 rpm
24.11	Speed correction	*Real*	-10000.00…10000.00	rpm	100 = 1 rpm
24.12	Speed error filter time	*Real*	0…10000	ms	1 = 1 ms
25 Speed control					
25.01	Torque reference speed control	*Real*	-1600.0…1600.0	%	10 = 1%
25.02	Speed proportional gain	*Real*	0.00…250.00	-	100 = 1
25.03	Speed integration time	*Real*	0.00…1000.00	s	100 = 1 s
25.04	Speed derivation time	*Real*	0.000…10.000	s	1000 = 1 s
25.05	Derivation filter time	*Real*	0…10000	ms	1 = 1 ms
25.06	Acc comp derivation time	*Real*	0.00…1000.00	s	100 = 1 s
25.07	Acc comp filter time	*Real*	0.0…1000.0	ms	10 = 1 ms
25.15	Proportional gain em stop	*Real*	1.00…250.00	-	100 = 1
25.53	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%
26 Torque reference chain					
26.01	Torque reference to TC	*Real*	-1600.0…1600.0	%	10 = 1%

No.	Name	Type	Range	Unit	FbEq32
26.02	Torque reference used	*Real*	-1600.0…1600.0	%	10 = 1%
26.08	Minimum torque ref	*Real*	-1000.0…0.0	%	10 = 1%
26.09	Maximum torque ref	*Real*	0.0…1000.0	%	10 = 1%
26.11	Torque ref1 source	*Analog src*	-	-	1 = 1
26.12	Torque ref2 source	*Analog src*	-	-	1 = 1
26.13	Torque ref1 function	*List*	0…5	-	1 = 1
26.14	Torque ref1/2 selection	*Binary src*	-	-	1 = 1
26.17	Torque ref filter time	*Real*	0.000…30.000	s	1000 = 1 s
26.18	Torque ramp up time	*Real*	0.000…60.000	s	1000 = 1 s
26.19	Torque ramp down time	*Real*	0.000…60.000	s	1000 = 1 s
26.21	Torque sel torque in	*Binary src*	-	-	1 = 1
26.22	Torque sel speed in	*Binary src*	-	-	1 = 1
26.70	Torque reference act 1	*Real*	-1600.0…1600.0	%	10 = 1%
26.71	Torque reference act 2	*Real*	-1600.0…1600.0	%	10 = 1%
26.72	Torque reference act 3	*Real*	-1600.0…1600.0	%	10 = 1%
26.73	Torque reference act 4	*Real*	-1600.0…1600.0	%	10 = 1%
26.74	Torque ref ramp out	*Real*	-1600.0…1600.0	%	10 = 1%
26.75	Torque reference act 5	*Real*	-1600.0…1600.0	%	10 = 1%
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
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

No.	Name	Type	Range	Unit	FbEq32
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
28.82	Shape time 1	*Real*	0.000…1800.000	s	1000 = 1 s
28.83	Shape time 2	*Real*	0.000…1800.000	s	1000 = 1 s
28.92	Frequency ref act 3	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.96	Frequency ref act 7	*Real*	-500.00…500.00	Hz	100 = 1 Hz
30 Limits					
30.01	Limit word 1	*PB*	0000h…FFFFh	-	1 = 1
30.02	Torque limit status	*PB*	0000h…FFFFh	-	1 = 1
30.11	Minimum speed	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
30.12	Maximum speed	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
30.13	Minimum frequency	*Real*	-500.00…500.00	Hz	100 = 1 Hz
30.14	Maximum frequency	*Real*	-500.00…500.00	Hz	100 = 1 Hz
30.17	Maximum current	*Real*	0.00…30000.00	A	100 = 1 A
30.18	Torq lim sel	*Binary src*	-	-	1 = 1
30.19	Minimum torque 1	*Real*	-1600.0…0.0	%	10 = 1%
30.20	Maximum torque 1	*Real*	0.0…1600.0	%	10 = 1%
30.21	Min torque 2 source	*Analog src*	-	-	1 = 1
30.22	Max torque 2 source	*Analog src*	-	-	1 = 1
30.23	Minimum torque 2	*Real*	-1600.0…0.0	%	10 = 1%
30.24	Maximum torque 2	*Real*	0.0…1600.0	%	10 = 1%

No.	Name	Type	Range	Unit	FbEq32
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
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…3	-	1 = 1
31.23	Cross connection	*List*	0…1	-	1 = 1
31.24	Stall function	*List*	0…2	-	1 = 1
31.25	Stall current limit	*Real*	0.0…1600.0	%	10 = 1%
31.26	Stall speed limit	*Real*	0.00…10000.00	rpm	100 = 1 rpm
31.27	Stall frequency limit	*Real*	0.00…1000.00	Hz	100 = 1 Hz
31.28	Stall time	*Real*	0…3600	s	1 = 1 s
31.30	Overspeed trip margin	*Real*	0.00…10000.00	rpm	100 = 1 rpm
31.32	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*	000…111b	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
32.05	Supervision 1 function	*List*	0…6	-	1 = 1
32.06	Supervision 1 action	*List*	0…2	-	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*	-21474830.00… 21474830.00	-	100 = 1
32.10	Supervision 1 high	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.11	Supervision 1 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.15	Supervision 2 function	*List*	0…6	-	1 = 1
32.16	Supervision 2 action	*List*	0…2	-	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*	-21474830.00… 21474830.00	-	100 = 1
32.20	Supervision 2 high	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.21	Supervision 2 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.25	Supervision 3 function	*List*	0…6	-	1 = 1
32.26	Supervision 3 action	*List*	0…2	-	1 = 1
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*	-21474830.00… 21474830.00	-	100 = 1
32.30	Supervision 3 high	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.31	Supervision 3 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.35	Supervision 4 function	*List*	0…6	-	1 = 1
32.36	Supervision 4 action	*List*	0…2	-	1 = 1
32.37	Supervision 4 signal	*Analog src*	-	-	1 = 1
32.38	Supervision 4 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.39	Supervision 4 low	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.40	Supervision 4 high	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.41	Supervision 4 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.45	Supervision 5 function	*List*	0…6	-	1 = 1
32.46	Supervision 5 action	*List*	0…2	-	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

No.	Name	Type	Range	Unit	FbEq32
32.49	Supervision 5 low	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.50	Supervision 5 high	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.51	Supervision 5 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.55	Supervision 6 function	*List*	0…6	-	1 = 1
32.56	Supervision 6 action	*List*	0…2	-	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*	-21474830.00… 21474830.00	-	100 = 1
32.60	Supervision 6 high	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.61	Supervision 6 hysteresis	*Real*	0.00…100000.00	-	100 = 1
34 Timed functions					
34.01	Combined timer status	*PB*	0000h…FFFFh	-	1 = 1
34.02	Timer status	*PB*	0000h…FFFFh	-	1 = 1
34.04	Season/exception day status	*PB*	0000h…FFFFh	-	1 = 1
34.10	Timed functions enable	*Binary src*	-	-	1 = 1
34.11	Timer 1 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.12	Timer 1 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.13	Timer 1 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.14	Timer 2 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.15	Timer 2 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.16	Timer 2 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.17	Timer 3 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.18	Timer 3 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.19	Timer 3 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.20	Timer 4 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.21	Timer 4 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.22	Timer 4 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.23	Timer 5 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.24	Timer 5 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.25	Timer 5 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.26	Timer 6 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.27	Timer 6 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.28	Timer 6 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.29	Timer 7 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.30	Timer 7 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.31	Timer 7 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.32	Timer 8 configuration	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
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
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	Combined timer 1	*PB*	0000h…FFFFh	-	1 = 1
34.101	Combined timer 2	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
34.102	Combined timer 3	*PB*	0000h…FFFFh	-	1 = 1
34.110	Extra time function	*PB*	0000h…FFFFh	-	1 = 1
34.111	Extra time activation source	*Binary src*	-	-	1 = 1
34.112	Extra 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*	-10…1000 °C or 14…1832 °F	°C, °F or ohm	1 = 1 unit
35.03	Measured temperature 2	*Real*	-10…1000 °C or 14…1832 °F	°C, °F or ohm	1 = 1 unit
35.11	Temperature 1 source	*List*	0…2, 5…7, 11…17	-	1 = 1
35.14	Temperature 1 AI source	*Analog src*	-	-	1 = 1
35.21	Temperature 2 source	*List*	0…2, 5…7, 11…17	-	1 = 1
35.24	Temperature 2 AI source	*Analog src*	-	-	1 = 1
35.50	Motor ambient temperature	*Real*	-60…100 °C or -75 … 212 °F	°C	1 = 1 °
35.51	Motor load curve	*Real*	50…150	%	1 = 1%
35.52	Zero speed load	*Real*	50…150	%	1 = 1%
35.53	Break point	*Real*	1.00 … 500.00	Hz	100 = 1 Hz
35.54	Motor nominal temperature rise	*Real*	0…300 °C or 32…572 °F	°C or °F	1 = 1°
35.55	Motor thermal time const	*Real*	100…10000	s	1 = 1 s
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… 30000	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%

No.	Name	Type	Range	Unit	FbEq32
36.22	AL1 20 to 30%	*Real*	0.00…100.00	%	100 = 1%
36.23	AL1 30 to 40%	*Real*	0.00…100.00	%	100 = 1%
36.24	AL1 40 to 50%	*Real*	0.00…100.00	%	100 = 1%
36.25	AL1 50 to 60%	*Real*	0.00…100.00	%	100 = 1%
36.26	AL1 60 to 70%	*Real*	0.00…100.00	%	100 = 1%
36.27	AL1 70 to 80%	*Real*	0.00…100.00	%	100 = 1%
36.28	AL1 80 to 90%	*Real*	0.00…100.00	%	100 = 1%
36.29	AL1 over 90%	*Real*	0.00…100.00	%	100 = 1%
36.40	AL2 0 to 10%	*Real*	0.00…100.00	%	100 = 1%
36.41	AL2 10 to 20%	*Real*	0.00…100.00	%	100 = 1%
36.42	AL2 20 to 30%	*Real*	0.00…100.00	%	100 = 1%
36.43	AL2 30 to 40%	*Real*	0.00…100.00	%	100 = 1%
36.44	AL2 40 to 50%	*Real*	0.00…100.00	%	100 = 1%
36.45	AL2 50 to 60%	*Real*	0.00…100.00	%	100 = 1%
36.46	AL2 60 to 70%	*Real*	0.00…100.00	%	100 = 1%
36.47	AL2 70 to 80%	*Real*	0.00…100.00	%	100 = 1%
36.48	AL2 80 to 90%	*Real*	0.00…100.00	%	100 = 1%
36.49	AL2 over 90%	*Real*	0.00…100.00	%	100 = 1%
36.50	AL2 reset date	*Data*	-	-	1 = 1
36.51	AL2 reset time	*Data*	-	-	1 = 1
37 User load curve					
37.01	ULC output status word	*PB*	0000h…FFFFh	-	1 = 1
37.02	ULC supervision signal	*Analog src*	-	-	1 = 1
37.03	ULC overload actions	*List*	0…3	-	1 = 1
37.04	ULC underload actions	*List*	0…3	-	1 = 1
37.11	ULC speed table point 1	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.12	ULC speed table point 2	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.13	ULC speed table point 3	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.14	ULC speed table point 4	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.15	ULC speed table point 5	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.16	ULC frequency table point 1	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.17	ULC frequency table point 2	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.18	ULC frequency table point 3	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.19	ULC frequency table point 4	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.20	ULC frequency table point 5	*Real*	-500.0…500.0	Hz	10 = 1 Hz
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%

No.	Name	Type	Range	Unit	FbEq32
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*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
40.02	Process PID feedback actual	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
40.03	Process PID setpoint actual	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
40.04	Process PID deviation actual	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
40.06	Process PID status word	*PB*	0000h…FFFFh	-	1 = 1
40.07	Process PID operation mode	*List*	0…2	-	1 = 1
40.08	Set 1 feedback 1 source	*Analog src*	-	-	1 = 1
40.09	Set 1 feedback 2 source	*Analog src*	-	-	1 = 1
40.10	Set 1 feedback function	*List*	0…11	-	1 = 1
40.11	Set 1 feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
40.16	Set 1 setpoint 1 source	*Analog src*	-	-	1 = 1
40.17	Set 1 setpoint 2 source	*Analog src*	-	-	1 = 1
40.18	Set 1 setpoint function	*List*	0…11	-	1 = 1
40.19	Set 1 internal setpoint sel1	*Binary src*	-	-	1 = 1
40.20	Set 1 internal setpoint sel2	*Binary src*	-	-	1 = 1
40.21	Set 1 internal setpoint 1	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
40.22	Set 1 internal setpoint 2	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
40.23	Set 1 internal setpoint 3	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
40.26	Set 1 setpoint min	*Real*	-32768.00…32767.00	-	100 = 1
40.27	Set 1 setpoint max	*Real*	-32768.00…32767.00	-	100 = 1
40.28	Set 1 setpoint increase time	*Real*	0.0…1800.0	s	10 = 1 s
40.29	Set 1 setpoint decrease time	*Real*	0.0…1800.0	s	10 = 1 s
40.30	Set 1 setpoint freeze enable	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
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*	-32768.0…32767.0	-	10 = 1
40.37	Set 1 output max	*Real*	-32768.0…32767.0	-	10 = 1
40.38	Set 1 output freeze enable	*Binary src*	-	-	1 = 1
40.43	Set 1 sleep level	*Real*	0.0…32767.0	-	10 = 1
40.44	Set 1 sleep delay	*Real*	0.0…3600.0	s	10 = 1 s
40.45	Set 1 sleep boost time	*Real*	0.0…3600.0	s	10 = 1 s
40.46	Set 1 sleep boost step	*Real*	0.0…32767.0	-	10 = 1
40.47	Set 1 wake-up deviation	*Real*	-32768.00 … 32767.00	rpm, % or Hz	100 = 1 unit
40.48	Set 1 wake-up delay	*Real*	0.00…60.00	s	100 = 1 s
40.49	Set 1 tracking mode	*Binary src*	-	-	1 = 1
40.50	Set 1 tracking ref selection	*Analog src*	-	-	1 = 1
40.57	PID set1/set2 selection	*Binary src*	-	-	1 = 1
40.58	Set 1 increase prevention	*List*	0…3	-	1 = 1
40.59	Set 1 decrease prevention	*List*	0…3	-	1 = 1
40.62	PID internal setpoint actual	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
41 Process PID set 2					
41.07	Set 2 PID operation mode	*List*	0…2	-	1 = 1
41.08	Set 2 feedback 1 source	*Analog src*	-	-	1 = 1
41.09	Set 2 feedback 2 source	*Analog src*	-	-	1 = 1
41.10	Set 2 feedback function	*List*	0…11	-	1 = 1
41.11	Set 2 feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
41.16	Set 2 setpoint 1 source	*Analog src*	-	-	1 = 1
41.17	Set 2 setpoint 2 source	*Analog src*	-	-	1 = 1
41.18	Set 2 setpoint function	*List*	0…11	-	1 = 1
41.19	Set 2 internal setpoint sel1	*Binary src*	-	-	1 = 1
41.20	Set 2 internal setpoint sel2	*Binary src*	-	-	1 = 1
41.21	Set 2 internal setpoint 1	*Real*	-32768.0…32767.0	rpm, % or Hz	100 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
41.22	Set 2 internal setpoint 2	Real	-32768.0…32767.0	rpm, % or Hz	100 = 1 unit
41.23	Set 2 internal setpoint 3	Real	-32768.0…32767.0	rpm, % or Hz	100 = 1 unit
41.26	Set 2 setpoint min	Real	-32768.0…32767.0	-	100 = 1
41.27	Set 2 setpoint max	Real	-32768.0…32767.0	-	100 = 1
41.28	Set 2 setpoint increase time	Real	0.0…1800.0	s	10 = 1 s
41.29	Set 2 setpoint decrease time	Real	0.0…1800.0	s	10 = 1 s
41.30	Set 2 setpoint freeze enable	Binary src	-	-	1 = 1
41.31	Set 2 deviation inversion	Binary src	-	-	1 = 1
41.32	Set 2 gain	Real	0.10…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	-32768.0…32767.0	-	10 = 1
41.37	Set 2 output max	Real	-32768.0…32767.0	-	10 = 1
41.38	Set 2 output freeze enable	Binary src	-	-	1 = 1
41.43	Set 2 sleep level	Real	0.0…32767.0	-	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…32767.0	-	10 = 1
41.47	Set 2 wake-up deviation	Real	-2147483648… 2147483647	rpm, % or Hz	100 = 1 unit
41.48	Set 2 wake-up delay	Real	0.00…60.00	s	100 = 1 s
41.49	Set 2 tracking mode	Binary src	-	-	1 = 1
41.50	Set 2 tracking ref selection	Analog src	-	-	1 = 1
41.58	Set 2 increase prevention	List	0…3	-	1 = 1
41.59	Set 2 decrease prevention	List	0…3	-	1 = 1
41.62	PID internal setpoint actual	Real	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
43 Brake chopper					
43.01	Braking resistor temperature	Real	0.0…120.0	%	10 = 1%
43.06	Brake chopper enable	List	0…2	-	1 = 1
43.07	Brake chopper runtime enable	Binary src	-	-	1 = 1
43.08	Brake resistor thermal tc	Real	0…10000	s	1 = 1 s
43.09	Brake resistor Pmax cont	Real	0.00…10000.00	kW	100 = 1 kW
43.10	Brake resistance	Real	0.0…1000.0	ohm	10 = 1 ohm
43.11	Brake resistor fault limit	Real	0…150	%	1 = 1%

No.	Name	Type	Range	Unit	FbEq32
43.12	Brake resistor warning limit	*Real*	0…150	%	1 = 1%
44 Mechanical brake control					
44.01	Brake control status	*PB*	0000h…FFFFh	-	1 = 1
44.06	Brake control enable	*Binary src*	-	-	1 = 1
44.08	Brake open delay	*Real*	0.00…5.00	s	100 = 1 s
44.13	Brake close delay	*Real*	0.00…60.00	s	100 = 1 s
44.14	Brake close level	*Real*	0.0…1000.0	rpm	100 = 1 rpm
45 Energy efficiency					
45.01	Saved GW hours	*Real*	0…65535	GWh	1 = 1 GWh
45.02	Saved MW hours	*Real*	0…999	MWh	1 = 1 MWh
45.03	Saved kW hours	*Real*	0.0…999.0	kWh	10 = 1 kWh
45.04	Saved energy	*Real*	0.0…214748364.7	kWh	10 = 1 kWh
45.05	Saved money x1000	*Real*	0…4294967295 thousands	(selecta-ble)	1 = 1 unit
45.06	Saved money	*Real*	0.00…999.99	(selecta-ble)	100 = 1 unit
45.07	Saved amount	*Real*	0.00…21474836.47	(selecta-ble)	100 = 1 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…214748365.7	metric ton	10 = 1 metric ton
45.11	Energy optimizer	*List*	0…1	-	1 = 1
45.12	Energy tariff 1	*Real*	0.000…4294967.295	(selecta-ble)	1000 = 1 unit
45.13	Energy tariff 2	*Real*	0.000…4294967.295	(selecta-ble)	1000 = 1 unit
45.14	Tariff selection	*Binary src*	-	-	1 = 1
45.17	Tariff currency unit	*List*	100…102	-	1 = 1
45.18	CO2 conversion factor	*Real*	0.000…65.535	metric ton/ MWh	1000 = 1 metric ton/MWh
45.19	Comparison power	*Real*	0.00…100000.00	kW	10 = 1 kW
45.21	Energy calculations reset	*List*	0…1	-	1 = 1
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*	0.1…30000.0 kW or 0.1…40215.5 hp	kW or hp	10 = 1 unit
46.05	Current scaling	*Real*	0…30000	A	1 = 1 A

No.	Name	Type	Range	Unit	FbEq32
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
46.23	At torque hysteresis	*Real*	0.00…300.00	%	1 = 1%
46.31	Above speed limit	*Real*	0.00…30000.00	rpm	100 = 1 rpm
46.32	Above frequency limit	*Real*	0.00…1000.00	Hz	100 = 1 Hz
46.33	Above torque limit	*Real*	0.0…1600.0	%	10 = 1%
46.41	kWh pulse scaling	*Real*	0.001…1000.000	kWh	1000 = 1 kWh
47 Data storage					
47.01	Data storage 1 real32	*Real*	-2147483.008… 2147483.008	-	1000 = 1
47.02	Data storage 2 real32	*Real*	-2147483.008… 2147483.008	-	1000 = 1
47.03	Data storage 3 real32	*Real*	-2147483.008… 2147483.008	-	1000 = 1
47.04	Data storage 4 real32	*Real*	-2147483.008… 2147483.008	-	1000 = 1
47.11	Data storage 1 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.12	Data storage 2 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.13	Data storage 3 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.14	Data storage 4 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.21	Data storage 1 int16	*Real*	-32768…32767	-	1 = 1
47.22	Data storage 2 int16	*Real*	-32768…32767	-	1 = 1
47.23	Data storage 3 int16	*Real*	-32768…32767	-	1 = 1
47.24	Data storage 4 int16	*Real*	-32768…32767	-	1 = 1
49 Panel port communication					
49.01	Node ID number	*Real*	1…32	-	1 = 1
49.03	Baud rate	*List*	1…5	-	1 = 1
49.04	Communication loss time	*Real*	0.1…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…3	-	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

No.	Name	Type	Range	Unit	FbEq32
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 enable	*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
…	…	…	…	…	
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…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
58.02	Protocol ID	*Real*	0…65535	-	1 = 1
58.03	Node address	*Real*	0…255	-	1 = 1
58.04	Baud rate	*List*	0…7	-	1 = 1
58.05	Parity	*List*	0…3	-	1 = 1
58.06	Communication control	*List*	0…2	-	1 = 1
58.07	Communication diagnostics	*PB*	0000h…FFFFh	-	1 = 1
58.08	Received packets	*Real*	0…4294967295	-	1 = 1
58.09	Transmitted packets	*Real*	0…4294967295	-	1 = 1
58.10	All packets	*Real*	0…4294967295	-	1 = 1
58.11	UART errors	*Real*	0…4294967295	-	1 = 1
58.12	CRC errors	*Real*	0…4294967295	-	1 = 1
58.14	Communication loss action	*List*	0…4	-	1 = 1
58.15	Communication loss mode	*List*	0…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	Internal 1	*PB*	0000h…FFFFh	-	1 = 1
58.19	Internal 2	*PB*	0000h…FFFFh	-	1 = 1
58.25	Control profile	*List*	0, 5	-	1 = 1
58.26	EFB ref1 type	*List*	0…5	-	1 = 1
58.27	EFB ref2 type	*List*	0…5	-	1 = 1
58.28	EFB act1 type	*List*	0…5	-	1 = 1
58.29	EFB act2 type	*List*	0…5	-	1 = 1
58.31	EFB act1 transparent source	*Analog src*	-	-	1 = 1
58.32	EFB act2 transparent source	*Analog src*	-	-	1 = 1
58.33	Addressing mode	*List*	0…5	-	1 = 1
58.34	Word order	*List*	0…1	-	1 = 1
58.35	Return app error	*List*	0…1	-	1 = 1
58.101	Data I/O 1	*Analog src*	-	-	1 = 1
58.102	Data I/O 2	*Analog src*	-	-	1 = 1
58.103	Data I/O 3	*Analog src*	-	-	1 = 1
58.104	Data I/O 4	*Analog src*	-	-	1 = 1
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

No.	Name	Type	Range	Unit	FbEq32
…	…	…	…	…	
58.130	Data I/O 30	*Analog src*	-	-	1 = 1
58.131	Data I/O 31	*Analog src*	-	-	1 = 1
58.132	Data I/O 32	*Analog src*	-	-	1 = 1
58.133	Data I/O 33	*Analog src*	-	-	1 = 1
58.134	Data I/O 34	*Analog src*	-	-	1 = 1
…	…	…	…	…	
58.140	Data I/O 40	*Analog src*	-	-	1 = 1
71 External PID1					
71.01	External PID act value	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
71.02	Feedback act value	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
71.03	Setpoint act value	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
71.04	Deviation act value	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
71.06	PID status word	*PB*	0000h…FFFFh	-	1 = 1
71.07	PID operation mode	*List*	0…2	-	1 = 1
71.08	Feedback 1 source	*Analog src*	-	-	1 = 1
71.11	Feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
71.14	Set 1 setpoint scaling	*Real*	-32768.00…32767.00	-	100 = 1
71.15	Set 1 output scaling	*Real*	-32768.00…32767.00	-	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*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
71.22	Internal setpoint 2	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
71.23	Internal setpoint 3	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
71.26	Setpoint min	*Real*	-32768.00…32767.00	-	100 = 1
71.27	Setpoint max	*Real*	-32768.00…32767.00	-	100 = 1
71.31	Deviation inversion	*Binary src*	-	-	1 = 1
71.32	Gain	*Real*	0.10…100.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
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*	-32768.0…32767.0	-	10 = 1
71.37	Output max	*Real*	-32768.0…32767.0	-	10 = 1
71.38	Output freeze enable	*Binary src*	-	-	1 = 1
71.39	Deadband range	*Real*	0.0…32767.0	-	10 = 1
71.40	Deadband delay	*Real*	0.0…3600.0	s	10 = 1 s
71.58	Increase prevention	*List*	0…3	-	1 = 1
71.59	Decrease prevention	*List*	0…3	-	1 = 1
71.62	Internal setpoint actual	*Real*	-32768.00…32767.00	rpm, % or Hz	100 = 1 unit
95 HW configuration					
95.01	Supply voltage	*List*	0…5	-	1 = 1
95.02	Adaptive voltage limits	*List*	0…1	-	1 = 1
95.03	Estimated AC supply voltage		0.0…1000.0	-	1 = 1 V
95.04	Control board supply	*List*	0…1	-	1 = 1
95.20	HW options word 1	*PB*	0000h…FFFFh	-	1 = 1
96 System					
96.01	Language	*List*	-	-	1 = 1
96.02	Pass code	*Data*	0…99999999	-	1 = 1
96.04	Macro select	*List*	0…3, 11…14	-	1 = 1
96.05	Macro active	*List*	1…3, 11…14	-	1 = 1
96.06	Parameter restore	*List*	0, 8, 62	-	1 = 1
96.07	Parameter save manually	*List*	0…1	-	1 = 1
96.08	Control board boot	*Real*	0…1	-	1 = 1
96.10	User set status	*List*	0…7, 20…23	-	-
96.11	User set save/load	*List*	0…5, 18…21	-	-
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*	000h…FFFFh		1 = 1
96.50	Parameter lock	Enum	0, 65535	-	-
97 Motor control					
97.01	Switching frequency reference	*List*	4…12	kHz	1 = 1
97.02	Minimum switching frequency	*List*	1…12	kHz	1 = 1
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
97.10	Signal injection	*List*	0…4	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
97.11	TR tuning	*Real*	25…400	%	1 = 1%
97.13	IR compensation	*Real*	0.00…50.00	%	100 = 1%
97.20	U/F ratio	*List*	0…1	-	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…1	-	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…800.0	V	10 = 1 V
99.08	Motor nominal frequency	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
99.09	Motor nominal speed	*Real*	0 … 30000	rpm	1 = 1 rpm
99.10	Motor nominal power	*Real*	-10000.00…10000.00 kW or -13405.83 … 13405.83 hp	kW or hp	100 = 1 unit
99.11	Motor nominal cos phi	*Real*	0.00 … 1.00	-	100 = 1
99.12	Motor nominal torque	*Real*	0.000…	N·m or lb·ft	1000 = 1 unit
99.13	ID run requested	*List*	0…3, 5…6,	-	1 = 1
99.14	Last ID run performed	*List*	0…3, 5…6,	-	1 = 1
99.15	Motor polepairs calculated	*Real*	0…1000	-	1 = 1
99.16	Motor phase order	*List*	0…1	-	1 = 1

15

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* on page *17* 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 latch and the drive will continue to operate the motor.

Faults do latch inside the drive and cause the drive to trip, and the motor stops. After the cause of a fault has been removed, the fault can be reset from a selectable source (**Menu - Primary settings - Advanced functions - Reset faults manually** (**Reset faults manually from:**); or parameter *31.11 Fault reset selection*) such as the control panel, Drive composer PC tool, the digital inputs of the drive, or fieldbus. After the fault is reset, the drive can be restarted.

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

Pure events

In addition to warnings and faults, there are pure events that are only recorded in the event log of the drive. The codes of these events are included in the *Warning messages* table on page (*426*).

Editable messages

For some warnings and faults, the message text can be edited and instructions and contact information added. To edit these messages, select **Menu** - **Primary settings** - **Edit texts** on the control panel.

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 *424*.

Auxiliary codes

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

Viewing warning/fault information

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

For active faults and warnings, see

- **Menu - Diagnostics - Active faults**
- **Menu - Diagnostics - Active warnings**
- **Options - Active faults**
- **Options - Active warnings**
- parameters in group *04 Warnings and faults* (page *232*).

For previously occurred faults and warnings, see

- **Menu - Diagnostics - Fault & event log**
- parameters in group *04 Warnings and faults* (page *232*).

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

Warning messages

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

Code (hex)	Warning / Aux. code	Cause	What to do
A2A1	Current calibration	Current offset and gain measurement calibration will occur at next start.	Informative warning. (See parameter *99.13 ID run requested*.)
A2B1	Overcurrent	Output current has exceeded internal fault limit.	Check motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control), *26 Torque reference chain* (torque control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See *Checking the insulation of the assembly* on page *76*. Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group *99 Motor data* corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable.
A2B3	Earth leakage	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See *Checking the insulation of the assembly* on page *76*. If an earth fault is found, fix or change the motor cable and/or motor. If no earth fault can be detected, contact your local ABB representative.
A2B4	Short circuit	Short-circuit in motor cable(s) or motor.	Check motor and motor cable for cabling errors. Check motor and motor cable (including phasing and delta/star connection). Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See *Checking the insulation of the assembly* on page *76*. Check there are no power factor correction capacitors or surge absorbers in motor cable.

Code (hex)	Warning / Aux. code	Cause	What to do
A2BA	IGBT overload	Excessive IGBT junction to case temperature. This warning protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A3A1	DC link overvoltage	Intermediate circuit DC voltage too high (when the drive is stopped).	Check the supply voltage setting (parameter *95.01 Supply voltage*). Note that the wrong setting of the parameter may cause the motor to rush uncontrollably, or may overload the brake chopper or resistor. Check the supply voltage. If the problem persists, contact your local ABB representative.
A3A2	DC link undervoltage	Intermediate circuit DC voltage too low (when the drive is stopped).	
A3AA	DC not charged	The voltage of the intermediate DC circuit has not yet risen to operating level.	
A491	External temperature 1 (Editable message text)	Measured temperature 1 has exceeded warning limit.	Check the value of parameter *35.02 Measured temperature 1*. Check the cooling of the motor (or other equipment whose temperature is being measured).
A492	External temperature 2 (Editable message text)	Measured temperature 2 has exceeded warning limit.	Check the value of parameter *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured).
A4A1	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4A9	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C/104 °F (frames R5…R9) or if it exceeds 50 °C /122 °F (frames R0…R9), ensure that load current does not exceed derated load capacity of drive. See section *Derating* on page *498*. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
A4B0	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4B1	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s).
A4F6	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A580	PU communication	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit.

Code (hex)	Warning / Aux. code	Cause	What to do
A5A0	Safe torque off Programmable warning: *31.22 STO indication run/stop*	Safe torque off function is active, ie safety circuit signal(s) connected to connector STO is lost.	Check safety circuit connections. For more information, see chapter *The Safe torque off function* on page *555* and description of parameter *31.22 STO indication run/stop* (page *311*).
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.
A5EC	PU communication internal	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit.
A5ED	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative.
A5EE	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative.
A5EF	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative.
A5F0	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
A6A4	Motor nominal value	The motor parameters are set incorrectly.	Check the settings of the motor configuration parameters in group 99.
		The drive is not dimensioned correctly.	Check that the drive is sized correctly for the motor.
A6A5	No motor data	Parameters in group 99 have not been set.	Check that all the required parameters in group 99 have been set. **Note:** It is normal for this warning to appear during the start-up and continue until the motor data is entered.
A6A6	Voltage category unselected	The voltage category has not been defined.	Set voltage category in parameter *95.01 Supply voltage*.
A6D1	FBA A parameter conflict	The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)*.
A6E5	AI parametrization	The current/voltage hardware setting of an analog input does not correspond to parameter settings.	Check the event log for an auxiliary code. The code identifies the analog input whose settings are in conflict. Adjust either the hardware setting (on the drive control unit) or parameter *12.15*/*12.25*. **Note:** Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.
A780	Motor stall Programmable warning: *31.24 Stall function*	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.

Code (hex)	Warning / Aux. code	Cause	What to do
A791	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor.
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.	Check the resistor data settings (parameters *43.08*…*43.10*).
A79C	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal warning limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameters *43.06*…*43.10*). Check minimum allowed resistor value for the chopper being used. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
A7AB	Extension I/O configuration failure	Installed CMOD module is not the same as configured.	Check that the installed module (shown by parameter *15.02 Detected extension module*) is the same as selected by parameter *15.01 Extension module type*.
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 Programmable warning: *49.05 Communication loss action*	Control panel or PC tool selected as active control location for drive has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Check mounting platform if being used. Disconnect and reconnect the control panel.
A8A0	AI supervision Programmable warning: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*.
A8A1	RO life warning	The relay has changed states more than the recommended number of times.	Change the control board or stop using the relay output.
	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, eg. if a fast changing frequency signal is connected to it. The relay lietime will be exceeded shortly.	Replace the signal connected to the relay output source with a less frequently changing signal.
	0001	Relay output 1	Select a different signal with parameter *10.24 RO1 source*.
	0002	Relay output 2	Select a different signal with parameter *10.27 RO2 source*.
	0003	Relay output 3	Select a different signal with parameter *10.30 RO3 source*.
A8B0	Signal supervision (Editable message text) Programmable warning: *32.06 Supervision 1 action* *32.16 Supervision 2 action* *32.26 Supervision 3 action*	Warning generated by a signal supervision function.	Check the source of the warning (parameter *32.07*, *32.17* or *32.27*).
A8C0	ULC invalid speed table	User load curve: X-axis points (speed) are not valid.	Check that points fulfil conditions. See parameter *37.11 ULC speed table point 1*.
A8C1	ULC overload warning	User load curve: Signal has been too long over the overload curve.	See parameter *37.03 ULC overload actions*.
A8C4	ULC underload warning	User load curve: Signal has been too long under the underload curve.	See parameter *37.04 ULC underload actions*.
A8C5	ULC invalid underload table	User load curve: Underload curve points are not valid.	Check that points fulfil conditions. See parameter *37.21 ULC underload point 1*.
A8C6	ULC invalid overload table	User load curve: Overload curve points are not valid.	Check that points fulfil conditions. See parameter *37.31 ULC overload point 1*.

Code (hex)	Warning / Aux. code	Cause	What to do
A8C8	ULC invalid frequency table	User load curve: X-axis points (frequency) are not valid.	Check that points fulfil conditions. -500.0 Hz ≤ *37.16* < *37.17* < *37.18* < *37.19* < *37.20* ≤ 500.0 Hz. See parameter *37.16 ULC frequency table point 1*.
A981	External 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 5.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
A985	External warning 5 (Editable message text) Programmable warning: *31.09 External event 5 source* *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.
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 *204*), 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.	

Code (hex)	Warning / Aux. code	Cause	What to do
AFEA	Enable start signal missing (Editable message text)	No enable start signal received.	Check the setting of (and the source selected by) parameter *20.19 Enable start 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*.
AFEB	Run enable missing	No run enable signal is received.	Check setting of parameter *20.12 Run enable 1 source*. Switch signal on (e.g. in the fieldbus Control Word) or check wiring of selected source.
AFEC	External power signal missing	*95.04 Control board supply* is set to *External 24V* but no voltage is connected to the control unit.	Check the external 24 V DC power supply to the control unit, or change the setting of parameter *95.04*.
AFED	Enable to rotate	Signal enable to rotate has not been received within a fixed time delay.	Switch enable to rotate signal on (eg. in digital inputs). Check the setting of (and source selected by) parameter *20.22 Enable to rotate*.
AFF6	Identification run	Motor ID run will occur at next start.	Informative warning.
B5A0	STO event Programmable event: *31.22 STO indication run/stop*	Safe torque off function is active, ie. safety circuit signal(s) connected to connector STO is lost.	Check safety circuit connections. For more information, see *The Safe torque off function* on page *555* and description of parameter *31.22 STO indication run/stop* (page *311*).

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. If the fault reappears, cycle the power to the drive. You may have to be repeat this. If the fault persists, contact your local ABB representative.
2281	Calibration	Measured offset of output phase current measurement or difference between output phase U2 and W2 current measurement is too great (the values are updated during current calibration).	Try performing the current calibration again (select *Current measurement calibration* at parameter *99.13*). If the fault persists, contact your local ABB representative.
2310	Overcurrent	Output current has exceeded internal fault limit.	Check motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control), *26 Torque reference chain* (torque control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See *Checking the insulation of the assembly* on page *76*.
2330	Earth leakage 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. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter *99.04 Motor control mode*.) If no earth fault can be detected, contact your local ABB representative.

Code (hex)	Fault / Aux. code	Cause	What to do
2340	Short circuit	Short-circuit in motor cable(s) or motor	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable. Cycle the power to the drive.
2381	IGBT overload	Excessive IGBT junction to case temperature. This fault protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
3130	Input phase loss Programmable fault: *31.21 Supply phase loss*	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses. Check for loose power cable connections. Check for input power supply imbalance.
3181	Cross connection Programmable fault: *31.23 Cross connection*	Incorrect input power and motor cable connection (ie. input power cable is connected to drive motor connection).	Check input power connections.
3210	DC link overvoltage	Excessive intermediate circuit DC voltage.	Check that overvoltage control is on (parameter *30.30 Overvoltage control*). Check that the supply voltage matches the nominal input voltage of the drive. Check the supply line for static or transient overvoltage. Check brake chopper and resistor (if present). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit drive with brake chopper and brake resistor. Check that the brake resistor is dimensioned properly and the resistance is between acceptable range for the drive.
3220	DC link undervoltage	Intermediate circuit DC voltage is not sufficient because of a missing supply phase, blown fuse or fault in the rectifier bridge.	Check supply cabling, fuses and switchgear.
3381	Output phase loss Programmable fault: *31.19 Motor phase loss*	Motor circuit fault due to missing motor connection (all three phases are not connected).	Connect motor cable.
4110	Control board temperature	Control board temperature is too high.	Check proper cooling of the drive. Check the auxiliary cooling fan.
4210	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.

Code (hex)	Fault / Aux. code	Cause	What to do
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C/104 °F (frames R5…R9) or if it exceeds 50 °C /122 °F (frames R0…R9), ensure that load current does not exceed derated load capacity of drive. See section *Derating* on page *498*. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
42F1	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4310	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4380	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s).
4981	External temperature 1 (Editable message text)	Measured temperature 1 has exceeded fault limit.	Check the value of parameter *35.02 Measured temperature 1*. Check the cooling of the motor (or other equipment whose temperature is being measured).
4982	External temperature 2 (Editable message text)	Measured temperature 2 has exceeded fault limit.	Check the value of parameter *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured).
5081	Auxiliary fan broken	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	Check auxiliary fan(s) and connection(s). Replace fan if faulty. Make sure the front cover of the drive module is in place and tightened. Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
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 safe torque off circuit connections. For more information, see chapter *The Safe torque off function* on page *555* and description of parameter *31.22 STO indication run/stop* (page *311*).
5092	PU logic error	Power unit memory has cleared.	Contact your local ABB representative.

Code (hex)	Fault / Aux. code	Cause	What to do
5093	Rating ID mismatch	The hardware of the drive does not match the information stored in the memory unit. This may occur eg. after a firmware update or memory unit replacement.	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.
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.
5682	Power unit lost	Connection between the drive control unit and the power unit is lost.	Check the connection between the control unit and the power unit.
5690	PU communication internal	Internal communication error.	Contact your local ABB representative.
5691	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative.
5692	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
5693	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative.
5696	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative.
5697	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system
6181	FPGA version incompatible	Firmware and FPGA versions are incompatible.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative
6306	FBA A mapping file	Fieldbus adapter A mapping file read error.	Contact your local ABB representative.
6481	Task overload	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative
6487	Stack overflow	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative
64A1	Internal file load	File read error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative

Code (hex)	Fault / Aux. code	Cause	What to do
64B2	User set fault	Loading of user parameter set failed because • requested set does not exist • set is not compatible with control program • drive was switched off during loading.	Ensure that a valid user parameter set exists. Reload if uncertain.
64E1	Kernel overload	Operating system error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative
6581	Parameter system	Parameter load or save failed.	Try forcing a save using parameter *96.07 Parameter save manually*. Retry.
65A1	FBA A parameter conflict	The drive does not have a functionality requested by PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *51 FBA A settings*.
6681	EFB comm loss Programmable fault: *58.14 Communication loss action*	Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the EIA-485/X5 terminals 29, 30 and 31 on the control unit.
6682	EFB config file	Embedded fieldbus (EFB) configuration file could not be read.	Contact your local ABB representative.
6683	EFB invalid parameterization	Embedded fieldbus (EFB) parameter settings inconsistent or not compatible with selected protocol.	Check the settings in parameter group *58 Embedded fieldbus*.
6684	EFB load fault	Embedded fieldbus (EFB) protocol firmware could not be loaded.	Contact your local ABB representative.
		Version mismatch between EFB protocol firmware and drive firmware.	
6685	EFB fault 2	Fault reserved for the EFB protocol application.	Check the documentation of the protocol.
6686	EFB fault 3	Fault reserved for the EFB protocol application.	Check the documentation of the protocol.
6882	Text 32-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
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.
7121	Motor stall Programmable fault: *31.24 Stall function*	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.

Code (hex)	Fault / Aux. code	Cause	What to do
7181	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor. Check the dimensioning of the brake resistor.
7183	BR excess temperature	Brake resistor temperature has exceeded fault limit defined by parameter *43.11 Brake resistor fault limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check fault limit setting, parameter *43.11 Brake resistor fault limit*. Check that braking cycle meets allowed limits.
7184	Brake resistor wiring	Brake resistor short circuit or brake chopper control fault.	Check brake chopper and brake resistor connection. Ensure brake resistor is not damaged.
7191	BC short circuit	Short circuit in brake chopper IGBT.	Ensure brake resistor is connected and not damaged. Check the electrical specifications of the brake resistor against chapter *Resistor braking* on page *547*. Replace brake chopper (if replaceable).
7192	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal fault limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
7310	Overspeed	Motor is turning faster than highest allowed speed due to incorrectly set minimum/maximum speed, insufficient braking torque or changes in load when using torque reference.	Check minimum/maximum speed settings, parameters *30.11 Minimum speed* and *30.12 Maximum speed*. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
73B0	Emergency ramp failed	Emergency stop did not finish within expected time.	Check the settings of parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*. Check the predefined ramp times (*23.11*…*23.15* for mode Off1, *23.23* for mode Off3).

Code (hex)	Fault / Aux. code	Cause	What to do
7510	FBA A communication Programmable fault: *50.02 FBA A comm loss func*	Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups *50 Fieldbus adapter (FBA)*, *51 FBA A settings*, *52 FBA A data in* and *53 FBA A data out*. Check cable connections. Check if communication master is able to communicate.
8001	ULC underload fault	User load curve: Signal has been too long under the underload curve.	See parameter *37.04 ULC underload actions*.
8002	ULC overload fault	User load curve: Signal has been too long over the overload curve.	See parameter *37.03 ULC overload actions*.
80A0	AI supervision Programmable fault: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*.
80B0	Signal supervision (Editable message text) Programmable fault: *32.06 Supervision 1 action* *32.16 Supervision 2 action* *32.26 Supervision 3 action*	Fault generated by a signal supervision function.	Check the source of the fault (parameter *32.07*, *32.17* or *32.27*).
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 5.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
9085	External fault 5 (Editable message text) Programmable fault: *31.09 External event 5 source* *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.

Code (hex)	Fault / Aux. code	Cause	What to do
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* on page *555* and description of parameter *31.22 STO indication run/stop* (page *311*).
FA82	Safe torque off 2	Safe torque off function is active, ie. STO circuit 2 is broken.	
FF61	ID run	Motor ID run was not completed successfully.	Check the nominal motor values in parameter group *99 Motor data*. Check that no external control system is connected to the drive. Cycle the power to the drive (and its control unit, if powered separately). Check that no operation limits prevent the completion of the ID run. Restore parameters to default settings and try again. Check that the motor shaft is not locked.
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.

16

Fieldbus control through the embedded fieldbus interface (EFB)

What this chapter contains

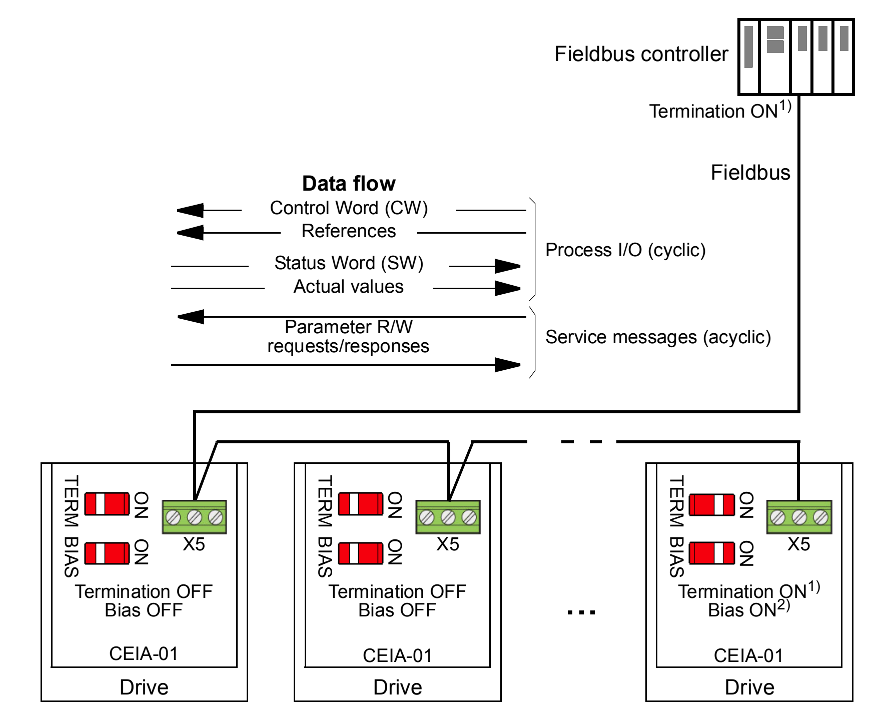
The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

System overview

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

The embedded fieldbus interface supports the Modbus RTU protocol. The drive control program can receive and send cyclic data from and to the Modbus master on 10 ms time level. The actual response time depends on other factors as well, such as the baud rate (a parameter setting in the drive).

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



1) The device at both ends on the fieldbus must have termination on.
2) One device, preferably at the end on the fieldbus must have bias on.

Connecting the fieldbus to the drive

Connect the fieldbus to terminal X5 on the CEIA-01, which is attached on the control unit of the drive. The connection diagram is shown below.

To be added

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* (default)	Defines the action taken when a communication loss is detected.
58.15	*Communication loss mode*	*None* (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 *446*).
58.26 … *58.29*	*EFB ref1 type* … *EFB act2 type*	*Speed or frequency* (default), *Transparent*, *General*, *Torque*, *Speed*, *Frequency*	Selects the reference and actual value types. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.
58.33	*Addressing mode*	*Mode 0* (default)	Defines the mapping between parameters and holding registers in the 100…65535 Modbus register range.
58.34	*Word order*	*LO-HI* (default)	Defines the order of the data words in the Modbus message frame.
58.35	*Return app error*	*No* (default)	Selects whether the drive returns Modbus exception codes or not.

Parameter	Setting for fieldbus control	Function/Information
58.101 Data I/O 1 … *58.140 Data I/O 40*	*None* (default)	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.
58.06 Communication control	*Refresh settings*	Validates the settings of the configuration parameters.

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

Setting the drive control parameters

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

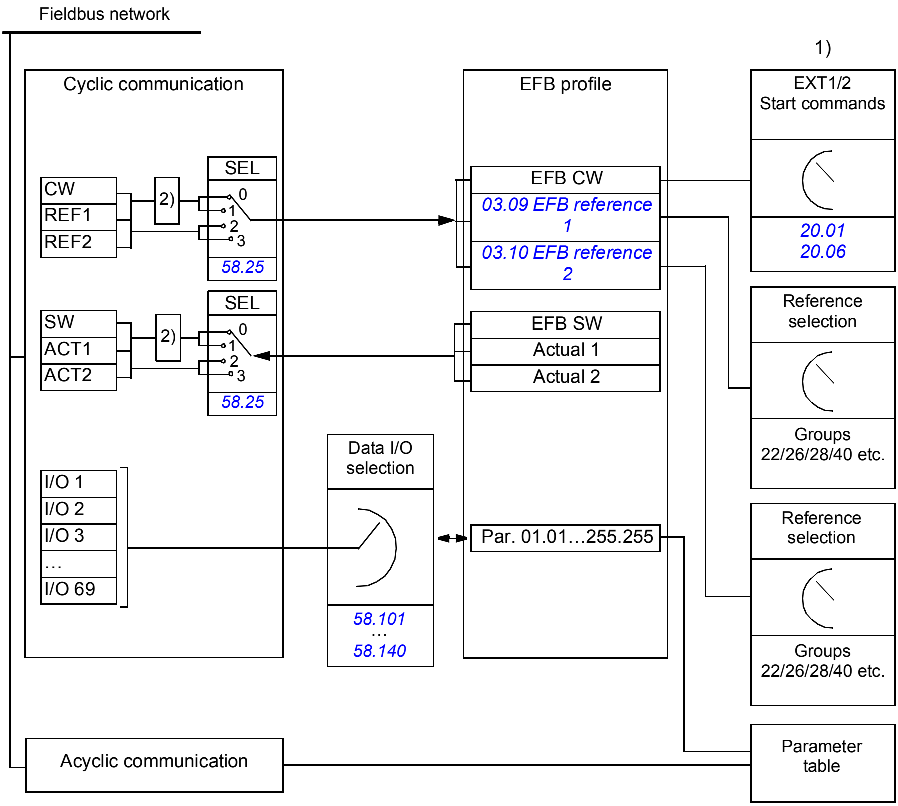
Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.02 Ext2 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
SPEED REFERENCE SELECTION		
22.11 Ext1 speed ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as speed reference 1.
22.18 Ext2 speed ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as speed reference 2.
TORQUE REFERENCE SELECTION		
26.11 Torque ref1 source	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as torque reference 1.
26.12 Torque ref2 source	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as torque reference 2.

Parameter	Setting for fieldbus control	Function/Information
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*.		
REFERENCE TYPE AND SCALING		
58.26 EFB ref1 type *58.27 EFB ref2 type*	*Speed or frequency* (default), *Transparent*, *General*, *Torque*, *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.
ACTUAL VALUE TYPE AND SCALING		
58.28 EFB act1 type *58.29 EFB act2 type*	*Speed or frequency* (default), *Transparent*, *General*, *Torque*, *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.
ACTUAL VALUE SOURCE SELECTION (when *Transparent* type is selected)		
58.31 EFB act1 transparent source *58.32 EFB act2 transparent source*	*Other*	Defines the source of actual values 1 and 2 when the selected type is *Transparent*.
SYSTEM CONTROL INPUTS		
96.07 Parameter save manually	*Save* (reverts to *Done*)	Saves parameter value changes (including those made through fieldbus control) to permanent memory.

Basics of the embedded fieldbus interface

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

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



1. See also other parameters which can be controlled through fieldbus.
2. Data conversion if parameter *58.25 Control profile* is set to *ABB Drives*. See section *About the control profiles* (page *449*).

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 *449*).

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 *449*).

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 *449*).

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 *449*).

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* … *58.140 Data I/O 40* 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.

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

About the control profiles

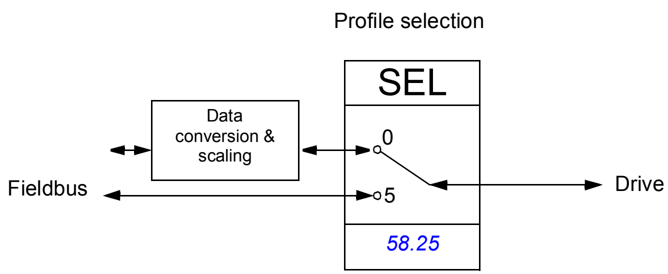
A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- if packed boolean words are converted and how
- if signal values are scaled and how
- how drive register addresses are mapped for the fieldbus master.

You can configure the drive to receive and send messages according to one of the two profiles:

- *ABB Drives*
- *DCU Profile*.

For the ABB Drives profile, the embedded fieldbus interface of the drive converts the fieldbus data to and from the native data used in the drive. The DCU Profile involves no data conversion or scaling. The figure below illustrates the effect of the profile selection.



Control profile selection with parameter *58.25 Control profile* is:
- (0) *ABB Drives*
- (5) *DCU Profile*.

Control Word

Control Word for the ABB Drives profile

The table below shows the contents of the fieldbus Control Word for the ABB Drives control profile. The embedded fieldbus interface converts this word to the form in which it is used in the drive. The upper case boldface text refers to the states shown in *State transition diagram for the ABB Drives profile* on page *457*.

Bit	Name	Value	STATE/Description
0	OFF1_ CONTROL	1	Proceed to READY TO OPERATE.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2_ CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	OFF3_ CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. **Warning:** Ensure that the motor and driven machine can be stopped using this stop mode.
3	INHIBIT_ OPERATION	1	Proceed to **OPERATION ENABLED**. **Note:** Run enable signal must be active; see the drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	RAMP_OUT_ ZERO	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp Function Generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.

Bit	Name	Value	STATE/Description
8 …9	Reserved		
10	REMOTE_ CMD	1	Fieldbus control enabled.
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus control enabled. 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	Reserved for REVERSE		Not yet implemented.
3	Reserved		
4	RESET	0=>1	Fault reset if an active fault exists.
		0	(no op)
5	EXT2	1	Select External control location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.
		0	Select External control location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.
6	RUN_DISABLE	1	Run disable. If the drive is set to receive the run enable signal from the fieldbus, this bit deactivates the signal.
		0	Run enable. If the drive is set to receive the run enable signal from the fieldbus, this bit activates the signal.

Bit	Name	Value	State/Description
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	Reserved for RAMP_PAIR _2		Not yet implemented.
11	RAMP_OUT_ZERO	1	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
		0	Normal operation.
12	RAMP_HOLD	1	Halt ramping (Ramp Function Generator output held).
		0	Normal operation.
13	RAMP_IN_ZERO	1	Force Ramp Function Generator input to zero.
		0	Normal operation.
14	Reserved for REQ_LOCAL_LOCK		Not yet implemented.
15	Reserved for TORQ_LIM_PAIR_2		Not yet implemented.
16	FB_LOCAL_CTL	1	Local mode for control from the fieldbus is requested. Steal control from the active source.
		0	(no op)
17	FB_LOCAL_REF	1	Local mode for reference from the fieldbus is requested. Steal reference from the active source.
		0	(no op)
18	Reserved for RUN_DISABLE_1		Not yet implemented. This is START_DISABLE_1 in HVAC.
19	Reserved		
20	Reserved		
21	Reserved		
22	USER_0		Writable control bits that can be combined with drive logic for application-specific functionality.
23	USER_1		
24	USER_2		
25	USER_3		
26 …31	Reserved		

Status Word

Status Word for the ABB Drives profile

The table below shows the fieldbus Status Word for the ABB Drives control profile. The embedded fieldbus interface converts the drive Status Word into this form for the fieldbus. The upper case boldface text refers to the states shown in *State transition diagram for the ABB Drives profile* on page *457*.

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, e.g. in speed control, speed error is 10% max. of nominal motor speed).
		0	Actual value differs from Reference (is outside tolerance limits).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	ABOVE_ LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
12	USER_1		
13	USER_2		
14	USER_3		
15	Reserved		

Status Word for the DCU Profile

The embedded fieldbus interface writes the drive Status Word bits 0 to 15 to the fieldbus Status Word as is. Bits 16 to 32 of the drive Status Word are not in use.

Bit	Name	Value	State/Description
0	READY	1	Drive is ready to receive the start command.
		0	Drive is not ready.
1	ENABLED	1	External run enable signal is active.
		0	External run enable signal is not active.
2	Reserved for ENABLED_TO_ROTATE		Not yet implemented. This is STARTED in HVAC.
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	Reserved for ACCELERATING		Not yet implemented.
6	Reserved for DECELERATING		Not yet implemented.
7	AT_SETPOINT	1	Drive is at setpoint.
		0	Drive is not at setpoint.
8	LIMIT	1	Drive operation is limited.
		0	Drive operation is not limited.
9	SUPERVISION	1	Actual value (speed, frequency or torque) is above a limit. Limit is set with parameters 46.31…46.33
		0	Actual value (speed, frequency or torque) is within limits.
10	Reserved for REVERSE_REF		Not yet implemented.
11	Reserved for REVERSE_ACT		Not yet implemented.
12	PANEL_LOCAL	1	Panel/keypad (or PC tool) is in local control mode.
		0	Panel/keypad (or PC tool) is not in local control mode.
13	FIELDBUS_LOCAL	1	Fieldbus is in local control mode.
		0	Fieldbus is not in local control mode.
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.

Bit	Name	Value	State/Description
17	Reserved		
18	Reserved for DIRECTION_LOCK		Not yet implemented.
19	Reserved		
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 is requested in this channel.
		0	Control is not requested in this channel.
27 … 31	Reserved		

State transition diagrams

State transition diagram for the ABB Drives profile

The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile and the drive is configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections *Control Word for the ABB Drives profile* on page *450* and *Status Word for the ABB Drives profile* on page *454*.

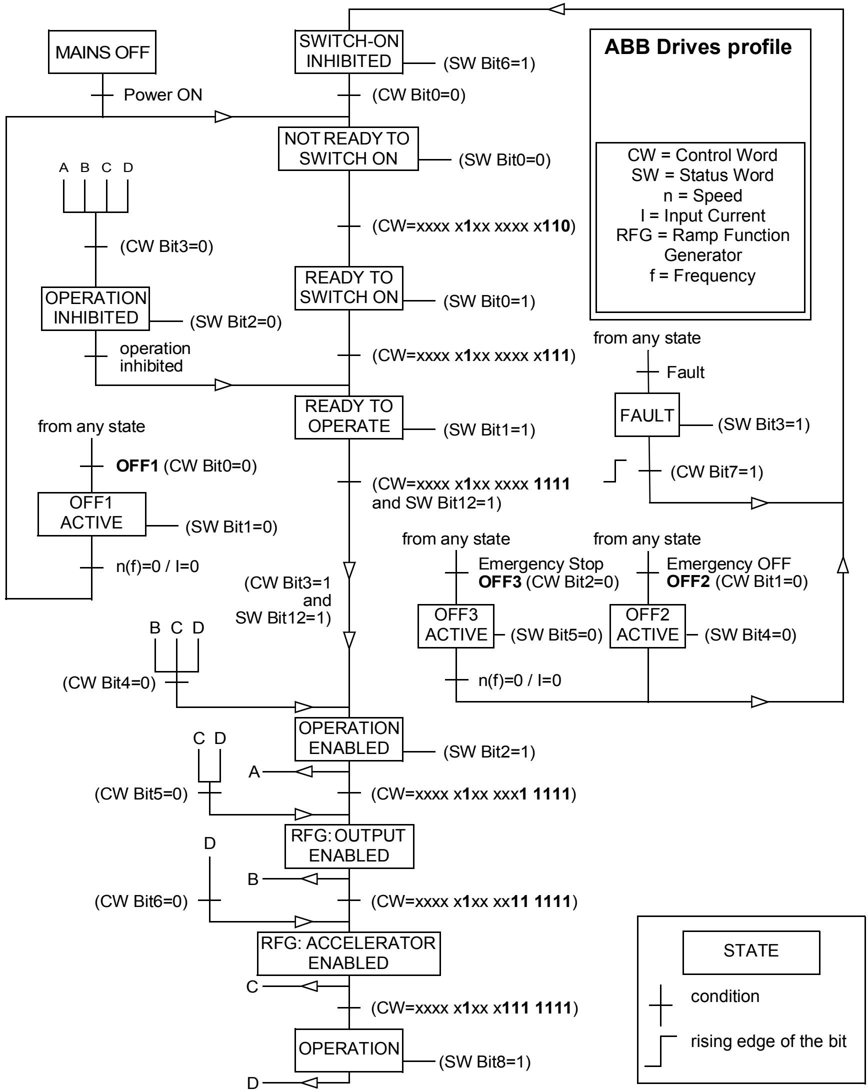


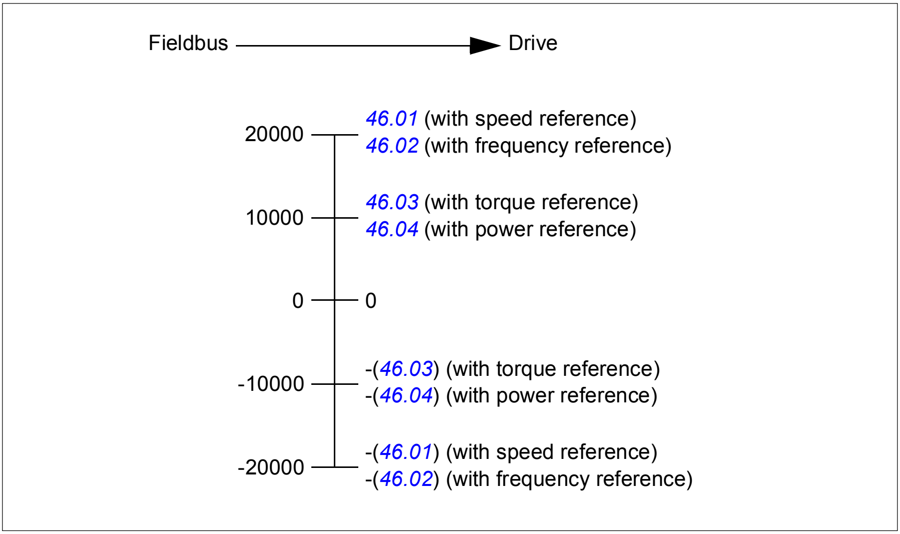
ABB Drives profile
CW = Control Word
SW = Status Word
n = Speed
I = Input Current
RFG = Ramp Function Generator
f = Frequency
MAINS OFF
Power ON
SWITCH-ON INHIBITED
(SW Bit6=1)
(CW Bit0=0)
NOT READY TO SWITCH ON
(SW Bit0=0)
(CW=xxxx x1xx xxxx x110)
READY TO SWITCH ON
(SW Bit0=1)
(CW=xxxx x1xx xxxx x111)
READY TO OPERATE
(SW Bit1=1)
(CW=xxxx x1xx xxxx 1111 and SW Bit12=1)
A B C D
(CW Bit3=0)
OPERATION INHIBITED
(SW Bit2=0)
operation inhibited
from any state
OFF1 (CW Bit0=0)
OFF1 ACTIVE
(SW Bit1=0)
n(f)=0 / I=0
from any state
Fault
FAULT
(SW Bit3=1)
(CW Bit7=1)
from any state
Emergency Stop
OFF3 (CW Bit2=0)
OFF3 ACTIVE
(SW Bit5=0)
n(f)=0 / I=0
from any state
Emergency OFF
OFF2 (CW Bit1=0)
OFF2 ACTIVE
(SW Bit4=0)
(CW Bit3=1 and SW Bit12=1)
B C D
(CW Bit4=0)
OPERATION ENABLED
(SW Bit2=1)
C D
A
(CW Bit5=0)
(CW=xxxx x1xx xxx1 1111)
RFG: OUTPUT ENABLED
D
B
(CW Bit6=0)
(CW=xxxx x1xx xx11 1111)
RFG: ACCELERATOR ENABLED
C
(CW=xxxx x1xx x111 1111)
OPERATION
(SW Bit8=1)
D
STATE
condition
rising edge of the bit

References

References for the ABB Drives profile and DCU Profile

The ABB Drives profile supports the use of two references, EFB reference 1 and EFB reference 2. The references are 16-bit words each containing a sign bit and a 15-bit integer. A negative reference is formed by calculating the two’s complement from the corresponding positive reference.

The references are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type* (see page *373*).



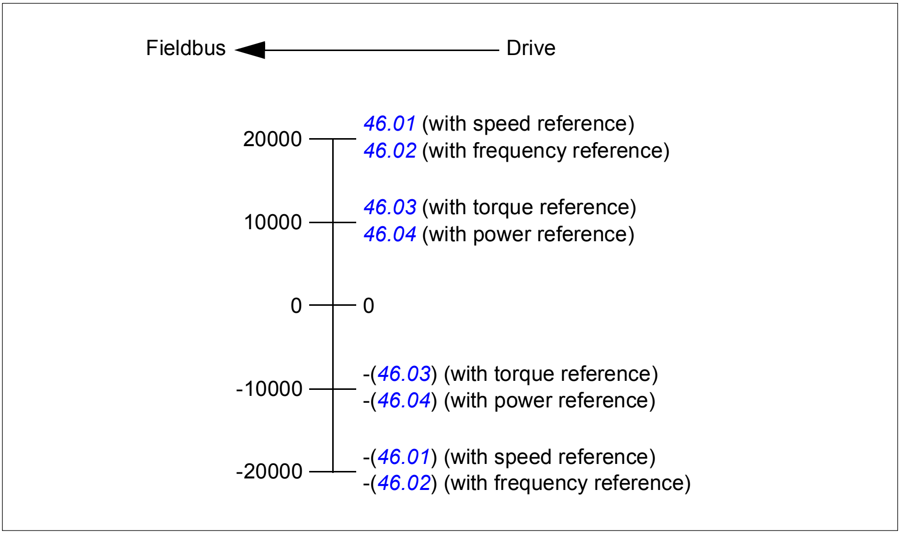
The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

Actual values

Actual values for the ABB Drives profile and DCU Profile

The ABB Drives profile supports the use of two fieldbus actual values, ACT1 and ACT2. The actual values are 16-bit words each containing a sign bit and a 15-bit integer. A negative value is formed by calculating the two's complement from the corresponding positive value.

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *58.28 EFB act1 type* and *58.29 EFB act2 type* (see page *373*).



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	Control word. See sections *Control Word for the ABB Drives profile* (page *450*) and *Control Word for the DCU Profile* (page *451*). The selection can be changed using parameter *58.101 Data I/O 1*.
400002	Reference 1 (REF1). The selection can be changed using parameter *58.102 Data I/O 2*.
400003	Reference 2 (REF2). The selection can be changed using parameter *58.102 Data I/O 2*.
400004	Status Word (SW). See sections *Status Word for the ABB Drives profile* (page *454*) and *Status Word for the DCU Profile* (page *455*). The selection can be changed using parameter *58.102 Data I/O 2*.
400005	Actual value 1 (ACT1). The selection can be changed using parameter *58.105 Data I/O 5*.
400006	Actual value 2 (ACT2). The selection can be changed using parameter *58.106 Data I/O 6*.
400007…400040	Data in/out 7…40. Selected by parameters *58.107 Data I/O 7* … *58.140 Data I/O 40*.
400070...400089	Unused
400090...400100	Error code access. See section *Error code registers (holding registers 400090…400100)* (page *466*).
400101...465536	Parameter read/write. Parameters are mapped to register addresses according to parameter *58.33 Addressing mode*.

Modbus function codes

The table below shows the Modbus function codes supported by the embedded fieldbus interface.

Code	Function name	Description
01h	Read Coils	N/A
02h	Read Discrete Inputs	N/A
03h	Read Holding Registers	N/A
05h	Write Single Coil	N/A
06h	Write Single Register	N/A
08h	Diagnostics	Provides a series of tests for checking the communication, or for checking various internal error conditions. Supported subcodes: • 00h Return Query Data: Echo/loopback test. • 01h Restart Comm Option: Restarts and initializes the EFB, clears communications event counters. • 04h Force Listen Only Mode • 0Ah Clear Counters and Diagnostic Register • 0Bh Return Bus Message Count • 0Ch Return Bus Comm. Error Count • 0Dh Return Bus Exception Error Count • 0Eh Return Slave Message Count • 0Fh Return Slave No Response Count • 10h Return Slave NAK (negative acknowledge) Count • 11h Return Slave Busy Count • 12h Return Bus Character Overrun Count • 14h Clear Overrun Counter and Flag
0Bh	Get Comm Event Counter	N/A
0Fh	Write Multiple Coils	N/A
10h	Write Multiple Registers	N/A
16h	Mask Write Register	N/A
17h	Read/Write Multiple Registers	N/A

Code	Function name	Description
2Bh / 0Eh	Encapsulated Interface Transport	Supported subcodes: • 0Eh Read Device Identification: Allows reading the identification and other information. Supported ID codes (access type): • 00h: Request to get the basic device identification (stream access) • 04h: Request to get one specific identification object (individual access) Supported Object IDs: • 00h: Vendor Name ("ABB") • 01h: Product Code (for example, "AINFX") • 02h: Major Minor Revision (combination of contents of parameters *07.05 Firmware version* and *58.02 Protocol ID*).

Exception codes

The table below shows the Modbus exception codes supported by the embedded fieldbus interface.

Code	Name	Description
01h	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server.
02h	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server.
03h	ILLEGAL DATA VALUE	A value contained in the query in not an allowable value for the server.
04h	SLAVE 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 *466*.
06h	SLAVE DEVICE BUSY	The server is engaged in processing a long-duration program command.

Coils (0xxxx reference set)

Coils are 1-bit read/write values. Control Word bits are exposed with this data type. The table below summarizes the Modbus coils (0xxxx reference set). Note that the references are 0-based index which match the address transmitted on the wire.

Reference	ABB Drives profile	DCU Profile
0	OFF1_CONTROL	STOP
1	OFF2_CONTROL	START
2	OFF3_CONTROL	Reserved
3	INHIBIT_OPERATION	Reserved
4	RAMP_OUT_ZERO	RESET
5	RAMP_HOLD	EXT2
6	RAMP_IN_ZERO	RUN_DISABLE
7	RESET	STOPMODE_RAMP
8	JOGGING_1	STOPMODE_EMERGENCY_RAMP
9	JOGGING_2	STOPMODE_COAST
10	REMOTE_CMD	Reserved
11	EXT_CTRL_LOC	RAMP_OUT_ZERO
12	USER_0	RAMP_HOLD
13	USER_1	RAMP_IN_ZERO
14	USER_2	Reserved
15	USER_3	Reserved
16	Reserved	FB_LOCAL_CTL
17	Reserved	FB_LOCAL_REF
18	Reserved	Reserved
19	Reserved	Reserved
20	Reserved	Reserved
21	Reserved	Reserved
22	Reserved	USER_0
23	Reserved	USER_1
24	Reserved	USER_2
25	Reserved	USER_3
26	Reserved	Reserved
27	Reserved	Reserved
28	Reserved	Reserved
29	Reserved	Reserved
30	Reserved	Reserved
31	Reserved	Reserved

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 0-based index which match the address transmitted on the wire.

Reference	ABB Drives profile	DCU Profile
0	RDY_ON	READY
1	RDY_RUN	ENABLED
2	RDY_REF	Reserved
3	TRIPPED	RUNNING
4	OFF_2_STATUS	ZERO_SPEED
5	OFF_3_STATUS	Reserved
6	SWC_ON_INHIB	Reserved
7	ALARM	AT_SETPOINT
8	AT_SETPOINT	LIMIT
9	REMOTE	SUPERVISION
10	ABOVE_LIMIT	Reserved
11	USER_0	Reserved
12	USER_1	PANEL_LOCAL
13	USER_2	FIELDBUS_LOCAL
14	USER_3	EXT2_ACT
15	Reserved	FAULT
16	Reserved	ALARM
17	Reserved	Reserved
18	Reserved	Reserved
19	Reserved	Reserved
20	Reserved	Reserved
21	Reserved	Reserved
22	Reserved	USER_0
23	Reserved	USER_1
24	Reserved	USER_2
25	Reserved	USER_3
26	Reserved	REQ_CTL
27	Reserved	Reserved
28	Reserved	Reserved
29	Reserved	Reserved
30	Reserved	Reserved
31	Reserved	Reserved

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
89	Reset Error Registers	1 = Reset internal error registers (91…95). 0 = Do nothing.
90	Error Function Code	Function code of the failed query.
91	Error Code	Set when exception code 04h is generated (see table above). • 00h No error • 02h Low/High limit exceeded • 03h Faulty Index: Unavailable index of an array parameter • 05h Incorrect Data Type: Value does not match the data type of the parameter • 65h General Error: Undefined error when handling query
92	Failed Register	The last register (discrete input, coil, input register or holding register) that failed to be read or written.
93	Last Register Written Successfully	The last register that was written successfully.
94	Last Register Read Successfully	The last register that was read successfully.

17

Fieldbus control through a fieldbus adapter

What this chapter contains

This chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) through an optional fieldbus adapter module.

The fieldbus control interface of the drive is described first, followed by a configuration example.

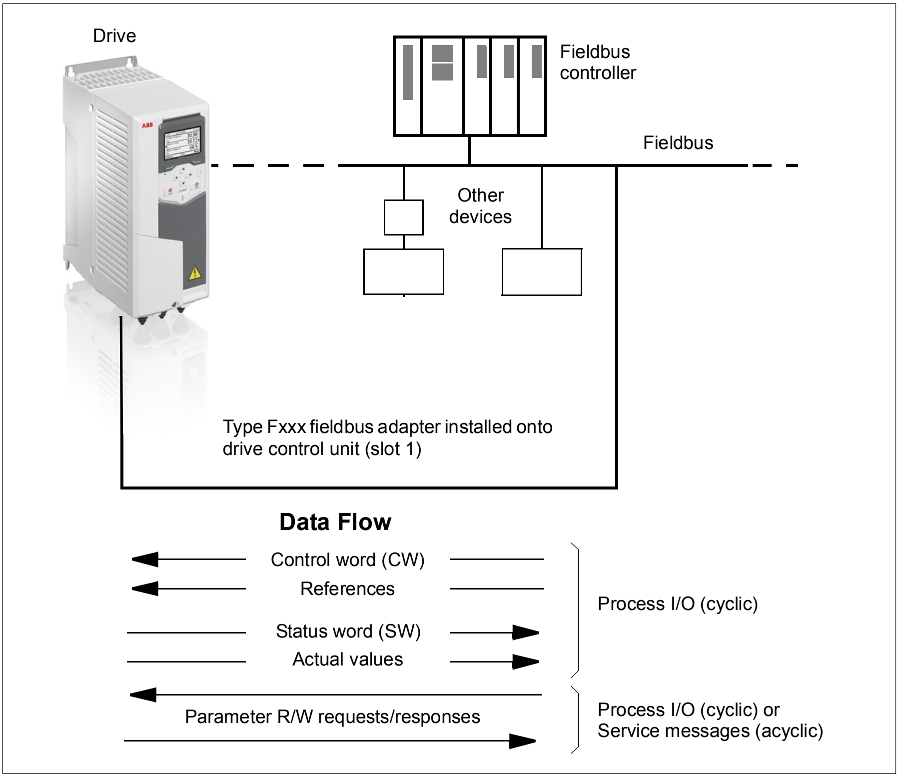
System overview

The drive can be connected to an external control system through an optional fieldbus adapter ("fieldbus adapter A" = FBA A) mounted onto the control unit of the drive. The drive can be configured to receive all of its control information through the fieldbus interface, or the control can be distributed between the fieldbus interface and other available sources such as digital and analog inputs, depending on how control locations EXT1 and EXT2 are configured.

Fieldbus adapters are available for various communication systems and protocols, for example

- PROFIBUS DP (FPBA-01 adapter)
- CANopen (FCAN-01 adapter)
- DeviceNet™ (FDNA-01 adapter)
- EtherNet/IP™ (FENA-11 adapter)

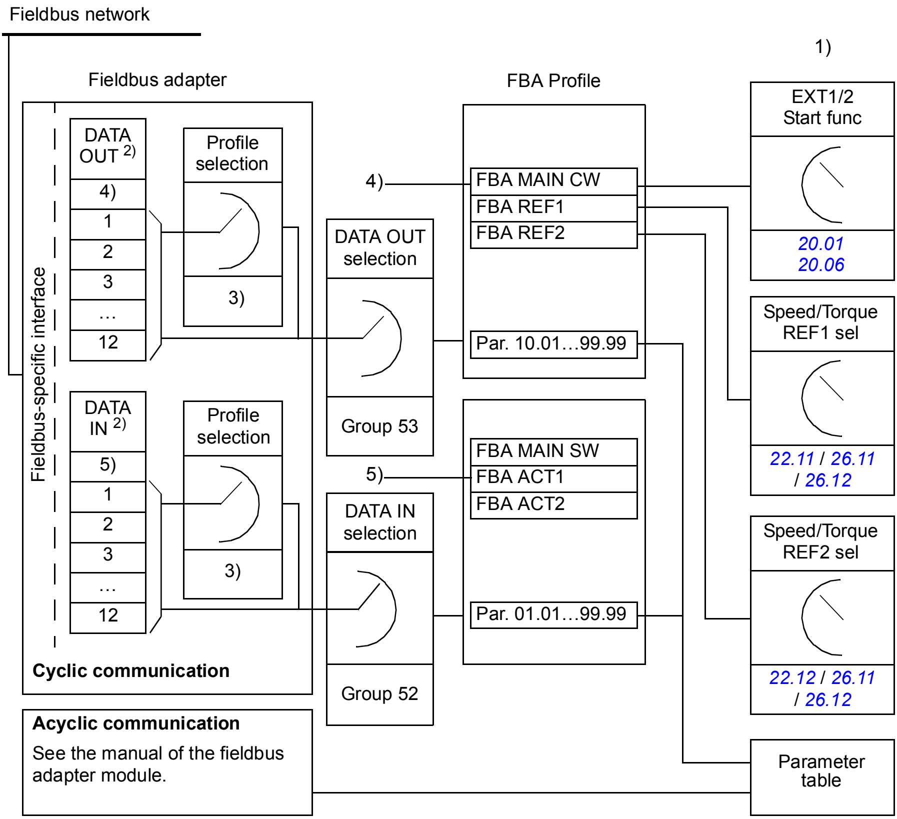
Note: The text and examples in this chapter describe the configuration of one fieldbus adapter (FBA A) by parameters *50.01*…*50.18* and parameter groups *51 FBA A settings*…*53 FBA A data out*.



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.

The contents of the Control word and the Status word are detailed on pages *473* and *475* respectively. The drive states are presented in the state diagram (page *476*).

Debugging the network words

If parameter *50.12 FBA A debug enable* is set to *Enable*, the Control word received from the fieldbus is shown by parameter *50.13 FBA A control word*, and the Status word transmitted to the fieldbus network by *50.16 FBA A status word*. This “raw” data is very useful to determine if the fieldbus master is transmitting the correct data before handing control to the fieldbus network.

References

References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

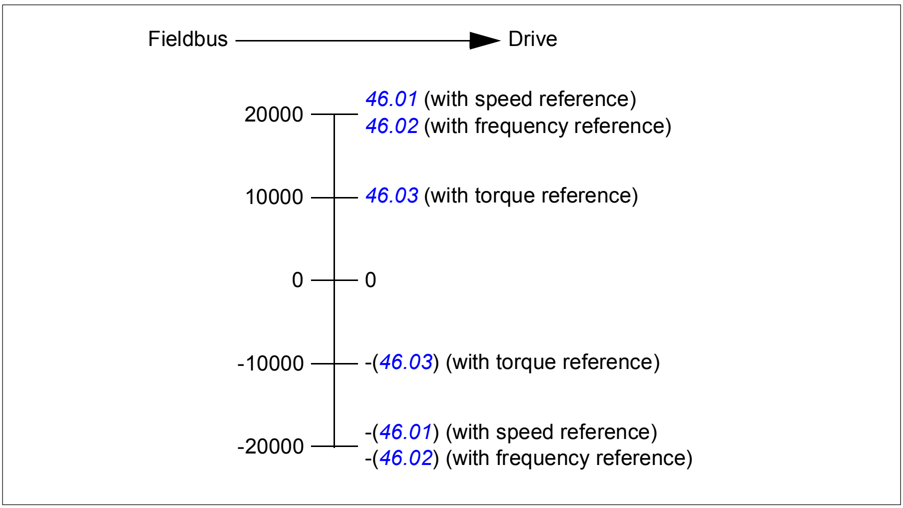
ABB drives can receive control information from multiple sources including analog and digital inputs, the drive control panel and a fieldbus adapter module. In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information such as reference. This is done using the source selection parameters in groups *22 Speed reference selection*, *26 Torque reference chain* and *28 Frequency reference chain*.

Debugging the network words

If parameter *50.12 FBA A debug enable* is set to *Enable*, the references received from the fieldbus are displayed by *50.14 FBA A reference 1* and *50.15 FBA A reference 2*.

Scaling of references

The references are scaled as defined by parameters *46.01*…*46.04*; which scaling is in use depends on the setting of *50.04 FBA A ref1 type* and *50.05 FBA A ref2 type*.



The scaled references are shown by parameters *03.05 FB A reference 1* and *03.06 FB A reference 2*.

Actual values

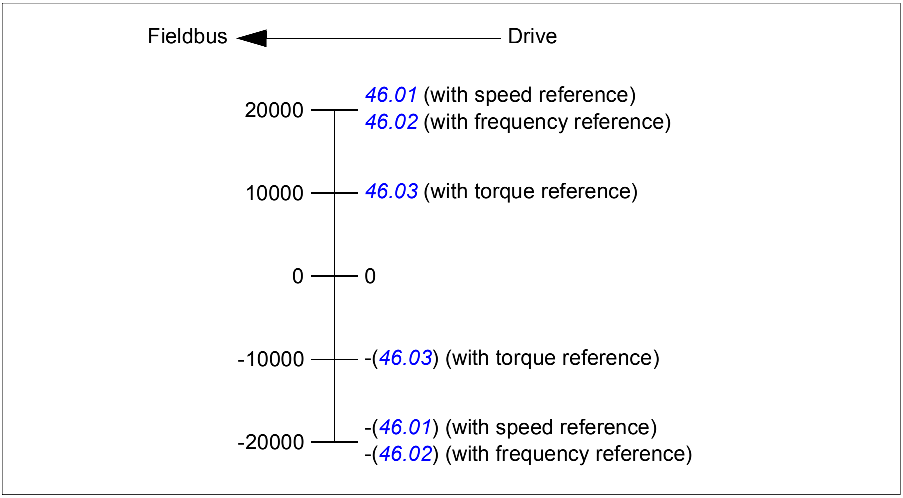
Actual values are 16-bit words containing information on the operation of the drive. The types of the monitored signals are selected by parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.

Debugging the network words

If parameter *50.12 FBA A debug enable* is set to *Enable*, the actual values sent to the fieldbus are displayed by *50.17 FBA A actual value 1* and *50.18 FBA A actual value 2*.

Scaling of actual values

The actual values are scaled as defined by parameters *46.01*…*46.04*; which scaling is in use depends on the setting of parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.



Contents of the fieldbus Control word

The upper case boldface text refers to the states shown in the state diagram (page *476*).

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 enable signal must be active; see drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	Ramp out zero	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp function generator output to zero. The drive will immediately decelerate to zero speed (observing the torque limits).
5	Ramp hold	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
6	Ramp in zero	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp function generator input to zero.
7	Reset	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source of the reset signal by drive parameters.
		0	Continue normal operation.
8	Inching 1	1	Accelerate to inching (jogging) setpoint 1. **Notes:** • Bits 4…6 must be 0. • See also section *Rush control* (page *191*).
		0	Inching (jogging) 1 disabled.
9	Inching 2	1	Accelerate to inching (jogging) setpoint 2. See notes at bit 8.
		0	Inching (jogging) 2 disabled.
10	Remote cmd	1	Fieldbus control 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	TBA
		0	TBA
13	User bit 1	1	TBA
		0	TBA

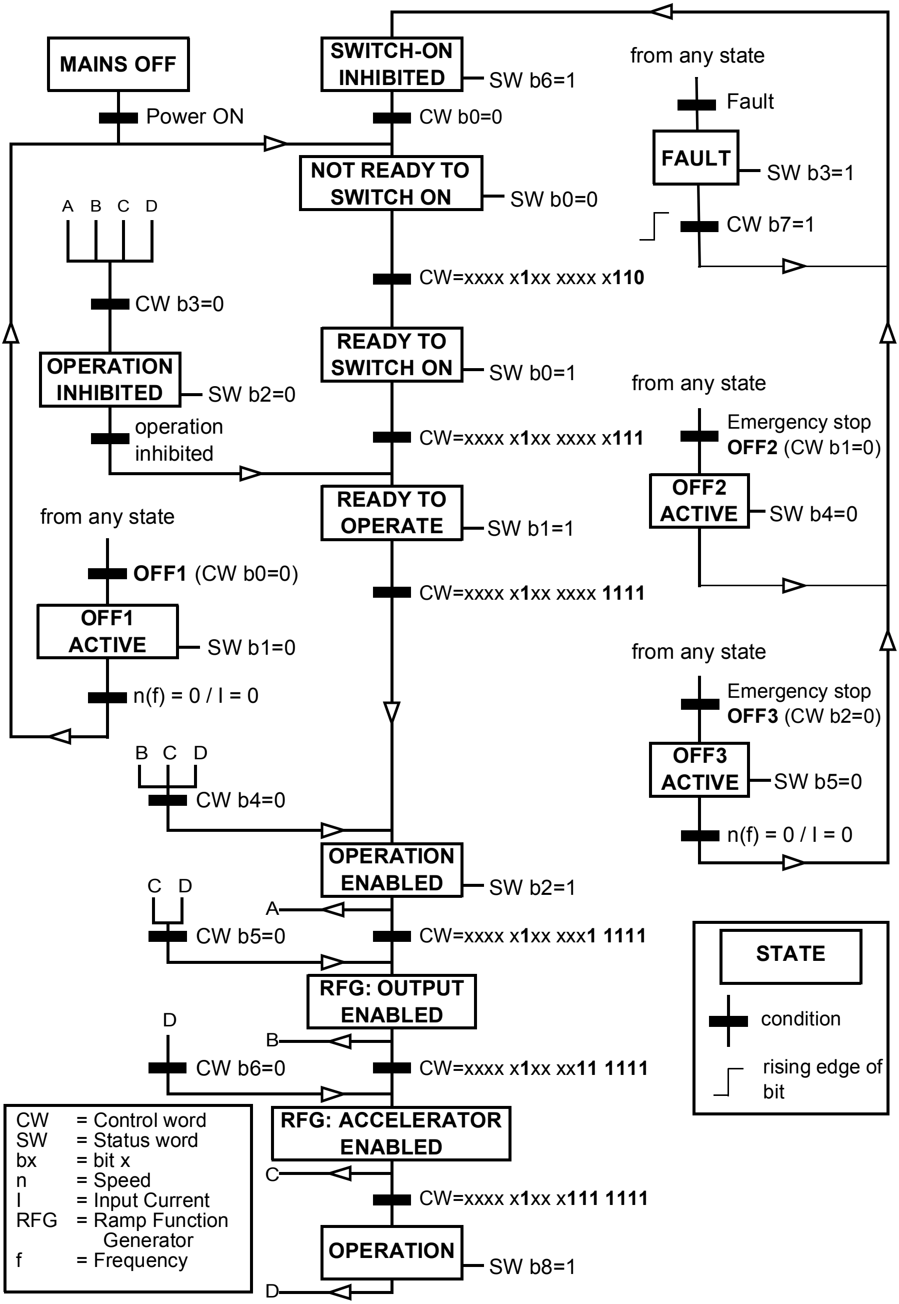
Bit	Name	Value	STATE/Description
14	User bit 2	1	TBA
		0	TBA
15	User bit 3	1	TBA
		0	TBA

Contents of the fieldbus Status word

The upper case boldface text refers to the states shown in the state diagram (page *476*).

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**.
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*…*46.23*).
		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 12 selection*.
14	User bit 3	-	See parameter *06.33 MSW bit 14 selection*.
15	Reserved		

The state diagram



Setting up the drive for fieldbus control

1. Install the fieldbus adapter module mechanically and electrically according to the instructions given in the *User's manual* of the module.
2. Power up the drive.
3. Enable the communication between the drive and the fieldbus adapter module with parameter *50.01 FBA A enable*.
4. With *50.02 FBA A comm loss func*, select how the drive should react to a fieldbus communication break.
   Note: This function monitors both the communication between the fieldbus master and the adapter module and the communication between the adapter module and the drive.
5. With *50.03 FBA A comm loss t out*, define the time between communication break detection and the selected action.
6. Select application-specific values for the rest of the parameters in group *50 Fieldbus adapter (FBA)*, starting from *50.04*. Examples of appropriate values are shown in the tables below.
7. Set the fieldbus adapter module configuration parameters in group *51 FBA A settings*. As a minimum, set the required node address and the communication profile.
8. Define the process data transferred to and from the drive in parameter groups *52 FBA A data in* and *53 FBA A data out*.
   Note: Depending on the communication protocol and profile being used, the Control word and Status word may already be configured to be sent/received by the communication system.
9. Save the valid parameter values to permanent memory by setting parameter *96.07 Parameter save manually* to *Save*.
10. Validate the settings made in parameter groups 51, 52 and 53 by setting parameter *51.27 FBA A par refresh* to *Configure*.
11. Configure control locations EXT1 and EXT2 to allow control and reference signals to come from the fieldbus. Examples of appropriate values are shown in the tables below.

Parameter setting example: FPBA (PROFIBUS DP)

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 ACS580 drives	Description
50.01 FBA A enable	**1** = [slot number]	Enables communication between the drive and the fieldbus adapter module.
50.04 FBA A ref1 type	**4** = *Speed*	Selects the fieldbus A reference 1 type and scaling.
50.07 FBA A actual 1 type	**0** = *Speed or frequency*	Selects the actual value type and scaling according to the currently active Ref1 mode defined in parameter *50.04*.
51.01 FBA A type	**1** = FPBA[1)]	Displays the type of the fieldbus adapter module.
51.02 Node address	3[2)]	Defines the PROFIBUS node address of the fieldbus adapter module.
51.03 Baud rate	12000[1)]	Displays the current baud rate on the PROFIBUS network in kbit/s.
51.04 MSG type	**1** = PPO1[1)]	Displays the telegram type selected by the PLC configuration tool.
51.05 Profile	**0** = PROFIdrive	Selects the Control word according to the PROFIdrive profile (speed control mode).
51.07 RPBA mode	**0** = Disabled	Disables the RPBA emulation mode.
52.01 FBA data in1	**4** = SW 16bit[1)]	Status word
52.02 FBA data in2	**5** = Act1 16bit	Actual value 1
52.03 FBA data in3	01.07[2)]	Motor current
52.05 FBA data in5	01.11[2)]	DC voltage
53.01 FBA data out1	**1** = CW 16bit[1)]	Control word
53.02 FBA data out2	**2** = Ref1 16bit	Reference 1 (speed)
53.03 FBA data out3	23.12[2)]	Acceleration time 1

Drive parameter	Setting for ACS580 drives	Description
53.05 FBA data out5	23.13[2)]	Deceleration time 1
51.27 FBA A par refresh	**1** = *Configure*	Validates the configuration parameter settings.
19.12 Ext1 control mode	**2** = *Speed*	Selects speed control as the control mode 1 for external control location EXT1.
20.01 Ext1 commands	**12** = *Fieldbus A*	Selects fieldbus adapter A as the source of the start and stop commands for external control location EXT1.
20.02 Ext1 start trigger type	**1** = *Level*	Selects a level-triggered start signal for external control location EXT1.
22.11 Ext1 speed ref1	**4** = *FB A ref1*	Selects fieldbus A reference 1 as the source for speed reference 1.

[1)] Read-only or automatically detected/set

[2)] Example

The start sequence for the parameter example above is given below.

Control word:

- 477h (1143 decimal) –> READY TO SWITCH ON
- 47Fh (1151 decimal) –> OPERATING (Speed mode)

18

Maintenance and hardware diagnostics

Contents of this chapter

The chapter contains preventive maintenance instructions and LED indicator descriptions.

Maintenance intervals

If installed in an appropriate environment, the drive requires very little maintenance. Section *Preventive maintenance intervals* on page *482* lists the routine maintenance intervals recommended by ABB for customer maintenance tasks.

The recommended maintenance intervals and component replacements are based on specified operational and environmental conditions. ABB recommends annual drive inspections to ensure the highest reliability and optimum performance. Consult your local ABB Service representative for more details on the maintenance. On the Internet, go to http://www.abb.com/drives. See the maintenance instructions in this chapter.

Preventive maintenance intervals

The table below shows the intervals for the preventive maintenance tasks allowed for the customer. For other maintenance tasks, consult your local ABB Service representative, or see the complete maintenance schedule on the Internet.

Maintenance task/object	Years from start-up												
	0	1	2	3	4	5	6	7	8	9	10	11	12	…
Cooling fans														
Main cooling fan (R0… R9). See page *485*.				(R)			R (R)			(R)			R (R)	
Auxiliary cooling fan for circuit boards (R6…R9). See page *489*.				R (R)			R (R)			R (R)			R (R)	
Batteries														
Control panel battery. See page *491*.										R (R)				
Connections and environment														
Quality of supply voltage		O	O	O	O	O	O	O	O	O	O	O	O	O
Improvements														
Based on product notes				I (I)			I (I)			I (I)			I (I)	
Spare parts														
Spare part stock		I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)
Reforming of DC circuit capacitors (spare modules and spare capacitors). See page *490*.		O	O	O	O	O	O	O	O	O	O	O	O	O
Other useful tasks														
Checking tightness of cable and busbar terminals. Tightening if needed.		I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)
Checking ambient conditions (dustiness, moisture, temperature)		I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)	I (I)
Cleaning the heatsink. See page *484*.		O (O)	O (O)	O (O)	O (O)	O (O)	O (O)	O (O)	O (O)	O (O)	O (O)	O (O)	O (O)	O (O)

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Symbols

- **I** **Inspection**, maintenance action if needed
- **(I)** **Inspection** in harsh conditions*, maintenance action if needed
- **R** **Replacement**
- **(R)** **Replacement** in harsh conditions*
- **O** **Other work** (commissioning, tests, measurements, etc.)

* Ambient temperature constantly over 40 °C, especially dusty or humid ambient conditions, cyclic heavy load, or continuous nominal (full) load.

To maintain the best possible performance and reliability of the drive, inspect the drive annually. Contact ABB Service at least once in three years for replacement of aging components.

Note: Recommended maintenance intervals and component replacements are based on operation in specified ambient conditions.

Heatsink

The drive heatsink fins pick up dust from the cooling air. The drive runs into overtemperature warnings and faults if the heatsink is not clean. When necessary, clean the heatsink as follows.

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

WARNING! Use a vacuum cleaner with antistatic hose and nozzle. Using a normal vacuum cleaner creates static discharges which can damage circuit boards.

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1. Stop the drive and disconnect it from the power line. Wait for 5 minutes and then make sure by measuring that there is no voltage. See section *Precautions before electrical work* on page *20* before you start the work.
2. Remove the cooling fan(s). See section *Fans* on page *485*.
3. Blow clean, dry and oilfree compressed air from bottom to top and simultaneously use a vacuum cleaner at the air outlet to trap the dust. **Note:** If there is a risk of dust entering adjoining equipment, perform the cleaning in another room.
4. Reinstall the cooling fan(s).

Fans

See section *Maintenance intervals* on page *481* for the fan replacement interval in average operation conditions. Parameter *05.04 Fan on-time counter* indicates the running time of the cooling fan. Reset the counter after a fan replacement.

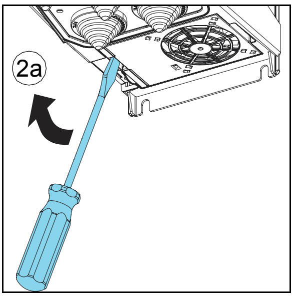
Replacement fans are available from ABB. Do not use other than ABB specified spare parts.

Replacing the cooling fan, frames R0…R3

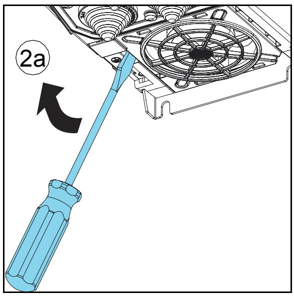
WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Stop the drive and disconnect it from the power line. Wait for 5 minutes and then make sure by measuring that there is no voltage. See section *Precautions before electrical work* on page *20* before you start the work.
2. Lever the fan assembly off the drive frame with for example a screwdriver (2a) and pull out the fan assembly (2b).

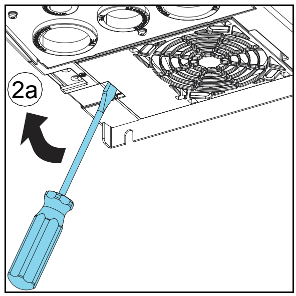
R0



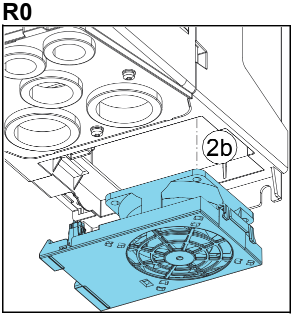
R1…R2



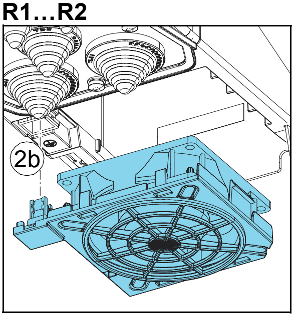
R3



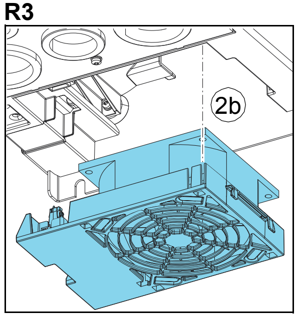
R0



R1…R2



R3

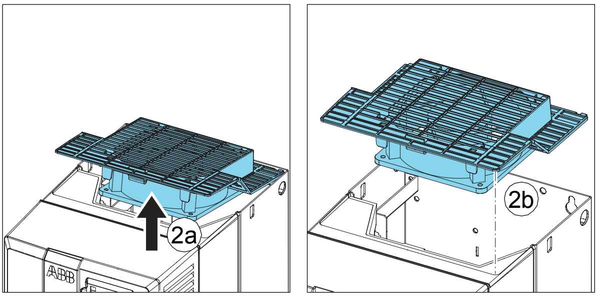


3. Install the fan assembly in reverse order.

Replacing the cooling fan, frame R5

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

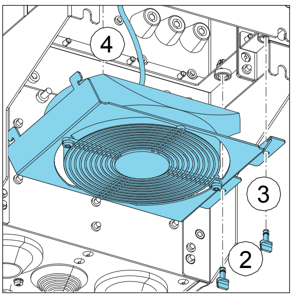
1. Stop the drive and disconnect it from the power line. Wait for 5 minutes and then make sure by measuring that there is no voltage. See section *Precautions before electrical work* on page *20* before you start the work.
2. Lift the fan assembly upwards from the front edge (2a) and remove the assembly (2b).
3. Install the new fan assembly in reverse order.

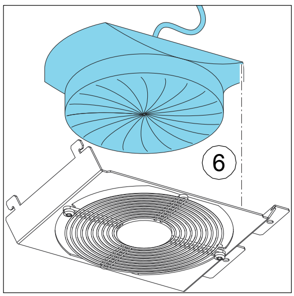


Replacing the main cooling fan, frames R6…R8

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Stop the drive and disconnect it from the power line. Wait for 5 minutes and then make sure by measuring that there is no voltage. See section *Precautions before electrical work* on page *20* before you start the work.
2. Undo the two mounting screws of the fan mounting plate at the bottom of the drive.
3. Pull the fan mounting plate down from the side edge.
4. Unplug the fan power supply wires from the drive.
5. Lift the fan mounting plate off.
6. Remove the fan from the mounting plate.
7. Install the new fan in reverse order.

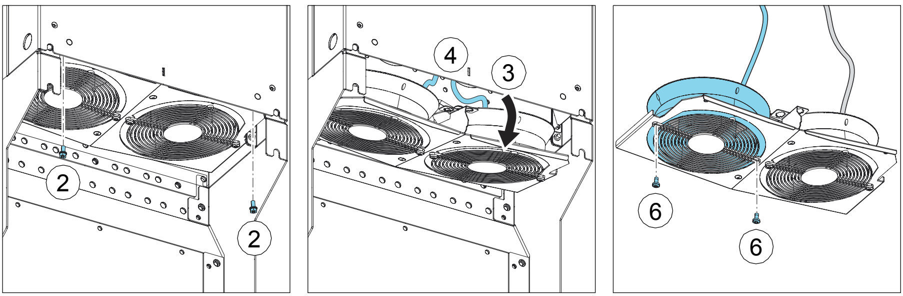




Replacing the main cooling fans, frame R9

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

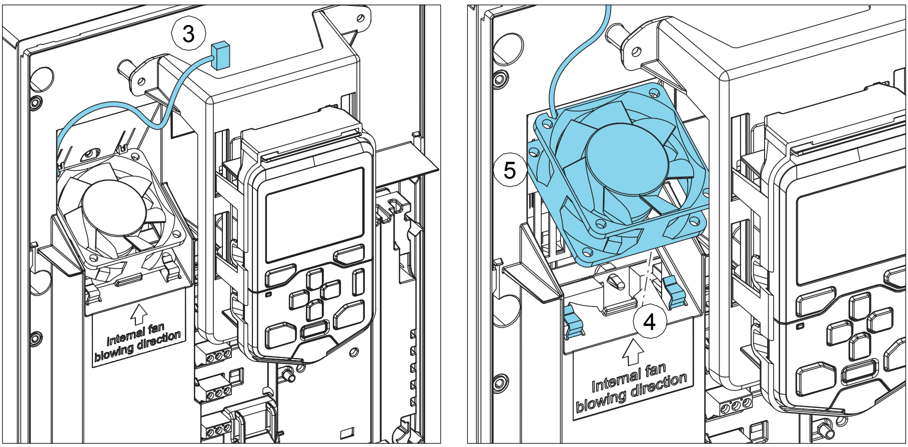
1. Stop the drive and disconnect it from the power line. Wait for 5 minutes and then make sure by measuring that there is no voltage. See section *Precautions before electrical work* on page *20* before you start the work.
2. Undo the two mounting screws of the fan mounting plate.
3. Turn the mounting plate downwards.
4. Unplug the fan power supply wires from the drive.
5. Remove the fan mounting plate.
6. Remove the fans by undoing the two mounting screws.
7. Install the new fans in reverse order.



Replacing the auxiliary cooling fan, frames R6…R9

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.

1. Stop the drive and disconnect it from the power line. Wait for 5 minutes and then make sure by measuring that there is no voltage. See section *Precautions before electrical work* on page *20* before you start the work.
2. Remove the front cover (see page *58*).
3. Unplug fan power supply wires from the drive.
4. Release the retaining clips.
5. Lift the fan off.
6. Install the new fan in reverse order. Make sure that the arrow on the fan points up.



Capacitors

The drive intermediate DC circuit employs several electrolytic capacitors. Their lifespan depends on the operating time of the drive, loading and ambient temperature. Capacitor life can be prolonged by lowering the ambient temperature.

Capacitor failure is usually followed by damage to the drive and an input cable fuse failure, or a fault trip. Contact ABB if capacitor failure is suspected. Replacements are available from ABB. Do not use other than ABB specified spare parts.

Reforming the capacitors

The capacitors must be reformed if the drive has been stored for a year or more. See section *Type designation label* on page *40* for how to find out the manufacturing date from the serial number.

For information on reforming the capacitors, see *Converter module capacitor reforming instructions* (3BFE64059629 [English]), available on the Internet (go to http://www.abb.com and enter the code in the Search field).

Control panel

Cleaning the control panel

Use a soft damp cloth to clean the control panel. Avoid harsh cleaners which could scratch the display window.

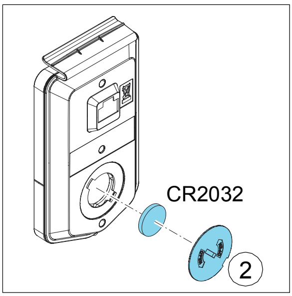
Replacing the battery in the assistant control panel

A battery is only used in assistant control panels that have the clock function. The battery keeps the clock operating in memory during power interruptions.

The expected life for the battery is greater than ten years.

Note: The battery is NOT required for any control panel or drive functions, except the clock.

1. Remove the control panel from the drive. See section *Control panel* on page *39*.
2. To remove the battery, use a coin to rotate the battery cover on the back of the control panel.
3. Replace the battery with type CR2032. Dispose the old battery according to local disposal rules or applicable laws.



LEDs

Drive LEDs

There is a green POWER and a red FAULT LED on the front of the drive. They are visible through the panel cover but invisible if a control panel is attached to the drive. The table below describes the drive LED indications.

<table>
<tr><td colspan="5">Drive LEDs POWER and FAULT, on the front of the drive, under the control panel / panel cover
If a control panel is attached to the drive, switch to remote control (otherwise a fault will be generated), and then remove the panel to be able to see the LEDs</td></tr>
<tr><td>LEDs off</td><td colspan="2">LED lit and steady</td><td colspan="2">LED blinking</td></tr>
<tr><td rowspan="2">No power</td><td>Green (POWER)</td><td>Power supply on the board OK</td><td>Green (POWER)</td><td><u>Blinking:</u>
Drive in an alarm state
<u>Blinking for one second:</u>
Drive selected on the control panel when multiple drives are connected to the same panel bus.</td></tr>
<tr><td>Red (FAULT)</td><td>Active fault in the drive. To reset the fault, press RESET from the control panel or switch off the drive power.</td><td>Red (FAULT)</td><td>Active fault in the drive. To reset the fault, switch off the drive power.</td></tr>
</table>

Assistant panel LEDs

The assistant control panel has one LED. The table below describes the control panel LED indications. For more information see A*CS-AP-x assistant control panels user's manual* (3AUA0000085685 [English]).

Assistant control panel LED, at the left edge of the control panel				
LED off	**LED lit and steady**		**LED blinking/flickering**	
Panel has no power.	Green	Drive functioning normally. Connection between the drive and control panel may be faulty or lost, or the panel and drive may be incompatible. Check the control panel display.	Green	<u>Blinking:</u> Active warning in the drive <u>Flickering:</u> Data transferred between the PC tool and drive through the USB connection of the control panel
	Red	Check the display to see where the fault is. • Active fault in the drive. Reset the fault. • Active fault in another drive in the panel bus. Switch to the drive in question and check and reset the fault.	Red	Active fault in the drive. To reset the fault, cycle the drive power.

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Technical data

Contents of this chapter

The chapter contains the technical specifications of the drive, for example ratings, sizes and technical requirements as well as provisions for fulfilling the requirements for CE, UL and other approval marks.

Ratings

IEC ratings

Type ACS580 -01-	Input rating	Max. current	Output ratings						Frame size
			Nominal use		Light- duty use		Heavy-duty use		
	I_{1N} A	I_{max} A	I_N A	P_N kW	I_{Ld} A	P_{Ld} kW	I_{Hd} A	P_{Hd} kW	
3-phase U_N = 400 V (380…415 V)									
02A6-4	2.6	3.2	2.6	0.75	2.5	0.75	1.8	0.55	R0
03A3-4	3.3	4.7	3.3	1.1	3.1	1.1	2.6	0.75	R0
04A0-4	4.0	5.9	4.0	1.5	3.8	1.5	3.3	1.1	R0
05A6-4	5.6	7.2	5.6	2.2	5.3	2.2	4.0	1.5	R0
07A2-4	7.2	10.1	7.2	3.0	6.8	3.0	5.6	2.2	R1
09A4-4	9.4	13.0	9.4	4.0	8.9	4.0	7.2	3.0	R1
12A6-4	12.6	14.1	12.6	5.5	12.0	5.5	9.4	4.0	R1
017A-4	17.0	22.7	17.0	7.5	16.2	7.5	12.6	5.5	R2
025A-4	25.0	30.6	25.0	11.0	23.8	11.0	17.0	7.5	R2
032A-4	32.0	44.3	32.0	15.0	30.4	15.0	24.6	11.0	R3
038A-4	38.0	56.9	38.0	18.5	36.1	18.5	31.6	15.0	R3
045A-4	45.0	67.9	45.0	22.0	42.8	22.0	37.7	18.5	R3
061A-4	61	76	61	30	58	30	45	22	R5
072A-4	72	104	72	37	68	37	61	30	R5
087A-4	87	122	87	45	83	45	72	37	R5
105A-4	105	148	105	55	100	55	87	45	R6
145A-4	145	178	145	75	138	75	105	55	R6
169A-4	169	247	169	90	161	90	145	75	R7
206A-4	206	287	206	110	196	110	169	90	R7
246A-4	246	350	246	132	234	132	206	110	R8
293A-4	293	418	293	160	278	160	246[1)]	132	R8
363A-4	363	498	363	200	345	200	293	160	R9
430A-4	430	617	430	250	400	200	363[2)]	200	R9

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See definitions and notes on page *497*.

NEMA ratings

Type ACS580 -01-	Input rating	Output ratings				Frame size
		Nominal use		Heavy-duty use		
	I_{1N}	I_{Ld}	P_{Ld}	I_{Hd}	P_{Hd}	
	A	A	hp	A	hp	
3-phase U_N = 460 V (440…480 V)						
02A6-4	2.1	2.1	1.0	1.6	0.75	R0
03A3-4	3.0	3.0	1.5	2.1	1.0	R0
04A0-4	3.4	3.4	2.0	3.0	1.5	R0
05A6-4	4.8	4.8	3.0	3.4	2.0	R0
07A2-4	6.0	6.0	3.0	4.0	3.0	R1
09A4-4	7.6	7.6	5.0	4.8	3.0	R1
12A6-4	11.0	11.0	7.5	7.6	5.0	R1
017A-4	14.0	14.0	10.0	11.0	7.5	R2
025A-4	21.0	21.0	15.0	14.0	10.0	R2
032A-4	27.0	27.0	20.0	21.0	15.0	R3
038A-4	34.0	34.0	25.0	27.0	20.0	R3
045A-4	40.0	40.0	30.0	34.0	25.0	R3
061A-4	52	52	40	40	30	R5
072A-4	65	65	50	52	40	R5
087A-4	77	77	60	65	50	R5
105A-4	96	96	75	77	60	R6
145A-4	124	124	100	96	75	R6
169A-4	156	156	125	124	100	R7
206A-4	180	180	150	156	125	R7
246A-4	240	240	200	180	150	R8
293A-4	260	260	200	240[1)]	150	R8
363A-4	361	361	300	302	250	R9
430A-4	414	414	350	361[2)]	300	R9

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Definitions

U_N	Nominal supply voltage
I_{1N}	Nominal input current. Continuous rms input current (for dimensioning cables and fuses).
I_{max}	Maximum output current. Available for two seconds at start.
I_N	Nominal output current. Maximum continuous rms output current allowed (no overload).
P_N	Nominal power of the drive. Typical motor power (no overloading). The kilowatt ratings apply to most IEC 4-pole motors. The horsepower ratings apply to most NEMA 4-pole motors.
I_{Ld}	Maximum current with 110% overload, allowed for one minute every ten minutes
P_{Ld}	Typical motor power in light-duty use (110% overload)

I_{Hd}	Maximum current with 150% overload, allowed for one minute every ten minutes 1) Maximum current with 130% overload, allowed for one minute every ten minutes 2) Maximum current with 125% overload, allowed for one minute every ten minutes
P_{Hd}	Typical motor power in heavy-duty use (150% overload)

Sizing

Drive sizing is based on the rated motor current and power. To achieve the rated motor power given in the table, the rated current of the drive must be higher than or equal to the rated motor current. Also the rated power of the drive must be higher than or equal to compared to the rated motor power. The power ratings are the same regardless of the supply voltage within one voltage range.

Note: For frames R0…R3 the ratings apply at ambient temperature of 50 °C (122 °F) for I_N. For frames R5…R9, the ratings apply at ambient temperature of 40 °C (104 °F) for I_N. Above theses temperatures derating is required.

The DriveSize dimensioning tool available from ABB is recommended for selecting the drive, motor and gear combination.

Derating

The load capacity (I_N, I_{Ld}, I_{Hd}; note that I_{max} is not derated) decreases for certain situations, as defined below. In such situations, where full motor power is required, oversize the drive so that the derated value provides sufficient capacity.

Note: If several situations are present at a time, the effect of derating for each situation is cumulative.

Example:

If your application requires continuous 12.0 A of motor current (I_N) at 8 kHz switching frequency, the supply voltage is 400 V and the drive is situated at 1500 m, calculate the appropriate drive size requirement as follows:

Switching frequency derating (page 499):
The minimum size required is I_N = 12.0 A / 0.66 = 18.18 A,
where 0.66 is the derating for 8 kHz switching frequency (frames R0…R3).

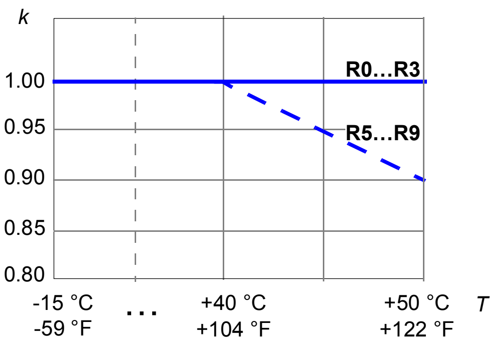
Altitude derating (page 499):
The derating factor for 1500 m is 1 - 1/1000 m · (1500 - 1000) m = 0.95.
The minimum size required becomes then I_N = 18.18 A / 0.95 = 19.14 A.

Referring to I_N in the ratings tables (starting from page 496), drive type ACS580-01-025A-4 exceeds the I_N requirement of 19.24 A.

Ambient temperature derating, IP21

Frame size	Temperature range	
R0…R3	up to +50 °C up to +122 °F	No derating
R5…R9	up to +40 °C up to +104 °F	No derating
	+40…+50 °C +104…+122 °F	Derate 1% for every 1 °C (1.8 °F)

The output current is calculated by multiplying the current given in the rating table by the derating factor (k, in the diagram below).



Switching frequency derating

The output current is calculated by multiplying the current given in the rating table by the derating factor given in the table below.

Note: If you change the minimum switching frequency with parameter *97.02 Minimum switching frequency*, derate according to the table below. Changing parameter *97.01 Switching frequency reference* does not require derating.

Frame size	Derating factor (k) for the minimum switching frequencies				
	1 kHz	2 kHz	4kHz	8 kHz	12 kHz
R0…R3	1	TBA	TBA	TBA	TBA
R5	1	TBA	TBA	TBA	TBA
R6	1	TBA	TBA	TBA	TBA
R7	1	TBA	TBA	TBA	TBA
R8	1	TBA	TBA	TBA	N/A
R9	1	TBA	TBA	TBA	N/A

Altitude derating

In altitudes 1000…4000 m (3300…13120 ft) above sea level, the derating is 1% for every 100 m (330 ft).

The output current is calculated by multiplying the current given in the rating table by the derating factor k, which for x meters (1000 m <= x <= 4000 m) is:

$k = 1 - 1/1000\ \text{m} \cdot (x - 1000)\ \text{m}$

Check the network compatibility restrictions above 2000 m (6562 ft), see *Installation site altitude* on page *515*. Check also PELV limitation on relay output terminals above 2000 m (6562 ft), see sections *Isolation areas, R0…R3:* on page *513* and *Isolation areas, R5…R9:* on page *514*.

Fuses (IEC)

gG as well as uR or aR fuses for protection against short-circuit in the input power cable or drive are listed below. Either fuse type can be used for frames R0…R3 and R5…R6 if it operates rapidly enough. The operating time depends on the supply network impedance and the cross-sectional area and length of the supply cable. For frames R7…R9 ultrarapid (aR) fuses must be used.

Note 1: See also *Implementing thermal overload and short-circuit protection* on page *68*.

Note 2: Fuses with higher current rating than the recommended ones must not be used.

Note 3: Fuses from other manufacturers can be used if they meet the ratings and the melting curve of the fuse does not exceed the melting curve of the fuse mentioned in the table.

gG fuses

Check on the fuse time-current curve to ensure the operating time of the fuse is below 0.5 seconds. Obey the local regulations.

Type ACS580 -01-	Min. short-circuit current1)	Input current	gG (IEC 60269)				
			Nominal current	I^2t	Voltage rating	ABB type	IEC 60269 size
	A	A	A	A^2s	V		
3-phase U_N = 400 or 460 V (380…415 V, 440…480 V)							
02A6-4	32	2.6	4	55	500	OFAF000H4	000
03A3-4	48	3.3	6	110	500	OFAF000H6	000
04A0-4	48	4.0	6	110	500	OFAF000H6	000
05A6-4	80	5.6	10	360	500	OFAF000H10	000
07A2-4	80	7.2	10	360	500	OFAF000H10	000
09A4-4	128	9.4	16	740	500	OFAF000H16	000
12A6-4	128	12.6	16	740	500	OFAF000H16	000
017A-4	200	17.0	25	2500	500	OFAF000H25	000
025A-4	256	25.0	32	4000	500	OFAF000H32	000
032A-4	320	32.0	40	7700	500	OFAF000H40	000
038A-4	400	38.0	50	16000	500	OFAF000H50	000
045A-4	500	45.0	63	20100	500	OFAF000H63	000
061A-4	800	61	80	37500	500	OFAF000H80	000
072A-4	1000	72	100	65000	500	OFAF000H100	000
087A-4	1000	87	100	65000	500	OFAF000H100	000
105A-4	1300	105	125	100000	500	OFAF00H125	00
145A-4	1700	145	160	170000	500	OFAF00H160	00
169A-4	N/A	169	Use aR fuses only.				
206A-4	N/A	206					
246A-4	N/A	246					
293A-4	N/A	293					

Type ACS580 -01-	Min. short-circuit current[1)]	Input current	gG (IEC 60269)				
			Nominal current	I^2t	Voltage rating	ABB type	IEC 60269 size
	A	A	A	A^2s	V		
363A-4	N/A	363	Use aR fuses only.				
430A-4	N/A	430					

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[1)] Minimum short-circuit current of the installation

uR and aR fuses

Type ACS580 -01-	Min. short-circuit current[1)]	Input current	uR or aR				
			Nominal current	I^2t	Voltage rating	Bussmann type	IEC 60269 size
	A	A	A	A^2s	V		
3-phase U_N = 400 or 460 V (380…415 V, 440…480 V)							
02A6-4	TBA	2.6	25	130	690	170M1561	000
03A3-4	TBA	3.3	25	130	690	170M1561	000
04A0-4	TBA	4.0	25	130	690	170M1561	000
05A6-4	TBA	5.6	25	130	690	170M1561	000
07A2-4	TBA	7.2	25	130	690	170M1561	000
09A4-4	TBA	9.4	25	130	690	170M1561	000
12A6-4	TBA	12.6	25	130	690	170M1561	000
017A-4	TBA	17.0	40	460	690	170M1563	000
025A-4	TBA	25.0	40	460	690	170M1563	000
032A-4	TBA	32.0	63	1450	690	170M1565	000
038A-4	TBA	38.0	63	1450	690	170M1565	000
045A-4	TBA	45.0	80	2550	690	170M1566	000
061A-4	380	61	100	4650	690	170M1567	1
072A-4	480	72	125	8500	690	170M1568	1
087A-4	480	87	125	8500	690	170M1568	1
105A-4	700	105	160	16000	690	170M1569	1
145A-4	700	145	200	28000	690	170M1570	1
169A-4	1280	169	315	46500	690	170M3817	1
206A-4	1280	206	315	46500	690	170M3817	1
246A-4	1520	246	350	68500	690	170M3818	1
293A-4	1810	293	400	105000	690	170M3819	1
363A-4	2620	363	550	190000	690	170M5811	1
430A-4	3010	430	630	275000	690	170M5812	1

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[1)] Minimum short-circuit current of the installation

Dimensions, weights and free space requirements

Frame size	Dimensions and weights IP21 / UL type 1						
	H1 mm	H2 mm	H3 mm	H4 mm	W mm	D mm	Weight kg
R0	330.0	303.0	N/A	N/A	125.0	210.0	4.47
R1	330.0	303.0	N/A	N/A	125.0	223.0	4.57
R2	430.0	394.0	N/A	N/A	125.0	227.0	7.54
R3	490.0	454.0	N/A	N/A	203.0	228.0	14.86
R5	596.0	597.5	726.0	626.5	203.0	283.0	23.00
R6	548.0	549.3	726.0	589.4	252.0	369.0	45.00
R7	600.0	601.3	880.0	641.4	284.0	370.0	55.00
R8	680.0	677.3	965.0	721.1	300.0	393.0	70.00
R9	680.0	680.0	955.0	741.4	380.0	418.0	98.00

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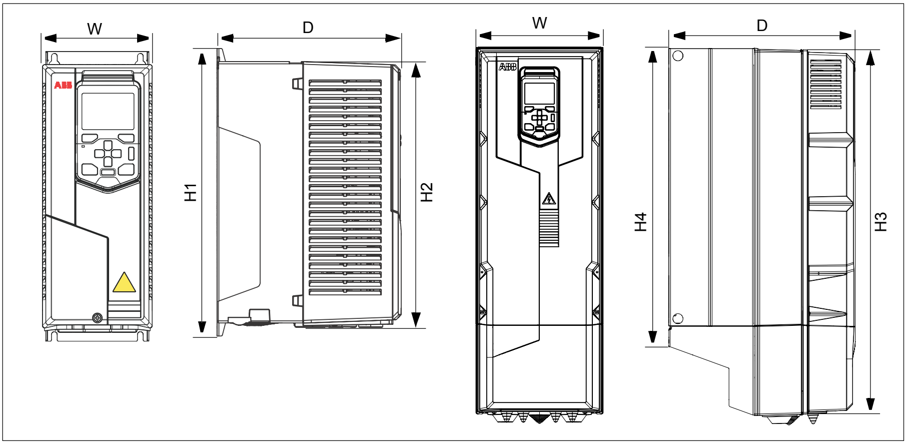

Symbols
IP21 / UL type 1
H1 Height back without gland box
H2 Height front without gland box
H3 Height front with gland box
H4 Height back with gland box
W Width
D Depth

Frame size	Free space							
	Vertical mounting stand alone		Vertical mounting side by side			Horizontal mounting		
	Above	Below	Above	Below	Between	Above	Below	Between
	mm	mm	mm	mm	mm	mm	mm	mm
R0	200	200	200	200	0	TBA	TBA	TBA
R1	200	200	200	200	0	TBA	TBA	TBA
R2	200	200	200	200	0	TBA	TBA	TBA
R3	200	200	200	200	0	TBA	TBA	TBA
R5	200	300	200	300	0	TBA	TBA	TBA
R6	200	300	200	300	0	TBA	TBA	TBA
R7	200	300	200	300	0	TBA	TBA	TBA
R8	200	300	200	300	0	TBA	TBA	TBA
R9	200	300	200	300	0	TBA	TBA	TBA

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See the figures in section *Checking the installation site* on page *44*.

Losses, cooling data and noise

The air flow direction is from bottom to top.

The table below specifies the heat dissipation in the main circuit at nominal load and in the control circuit with minimum load (I/O, options and panel not in use) and maximum load (all digital inputs and relays in the ON state, and the panel, fieldbus and fan in use). The total heat dissipation is the sum of the heat dissipation in the main and control circuits. Use the maximum losses when designing cabinet or electrical room cooling needs.

Type ACS580 -01-	Heat dissipation				Air flow	Noise	Frame size
	Main circuit at rated I_{1N} at I_N	Control circuit minimum	Control circuit maximum	Main and control boards maximum			
	W	W	W	W	m^3/h	dB(A)	
3-phase U_N = 400 or 460 V (380…415 V, 440…480 V)							
02A6-4	20	3.5	25	45	TBA	TBA	R0
03A3-4	30	3.5	25	55	TBA	TBA	R0
04A0-4	41	3.5	25	66	TBA	TBA	R0
05A6-4	59	3.5	25	84	TBA	TBA	R0
07A2-4	81	3.5	25	106	TBA	TBA	R1
09A4-4	108	3.5	25	133	TBA	TBA	R1
12A6-4	149	3.5	25	174	TBA	TBA	R1
017A-4	203	3.5	25	228	TBA	TBA	R2
025A-4	297	3.5	25	322	TBA	TBA	R2
032A-4	405	3.5	25	430	TBA	TBA	R3
038A-4	500	3.5	25	525	TBA	TBA	R3
045A-4	594	3.5	25	619	TBA	TBA	R3
061A-4	1117	4.1	36	1153	280	62	R5
072A-4	1117	4.1	36	1153	280	62	R5
087A-4	1120	4.1	36	1156	280	62	R5
105A-4	1295	4.1	36	1331	435	67	R6
145A-4	1440	4.1	36	1476	435	67	R6
169A-4	1940	4.1	36	1976	450	67	R7
206A-4	2310	4.1	36	2346	550	67	R7
246A-4	3300	4.1	36	3336	550	65	R8
293A-4	3900	4.1	36	3936	1150	65	R8
363A-4	4800	4.1	36	4836	1150	68	R9
430A-4	6000	4.1	36	6036	1150	68	R9

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Terminal and lead-through data for the power cables

Input, motor, resistor and DC cable cable lead-throughs, maximum wire sizes (per phase) and terminal screw sizes and tightening torques (*T*) are given below.

Frame size	Cable lead-throughs		L1, L2, L3, T1/U, T2/V, T3/W terminals					Grounding terminals	
	Per cable type	Ø[1]	Max wire size (solid/ stranded)	*T* (Wire screw)		*T* (Terminal nut)		Max wire size	*T*
	pcs	mm	mm^2	M…	N·m	M…	N·m	mm^2	N·m
R0	1	30	6/4	TBA	0.5…0.6	N/A	N/A	TBA	TBA
R1	1	30	6/4	TBA	0.5…0.6	N/A	N/A	TBA	TBA
R2	1	30	16/16	TBA	1.2…1.5	N/A	N/A	TBA	TBA
R3	1	30	35/25	TBA	2.5…4.5	N/A	N/A	TBA	TBA
R5	1	32	70	M8	5.6	N/A	N/A	35	2.9
R6	1	45	150	M10	30	N/A	N/A	185	9.8
R7	1	54	240	M10	40	N/A	N/A	185	9.8
R8	2	45	2×150	M10	40	M10	24	2×185	9.8
R9	2	54	2×240	M12	70	M10	24	2×185	9.8

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[1] Maximum cable diameter accepted. For the lead-through plate hole diameters, see chapter *Dimension drawings* on page *523*.

Frame size	Cable lead-throughs		R+, R-, UDC+ and UDC- terminals				
	Per cable type	Ø[1]	Max wire size (solid/stranded)	*T* (Wire screw)		*T* (Terminal nut)	
	pcs	mm	mm^2	M…	N·m	M…	N·m
R0	1	23	6/4		0.5…0.6	N/A	N/A
R1	1	23	6/4		0.5…0.6	N/A	N/A
R2	1	23	16/16		1.2…1.5	N/A	N/A
R3	1	23	35/25		2.5…4.5	N/A	N/A
R5	1	32	70	M8	5.6	N/A	N/A
R6	1	45	150	M8	20	N/A	N/A
R7	1	54	240	M10	30	N/A	N/A
R8	2	45	2×150	M10	40	M10	24
R9	2	54	2×240	M12	70	M10	24

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[1] Maximum cable diameter accepted. For the lead-through plate hole diameters, see chapter *Dimension drawings* on page *523*.

Terminal and lead-through data for the control cables

Control cable lead-throughs, wire sizes and tightening torques (*T*) are given below.

Frame size	**Cable lead-throughs**		**Control cable entries and terminal sizes**			
	Holes	**Max cable size**	**+24V, DCOM, DGND, EXT. 24V**		**DI, AI/O, AGND, RO, STO terminals**	
			Wire size	***T***	**Wire size**	***T***
	pcs	mm	mm^2	N·m	mm^2	N·m
R0	3	17	0.2…2.5	0.5…0.6	0.14…1.5	0.5…0.6
R1	3	17	0.2…2.5	0.5…0.6	0.14…1.5	0.5…0.6
R2	3	17	0.2…2.5	0.5…0.6	0.14…1.5	0.5…0.6
R3	3	17	0.2…2.5	0.5…0.6	0.14…1.5	0.5…0.6
R5	2	22	0.14…2.5	0.5…0.6	0.14…2.5	0.5…0.6
R6	4	17	0.14…2.5	0.5…0.6	0.14…2.5	0.5…0.6
R7	4	17	0.14…2.5	0.5…0.6	0.14…2.5	0.5…0.6
R8	4	17	0.14…2.5	0.5…0.6	0.14…2.5	0.5…0.6
R9	4	17	0.14…2.5	0.5…0.6	0.14…2.5	0.5…0.6

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Electrical power network specification

Voltage (U_1)	380 … 480 V AC 3-phase +10%…-15%
Network type	TN (grounded), IT (ungrounded) and corner-grounded TN systems. See section *Checking the compatibility with IT (ungrounded) and corner-grounded TN systems* on page *77*.
Rated conditional short-circuit current (IEC 61439-1)	65 kA when protected by fuses given in the fuse tables
Frequency	47 to 63 Hz
Imbalance	Max. ± 3% of nominal phase to phase input voltage
Fundamental power factor (cos phi_1)	0.98 (at nominal load)

Motor connection data

Motor types	Asynchronous AC induction motors and permanent magnet motors
Voltage (U_2)	0 to U_1, 3-phase symmetrical, U_{max} at the field weakening point
Short-circuit protection (IEC/EN 61800-5-1, UL 508C)	The motor output is short-circuit proof by IEC/EN 61800-5-1 and UL 508C.
Frequency	0.…500 Hz
Frequency resolution	0.01 Hz
Current	See section *Ratings* on page *496*.
Switching frequency	2 kHz, 4 kHz, 8 kHz, 12 kHz (depends on the frame and parameter settings)

Maximum recommended motor cable length

Operational functionality and motor cable length

The drive is designed to operate with optimum performance with the following maximum motor cable lengths.

Note: These motor cable lengths do not comply with EMC requirements.

Frame size	Maximum motor cable length, 4 kHz			
	Scalar control		Vector control	
	m	ft	m	ft
Standard drive, without external options				
R0	100	330	100	330
R1	100	330	100	330
R2	200	660	200	660
R3	300	990	300	990
R5	300	990	300	990
R6	300	990	300	990
R7	300	990	300	990
R8	300	990	300	990
R9	300	990	300	990

Note: In multimotor systems, the calculated sum of all motor cable lengths must not exceed the maximum motor cable length given in the table.

EMC compatibility and motor cable length

To comply with the European EMC Directive (standard EN 61800-3), use the following maximum motor cable lengths at 4 kHz switching frequency.

Frame size	Maximum motor cable length, 4 kHz	
	m	ft
EMC limits for Category C2 [1)] Standard drive with internal EMC filter. See Notes 2, 3.		
R0	100	330
R1	100	330
R2	100	330
R3	100	330
R5	100	330
R6	150	492
R7	150	492
R8	150	492
R9	150	492
EMC limits for Category C3 [1)] Standard drive with internal EMC filter. See Note 3.		
R0	100	330
R1	100	330
R2	100	330
R3	100	330
R5	100	330
R6	150	492
R7	150	492
R8	150	492
R9	150	492

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[1)] See the terms in section *Definitions* on page *519*.

Note 2: Radiated emissions are according to C2 with and without an external EMC filter.

Note 3: The internal EMC filter must be connected.

Brake resistor connection data

Short-circuit protection (IEC/EN 61800-5-1, IEC 60439-1, UL 508C)

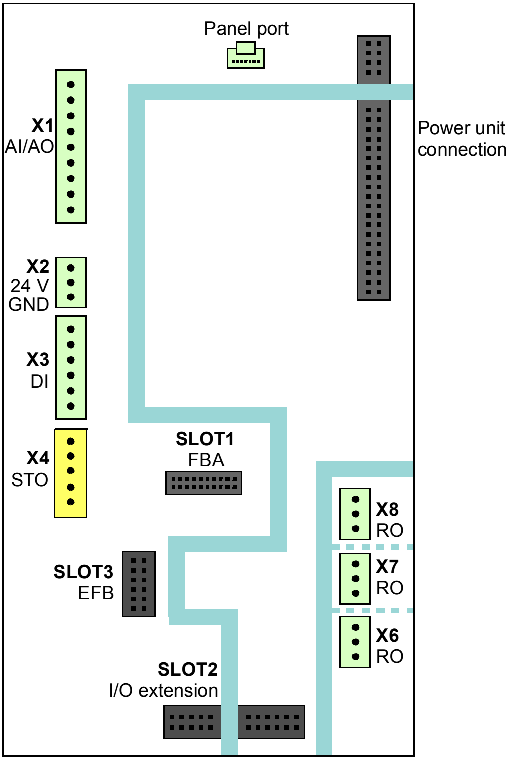
The brake resistor output is conditionally short-circuit proof by IEC/EN 61800-5-1 and UL 508C. For correct fuse selection, contact your local ABB representative. Rated conditional short-circuit current as defined in IEC 60439-1.

Control connection data

External power supply	Maximum power: Frames R0…R3: 25 W, 1.04 A at 24 V AC/DC ±10% with an optional module Frames R5…R9: 36 W, 1.50 A at 24 V AC/DC ±10% as standard Supplied from an external power supply through optional module CMOD-01 or CMOD-02. Terminal size: Frames R0…R3: 0.2…2.5 mm^2 Frames R5…R9: 0.14…2.5 mm^2
+24 V DC output (Term. 10)	Total load capacity of this outputs is 6.0 W (250 mA / 24 V) minus the power taken by the option modules installed on the board. Terminal size: Frames R0…R3: 0.2…2.5 mm^2 Frames R5…R9: 0.14…2.5 mm^2
Digital inputs DI1…DI6 (Term. 13…18)	Input type: NPN/PNP Terminal size: Frames R0…R3: 0.14…1.5 mm^2 Frames R5…R9: 0.14…2.5 mm^2 DI1…DI5 (Term.13…17) 12/24 V DC logic levels: “0” < 4 V, “1” > 8 V R_{in}: 2,68 kohm Hardware filtering: 0.04 ms, digital filtering: 2 ms sampling DI6 (Term.18) Can be used as a digital or frequency input. 12/24 V DC logic levels: “0” < 3 V, “1” > 8 V R_{in}: 6.2 kohm Max. frequency 16 kHz Symmetrical signal (duty cycle D = 0.50)
Relay outputs RO1…RO3 (Term. 19…27)	250 V AC / 30 V DC, 2 A Terminal size: Frames R0…R3: 0.14…1.5 mm^2 Frames R5…R9: 0.14…2.5 mm^2 See sections *Isolation areas, R0…R3:* on page *513* and *Isolation areas, R5…R9:* on page *514*.
Analog inputs AI1 and AI2 (Term. 2 and 5)	Current/voltage input mode selected with a dip switch, see page *100*. Current input: 0(4)…20 mA, R_{in}: 100 ohm Voltage input: 0(2)…10 V, R_{in}: > 200 koh Terminal size: Frames R0…R3: 0.14…1.5 mm^2 Frames R5…R9: 0.14…2.5 mm^2 Inaccuracy: typical ±1%, max. ±1.5% of full scale

Analog outputs AO1 and AO2 (Term. 7 and 8)	Current/voltage output mode for AO1 selected with a dip switch, see page 100. Current output: 0…20 mA, R_{load}: < 500 ohm Voltage input: 0…10 V, R_{load}: > 100 kohm (AO1 only) Terminal size: Frames R0…R3: 0.14…1.5 mm^2 Frames R5…R9: 0.14…2.5 mm^2 Inaccuracy: ±1% of full scale (in voltage and current modes)
Reference voltage output for analog inputs +10V DC (Term. 4)	Max. 20 mA output Inaccuracy: ±1%
Safe torque off (STO) inputs IN1 and IN2 (Term. 37 and 38)	24 V DC logic levels: “0” < 5 V, “1” > 13 V R_{in}: 2.47 kohm Terminal size: Frames R0…R3: 0.14…1.5 mm^2 Frames R5…R9: 0.14…2.5 mm^2
Control panel - drive connection	EIA-485, male RJ-45 connector, max. cable length 100 m
Control panel - PC connection	USB Type Mini-B, max. cable length 2 m

Isolation areas, R0…R3:

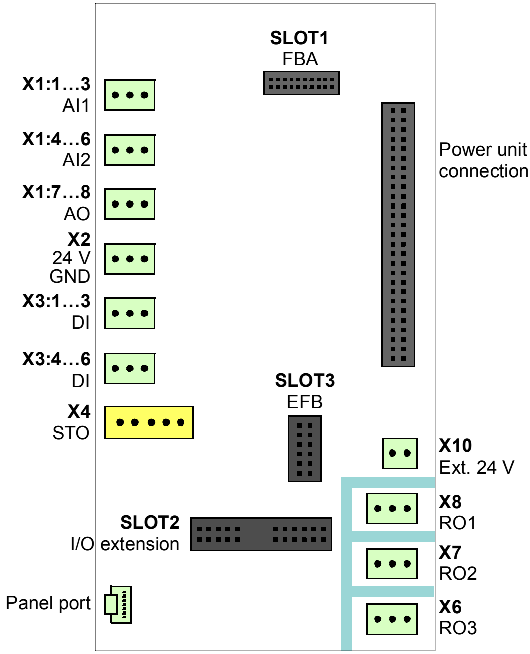


Symbol	Description
	Reinforced insulation (IEC/EN 61800-5-1:2007)
	Functional insulation (IEC/EN 61800-5-1:2007)

<u>Below altitudes 2000 m (6562 ft)</u>: The terminals on the control board fulfil the Protective Extra Low Voltage (PELV) requirements (EN 50178): There is adequate insulation between the user terminals which only accept ELV voltages and terminals that accept higher voltages (relay outputs).

<u>Between altitudes 2000 m (6562 ft) … 4000 m (13123 ft)</u>: If you connect higher than ELV voltage to one relay output, no relay output meets the Protective Extra Low Voltage (PELV) requirements (EN 50178), because there is only functional insulation between the individual relay outputs.

Isolation areas, R5…R9:



Symbol	Description
(light blue bar)	Reinforced insulation (IEC/EN 61800-5-1:2007)

The terminals on the control board fulfil the Protective Extra Low Voltage (PELV) requirements (EN 50178): There is reinforced insulation between the user terminals which only accept ELV voltages and terminals that accept higher voltages (relay outputs).

Note: There is reinforced insulation also between the individual relay outputs.

Note: There is reinforced insulation on the power unit.

Auxiliary circuit power consumption

Maximum external power supply:
Frames R0…R3: 25 W, 1.04 A at 24 V AC/DC (with optional modules CMOD-01, CMOD-02)
Frames R5…R9: 36 W, 1.50 A at 24 V AC/DC (as standard, terminals 40…41)

Efficiency

Approximately 98% at nominal power level

Degree of protection

IP21 (UL type 1)

Ambient conditions

Environmental limits for the drive are given below. The drive is to be used in a heated, indoor, controlled environment.

	Operation installed for stationary use	**Storage** in the protective package	**Transportation** in the protective package
Installation site altitude	• 0 to 4000 m (13123 ft) above sea level [1)] • 0 to 2000 m (6561 ft) above sea level [2)] Above 1000 m (3281 ft), see page *499*.	-	-
Air temperature	-15 to +50 °C (5 to 122 °F). 0 to -15 °C (32 to 5 °F): No frost allowed. See section *Ratings*.	-40 to +70 °C (-40 to +158 °F)	-40 to +70 °C (-40 to +158 °F)
Relative humidity	5 to 95%	Max. 95%	Max. 95%
	No condensation allowed. Maximum allowed relative humidity is 60% in the presence of corrosive gases.		
Contamination levels (IEC 60721-3-3, IEC 60721-3-2, IEC 60721-3-1)	No conductive dust allowed.		
	Chemical gases: Class 3C2 Solid particles: Class 3S2	Chemical gases: Class 1C2 Solid particles: Class 1S3	Chemical gases: Class 2C2 Solid particles: Class 2S2

<table>
<tr><td>Atmospheric pressure</td><td>70 to 106 kPa
0.7 to 1.05 atmospheres</td><td>70 to 106 kPa
0.7 to 1.05 atmospheres</td><td>60 to 106 kPa
0.6 to 1.05 atmospheres</td></tr>
<tr><td>Vibration (IEC 60068-2)</td><td>Max. 1 mm (0.04 in.)
(5 to 13.2 Hz),
max. 7 m/s^2 (23 ft/s^2)
(13.2 to 100 Hz)
sinusoidal</td><td>-</td><td>-</td></tr>
<tr><td>Vibration (ISTA)</td><td>-</td><td colspan="2">R0…R5 (ISTA 1A): Displacement, 25 mm peak to peak, 14200 vibratory impacts
R6…R9 TBA</td></tr>
<tr><td>Shock/Drop (ISTA)</td><td>Not allowed</td><td colspan="2">R0…R5 (ISTA 1A): Drop, 6 faces, 3 edges and 1 corner
<table><tr><td>Weight range</td><td>mm</td><td>in</td></tr><tr><td>0…10 kg (0…22 lb)</td><td>760</td><td>29.9</td></tr><tr><td>10…19 kg (22…42 lb)</td><td>610</td><td>24.0</td></tr><tr><td>19…28 kg (42…62 lb)</td><td>460</td><td>18.1</td></tr><tr><td>28…41 kg (62…90 lb)</td><td>340</td><td>13.4</td></tr></table>R6…R9 (ISTA 3E): Shock, incline impact: 1.1 m/s (3.61 ft/s)
Shock, rotational edge drop: 200 mm (7.9 in)</td></tr>
</table>

1) For neutral-grounded TN and TT systems and non-corner grounded IT systems.
See also section *Limiting relay output maximum voltages at high installation altitudes* on page *73*.

2) For corner-grounded TN, TT and IT systems

Materials

Drive enclosure	• PC/ABS 3 mm, color NCS 1502-Y (RAL 9002 / PMS 1C Cool Grey) and RAL 9017 • PC+10%GF 3.0mm, Color RAL 9017 (in frames R0…R3 only) • hot-dip zinc coated steel sheet 1.5 to 2.5 mm, thickness of coating 100 micrometers, color NCS 1502-Y
Package	Plywood, cardboard and moulded pulp. Foam cushions PP-E, bands PP.

Disposal	The main parts of the drive can be recycled to preserve natural resources and energy. Product parts and materials should be dismantled and separated. Generally all metals, such as steel, aluminum, copper and its alloys, and precious metals can be recycled as material. Plastics, rubber, cardboard and other packaging material can be used in energy recovery. Printed circuit boards and DC capacitors (C1-1 to C1-x) need selective treatment according to IEC 62635 guidelines. To aid recycling, plastic parts are marked with an appropriate identification code. Contact your local ABB distributor for further information on environmental aspects and recycling instructions for professional recyclers. End of life treatment must follow international and local regulations.

Applicable standards

The drive complies with the following standards. The compliance with the European Low Voltage Directive is verified according to standard EN 61800-5-1.

EN 60204-1:2006 + AC:2010	*Safety of machinery. Electrical equipment of machines. Part 1: General requirements*. *Provisions for compliance:* The final assembler of the machine is responsible for installing - emergency-stop device - supply disconnecting device.
IEC/EN 60529:1992 + A2: 2013	*Degrees of protection provided by enclosures (IP code)*
EN 61000-3-12:2011	*Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current*
IEC/EN 61800-3:2004 + A1:2012	*Adjustable speed electrical power drive systems. Part 3: EMC requirements and specific test methods*
IEC/EN 61800-5-1:2007	*Adjustable speed electrical power drive systems. Part 5-1: Safety requirements – electrical, thermal and energy*

CE marking

A CE mark is attached to the drive to verify that the drive follows the provisions of the European Low Voltage, EMC, RoHS and WEEE Directives.The CE marking also verifies that the drive, in regard to its safety functions (such as Safe torque off), conforms with the Machinery Directive as a safety component.

Compliance with the European Low Voltage Directive

The compliance with the European Low Voltage Directive has been verified according to standard EN 61800-5-1:2007. Declaration (3AXD10000302784) is available on the Internet. See section *Document library on the Internet* on the inside of the back cover.

Compliance with the European EMC Directive

The EMC Directive defines the requirements for immunity and emissions of electrical equipment used within the European Union. The EMC product standard (EN 61800-3:2004 + A1:2012) covers requirements stated for drives. See section *Compliance with the EN 61800-3:2004 + A1:2012* below. Declaration (3AXD10000302785) is available on the Internet. See section *Document library on the Internet* on the inside of the back cover.

Compliance with the European ROHS Directive 2002/95/EC

The RoHS Directive defines the restriction of the use of certain hazardous substances in electrical and electronic equipment.

Compliance with the European WEEE Directive 2002/96/EC

The WEEE Directive defines the regulated disposal and recycling of electric and electrical equipment.

Compliance with the European Machinery Directive 2006/42/EC 2nd Edition – June 2010

The drive is a machinery component that can be integrated into a wide range of machinery categories as specified in European Commission's *Guide to application of the Machinery Directive 2006/42/EC 2nd Edition – June 2010*. Declaration (3AXD10000302783) is available on the Internet. See section *Document library on the Internet* on the inside of the back cover.

Validating the operation of the Safe torque off function

See chapter *The Safe torque off function* on page *555*.

Compliance with the EN 61800-3:2004 + A1:2012

Definitions

EMC stands for **E**lectro**m**agnetic **C**ompatibility. It is the ability of electrical/electronic equipment to operate without problems within an electromagnetic environment. Likewise, the equipment must not disturb or interfere with any other product or system within its locality.

First environment includes establishments connected to a low-voltage network which supplies buildings used for domestic purposes.

Second environment includes establishments connected to a network not directly supplying domestic premises.

Drive of category C1: drive of rated voltage less than 1000 V and intended for use in the first environment.

Drive of category C2: drive of rated voltage less than 1000 V and intended to be installed and started up only by a professional when used in the first environment.

Note: A professional is a person or organization having necessary skills in installing and/or starting up power drive systems, including their EMC aspects.

Drive of category C3: drive of rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment.

Category C1

The emission limits are complied with the following provisions:

1. The optional EMC filter is selected according to the ABB documentation and installed as specified in the EMC filter manual.
2. The motor and control cables are selected as specified in this manual.
3. The drive is installed according to the instructions given in this manual.
4. For the maximum motor cable length with 4 kHz switching frequency, see page 509.

WARNING! In a domestic environment, this product may cause radio inference, in which case supplementary mitigation measures may be required.

Category C2

The emission limits are complied with the following provisions:

1. The motor and control cables are selected as specified in this manual.
2. The drive is installed according to the instructions given in this manual.
3. For the maximum motor cable length with 4 kHz switching frequency, see page *509*.

WARNING! The drive may cause radio interference if used in residential or domestic environment. The user is required to take measures to prevent interference, in association to the requirements for the CE compliance listed above, if necessary.

Note: Do not install a drive with the internal EMC filter connected on IT (ungrounded). The supply network becomes connected to ground potential through the internal EMC filter capacitors which may cause danger or damage to the drive. For disconnecting the EMC filter see page *78*.

Note: Do not install a drive with internal EMC filter connected on corner-grounded TN systems; otherwise the drive will be damaged. For disconnecting the internal EMC filter see page *78*.

Category C3

The drive complies with the standard with the following provisions:

1. The motor and control cables are selected as specified in this manual.
2. The drive is installed according to the instructions given in this manual.
3. For the maximum motor cable length with 4 kHz switching frequency, see page *509*

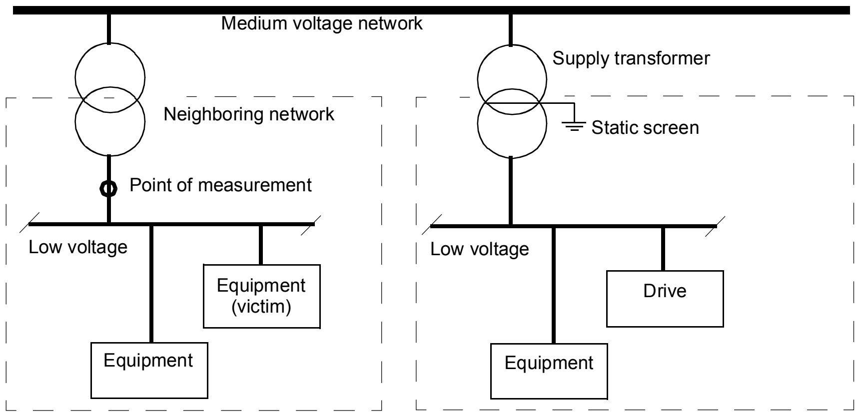
WARNING! A drive of category C3 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

Category C4

If the provisions under *Category C3* cannot be met, the requirements of the standard can be met as follows:

1. It is ensured that no excessive emission is propagated to neighboring low-voltage networks. In some cases, the inherent suppression in transformers and cables is

sufficient. If in doubt, the supply transformer with static screening between the primary and secondary windings can be used.



2. An EMC plan for preventing disturbances is drawn up for the installation. A template is available from the local ABB representative.
3. The motor and control cables are selected as specified in this manual.
4. The drive is installed according to the instructions given in this manual.

WARNING! A drive of category C4 is not intended to be used on a low-voltage public network which supplies domestic premises. Radio frequency interference is expected if the drive is used on such a network.

EAC marking

EAC marking is required in Russia, Belarus and Kazakhstan. The EAC certificate of conformity (3AXD10000312900) is available on the Internet. See section *Document library on the Internet* on the inside of the back cover.

Disclaimer

The manufacturer shall have no obligation with respect to any product which (i) has been improperly repaired or altered; (ii) has been subjected to misuse, negligence or accident; (iii) has been used in a manner contrary to the manufacturer's instructions; or (iv) has failed as a result of ordinary wear and tear.

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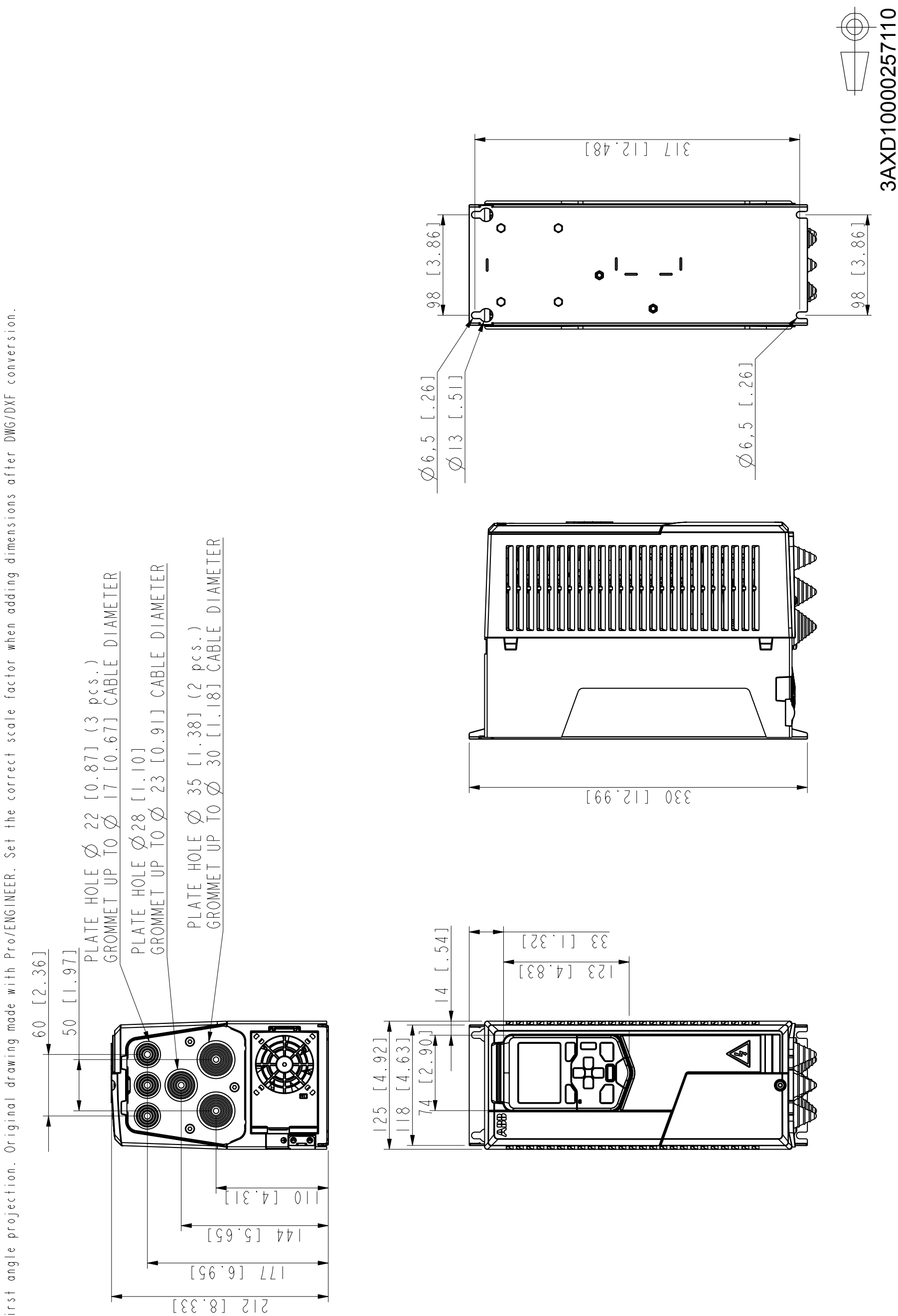
Dimension drawings

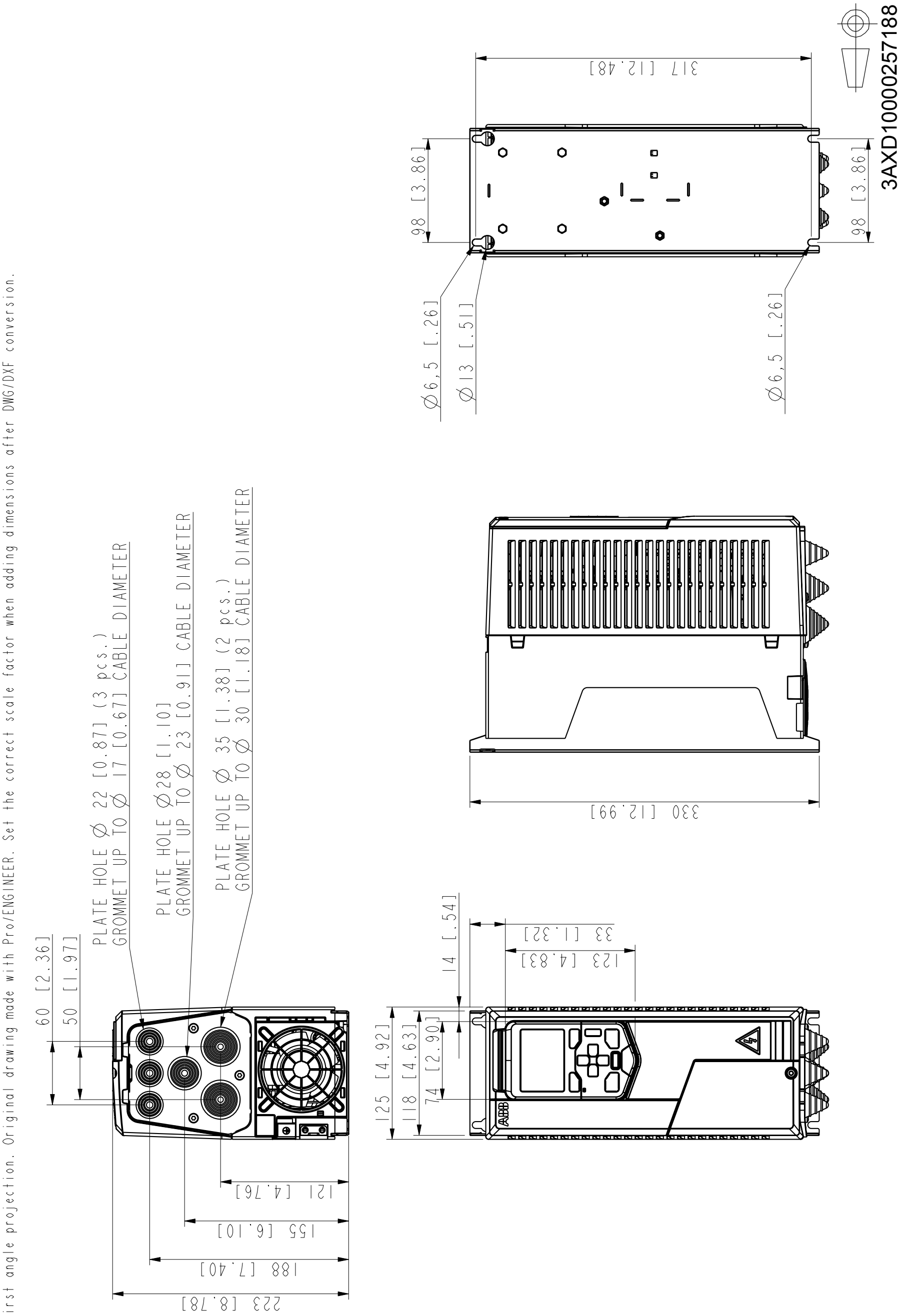
Contents of this chapter

This chapter shows the dimension drawings of the ACS580. The dimensions are given in millimeters and [inches].

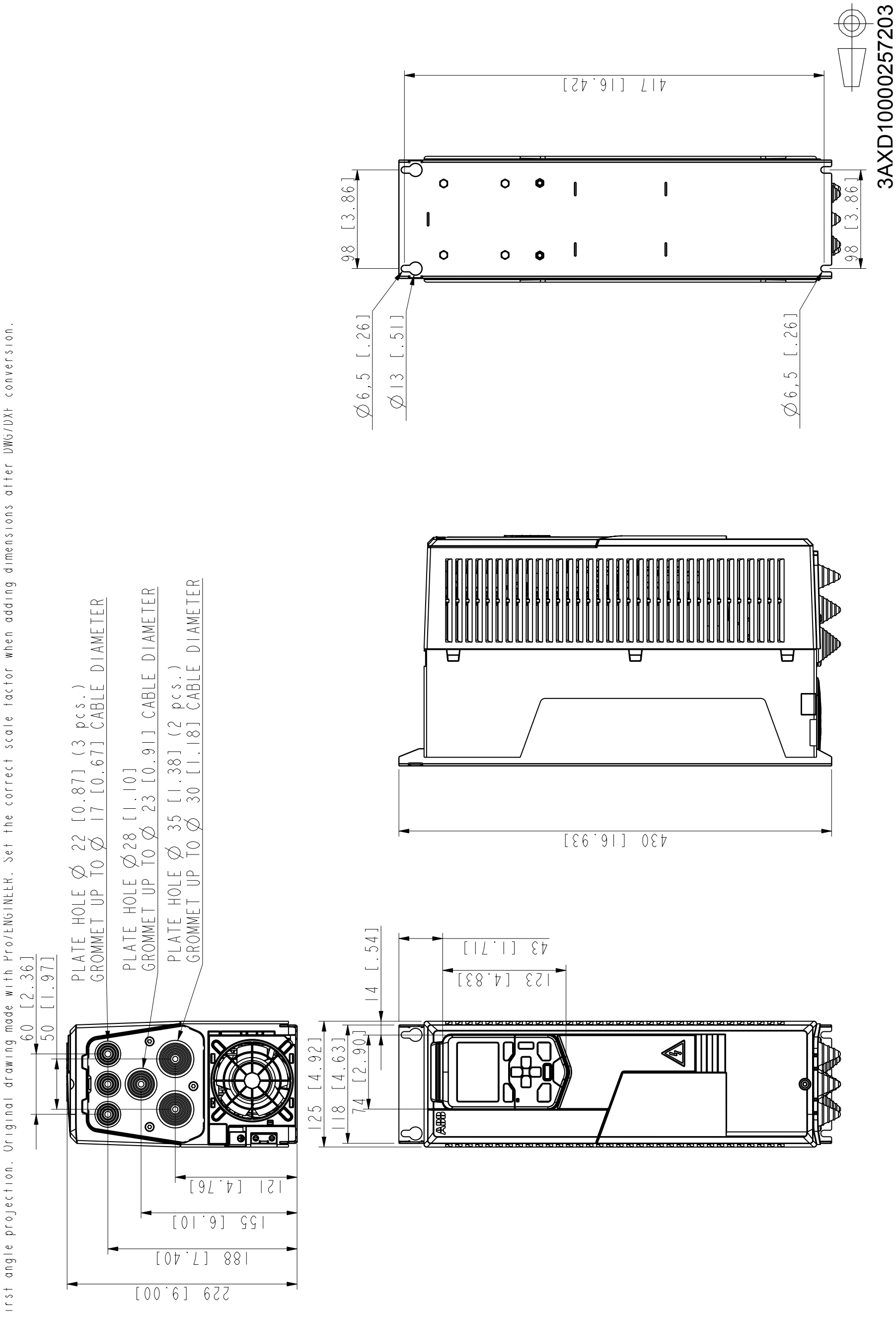
Frame R0, IP21



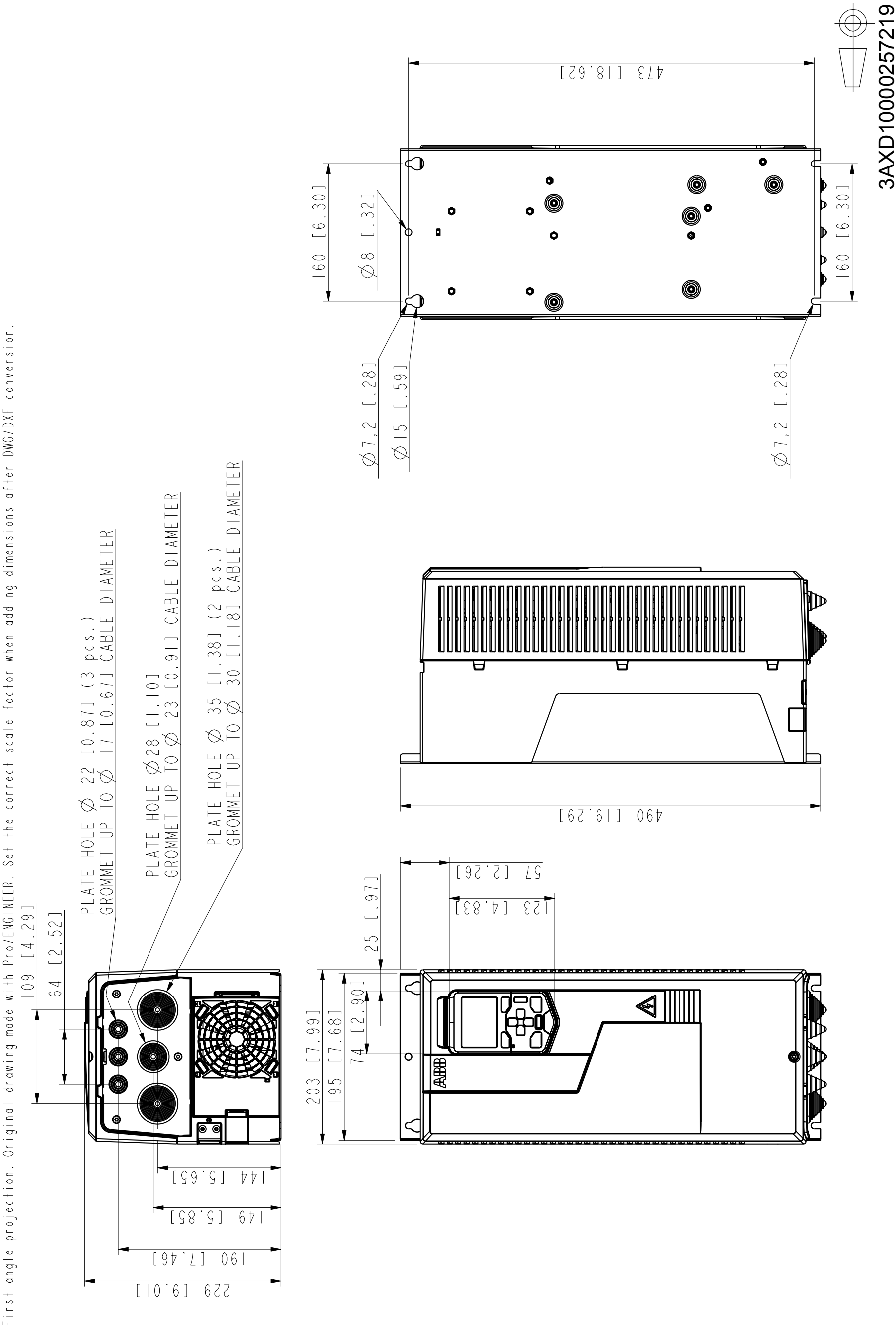
Frame R1, IP21



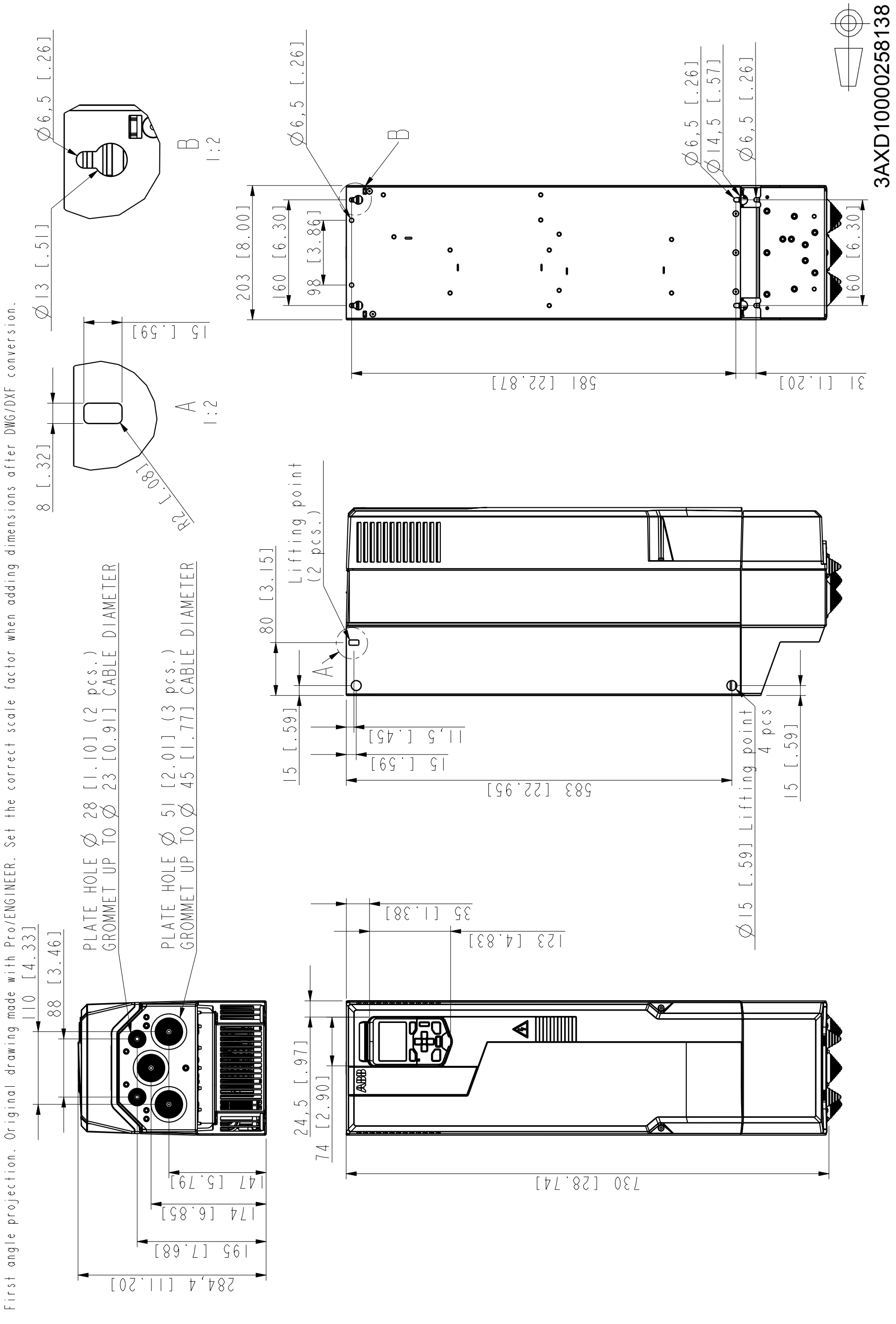
Frame R2, IP21



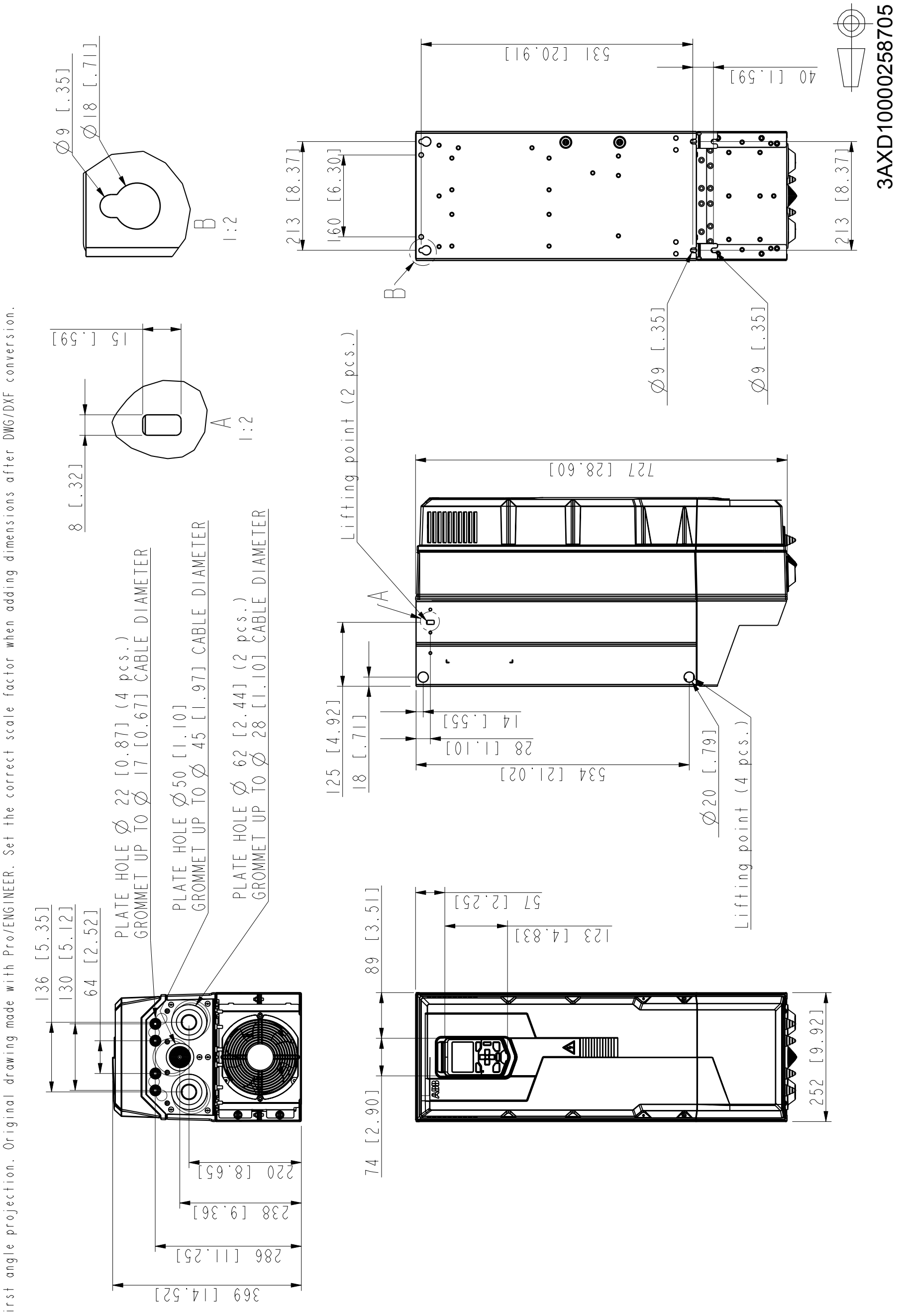
Frame R3, IP21



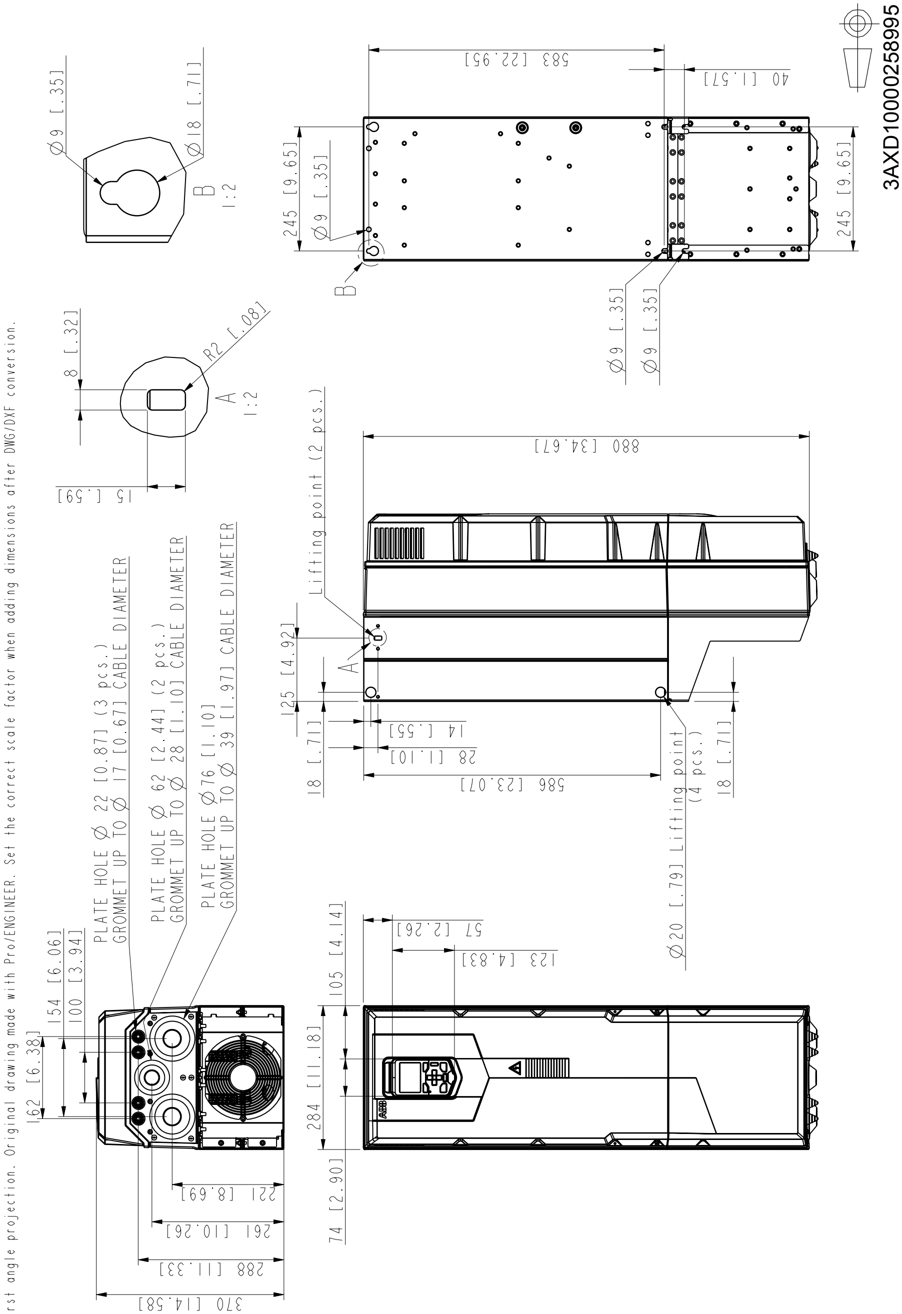
Frame R5, IP21



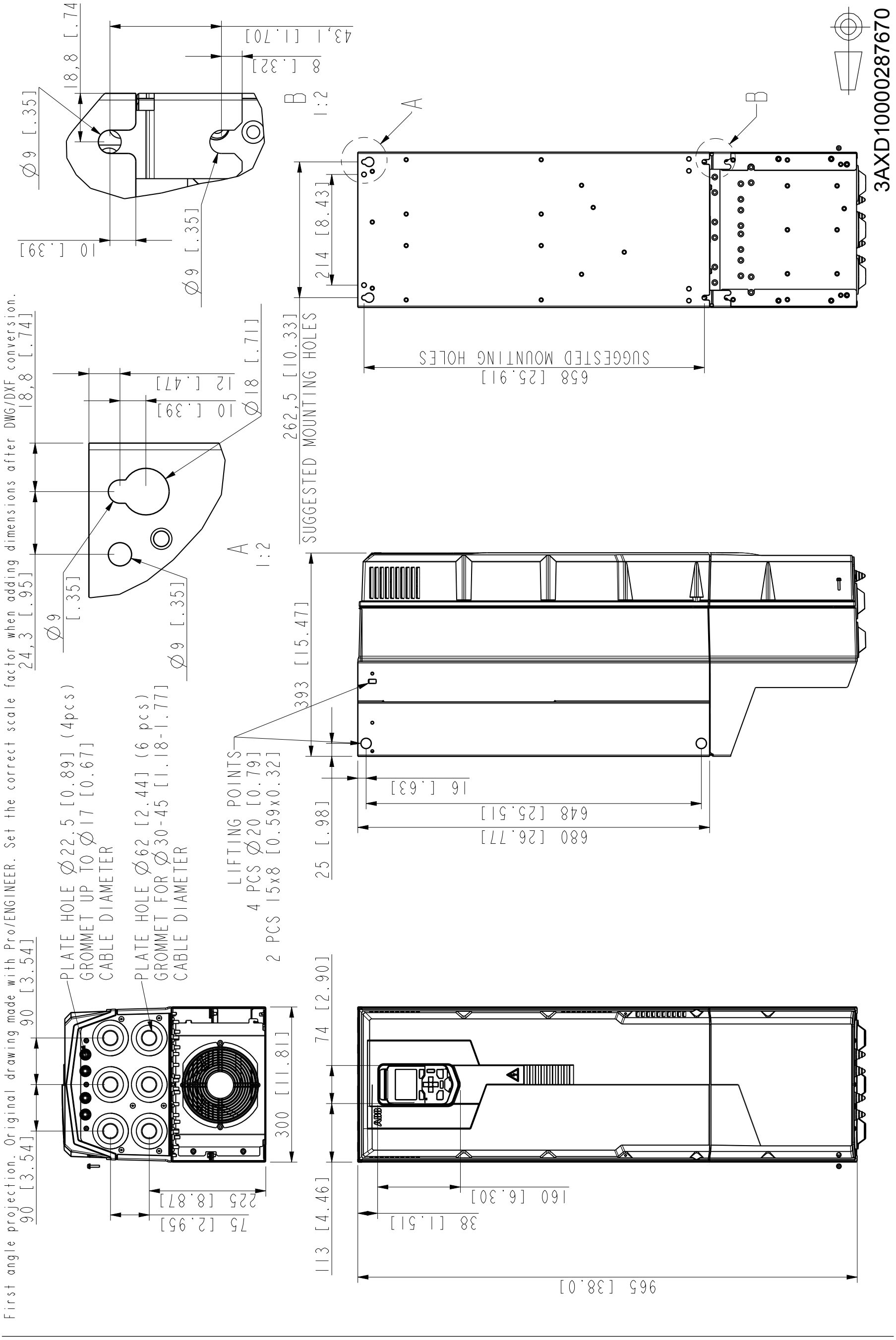
Frame R6, IP21



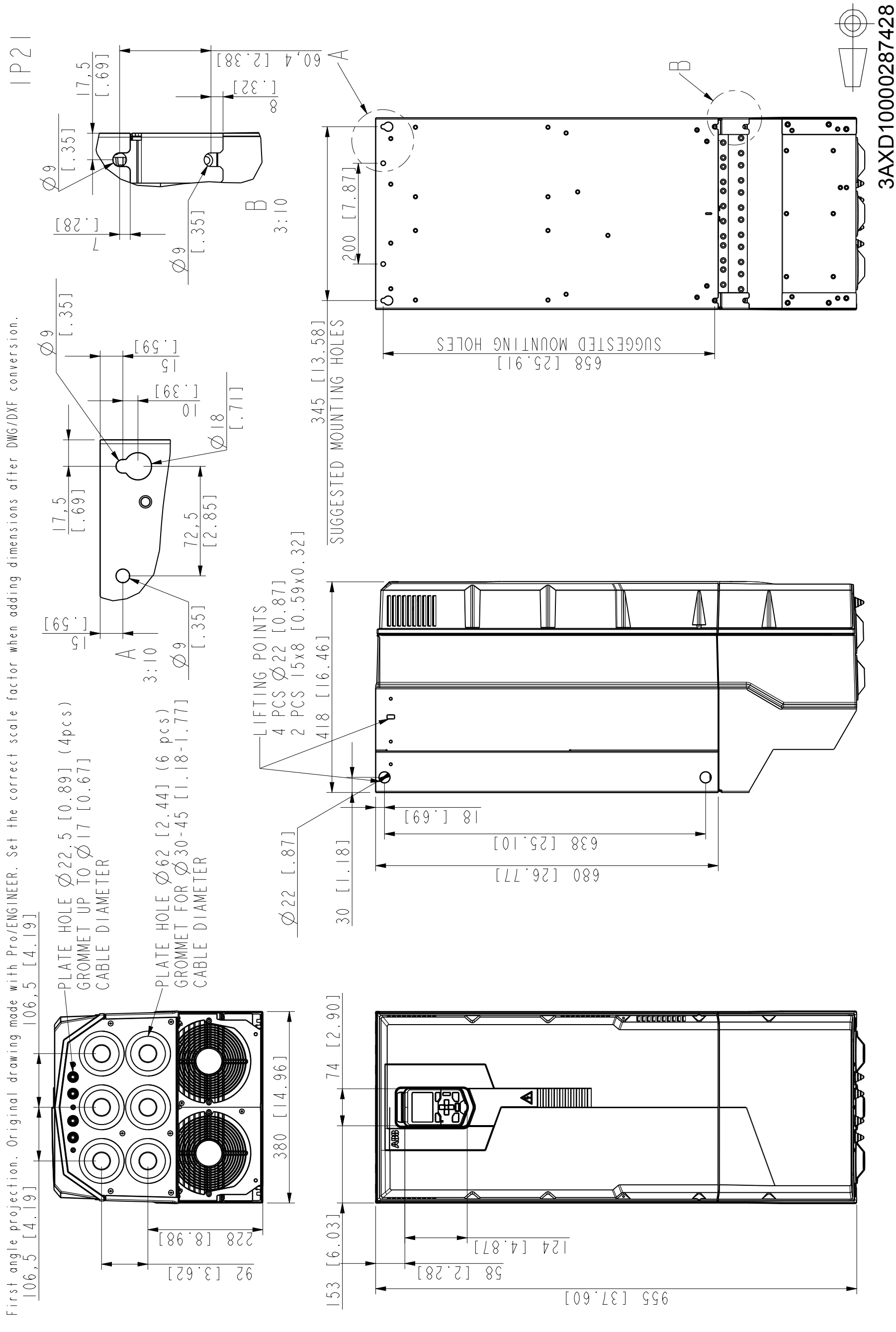
Frame R7, IP21



Frame R8, IP21



Frame R9, IP21



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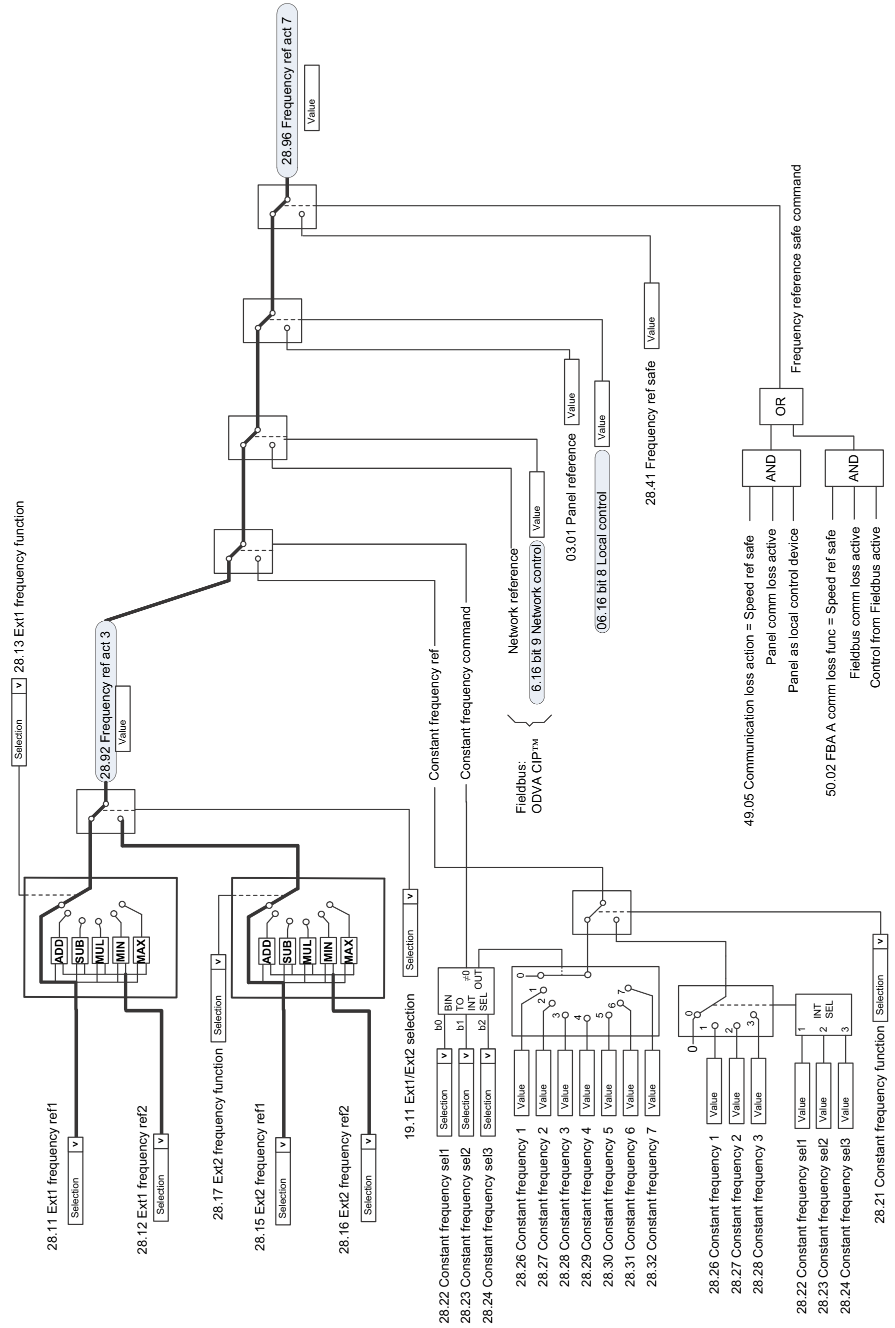
Control chain diagrams

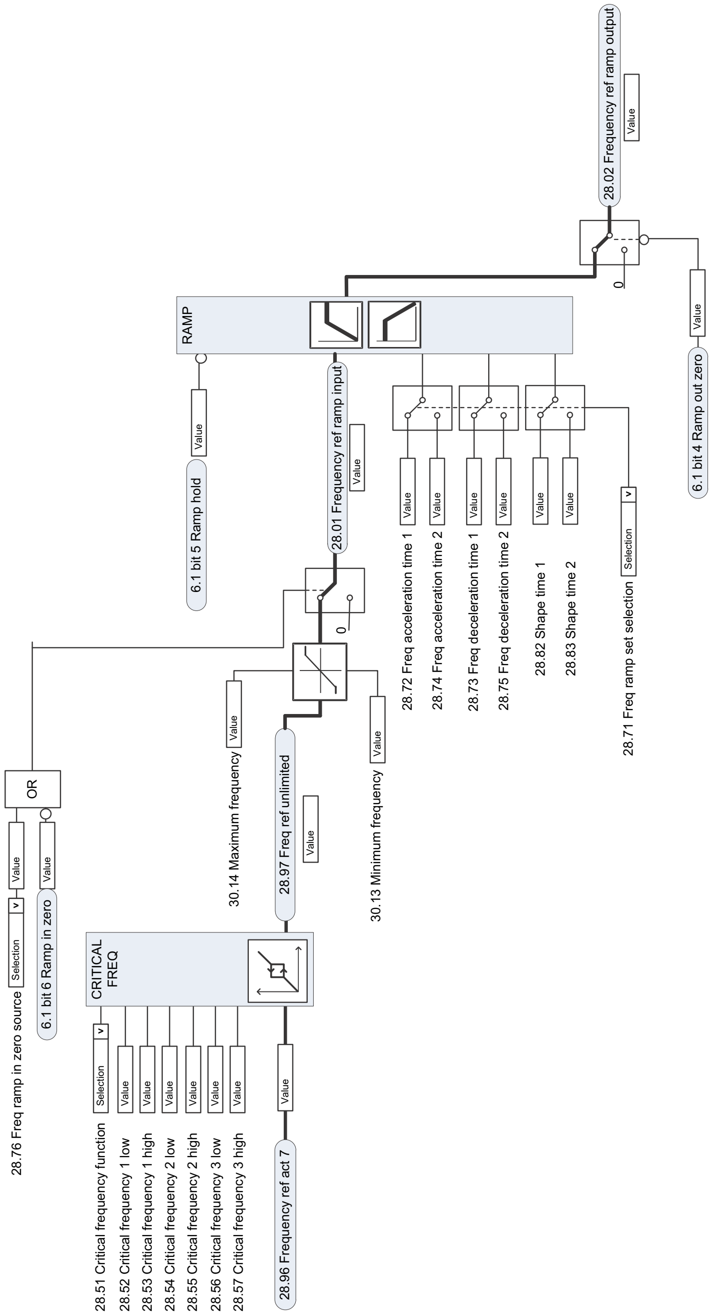
Contents of this chapter

The chapter presents the reference chains of the drive. For a general diagram, see section *Operating modes of the drive* (page *183*).

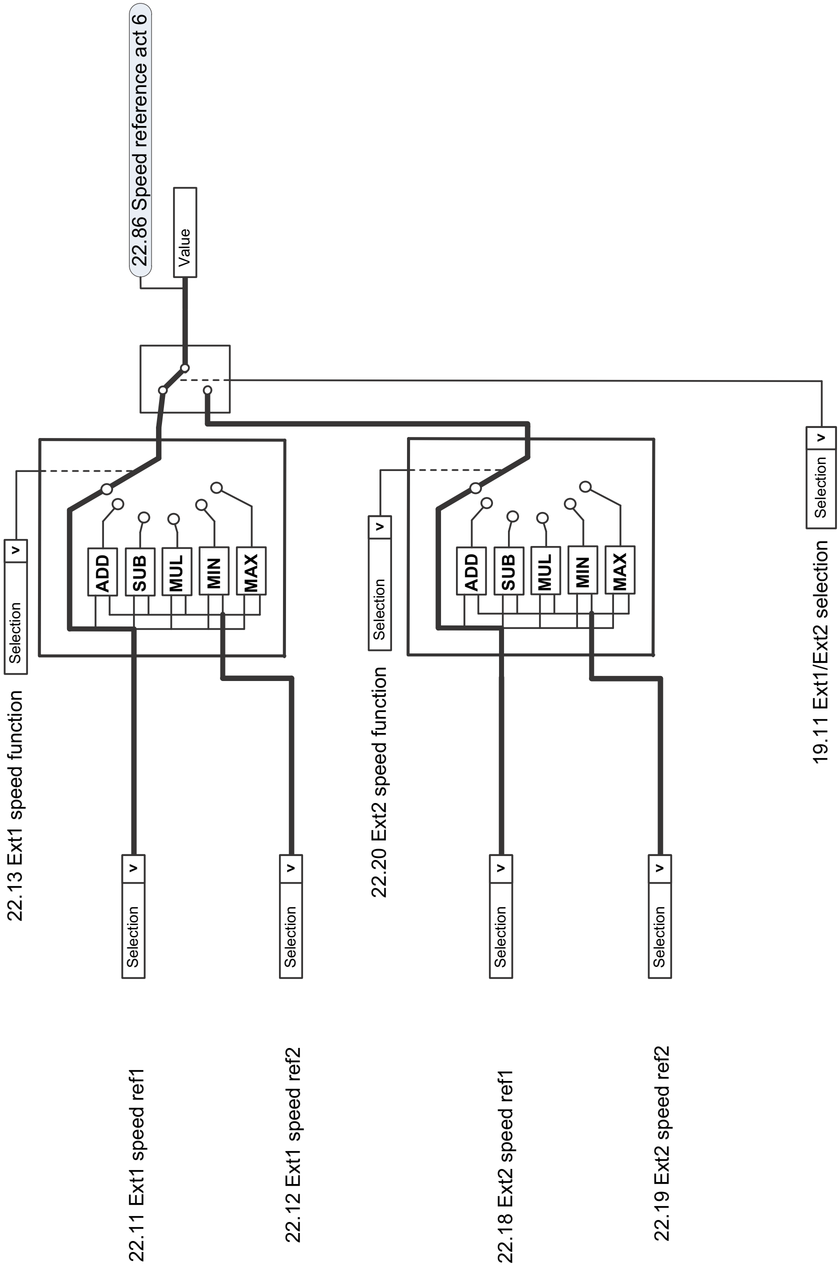
Frequency reference selection



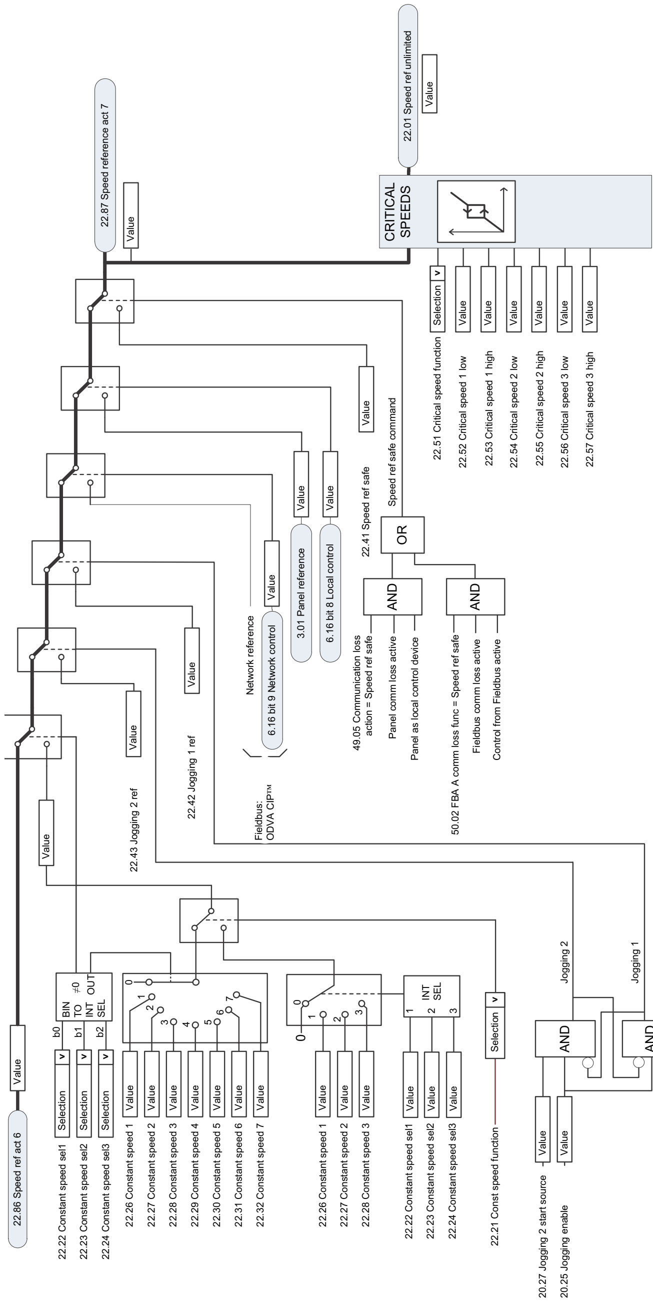
Frequency reference modification



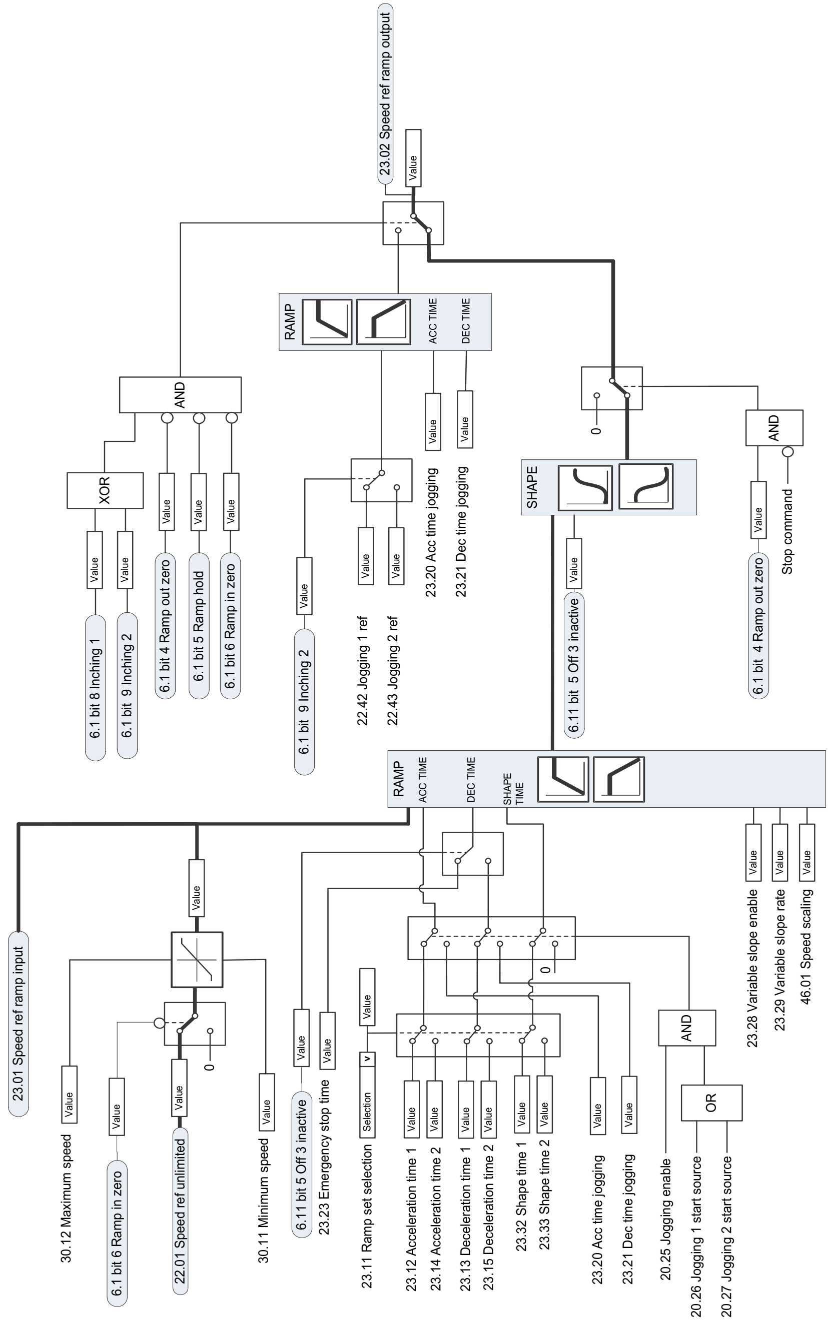
Speed reference source selection I



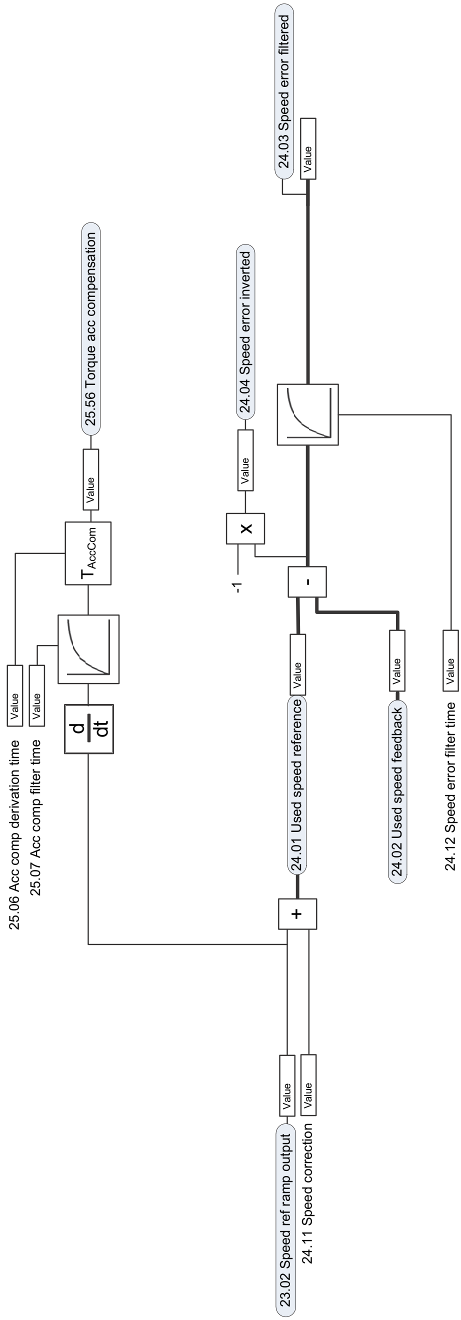
Speed reference source selection II



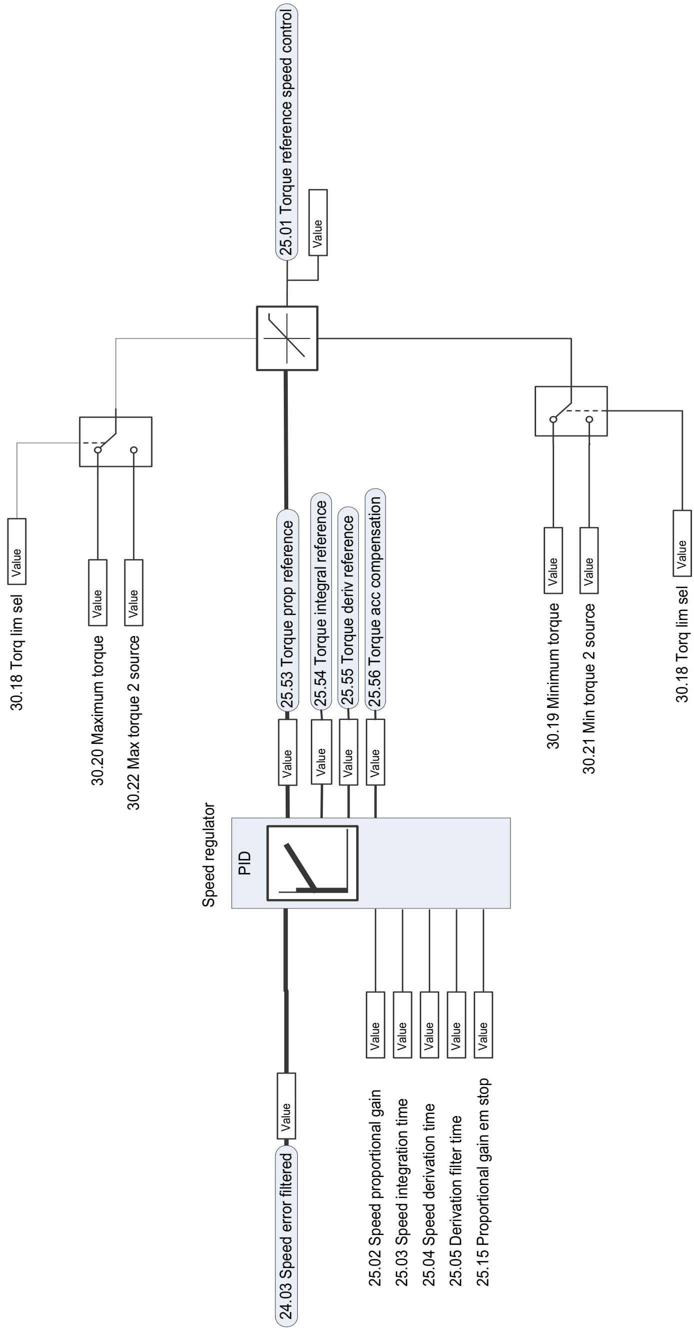
Speed reference ramping and shaping



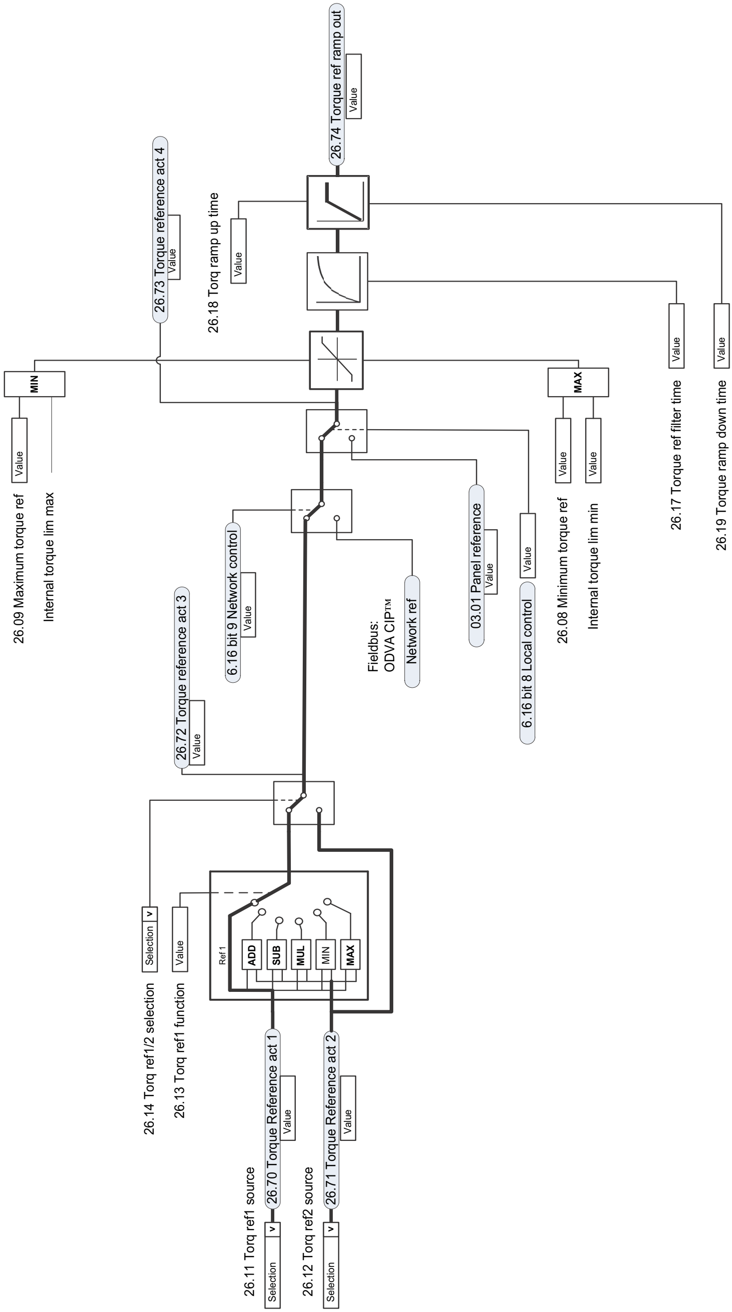
Speed error calculation



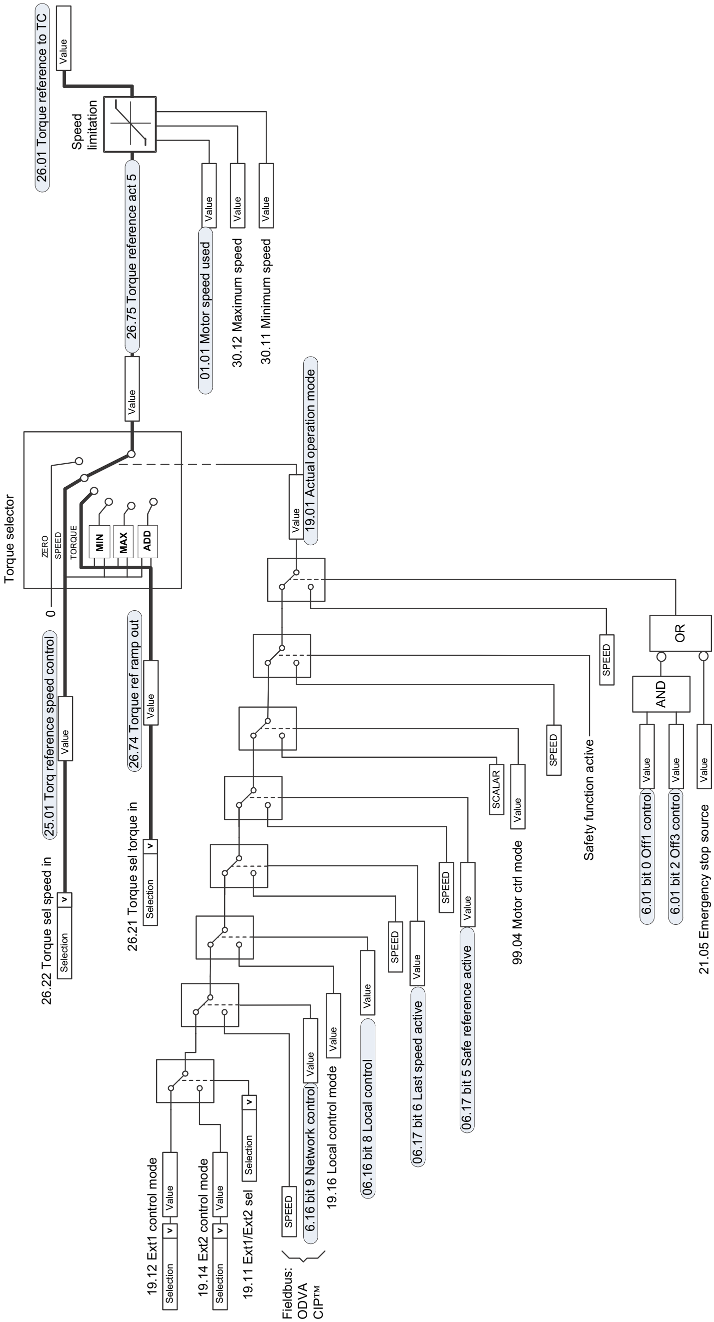
Speed controller



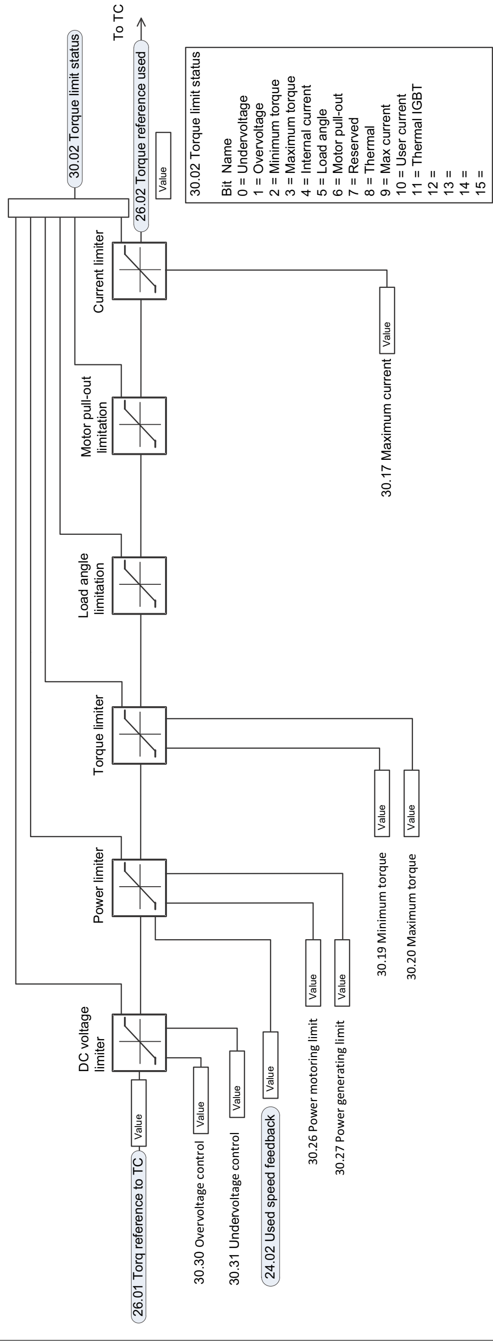
Torque reference source selection and modification



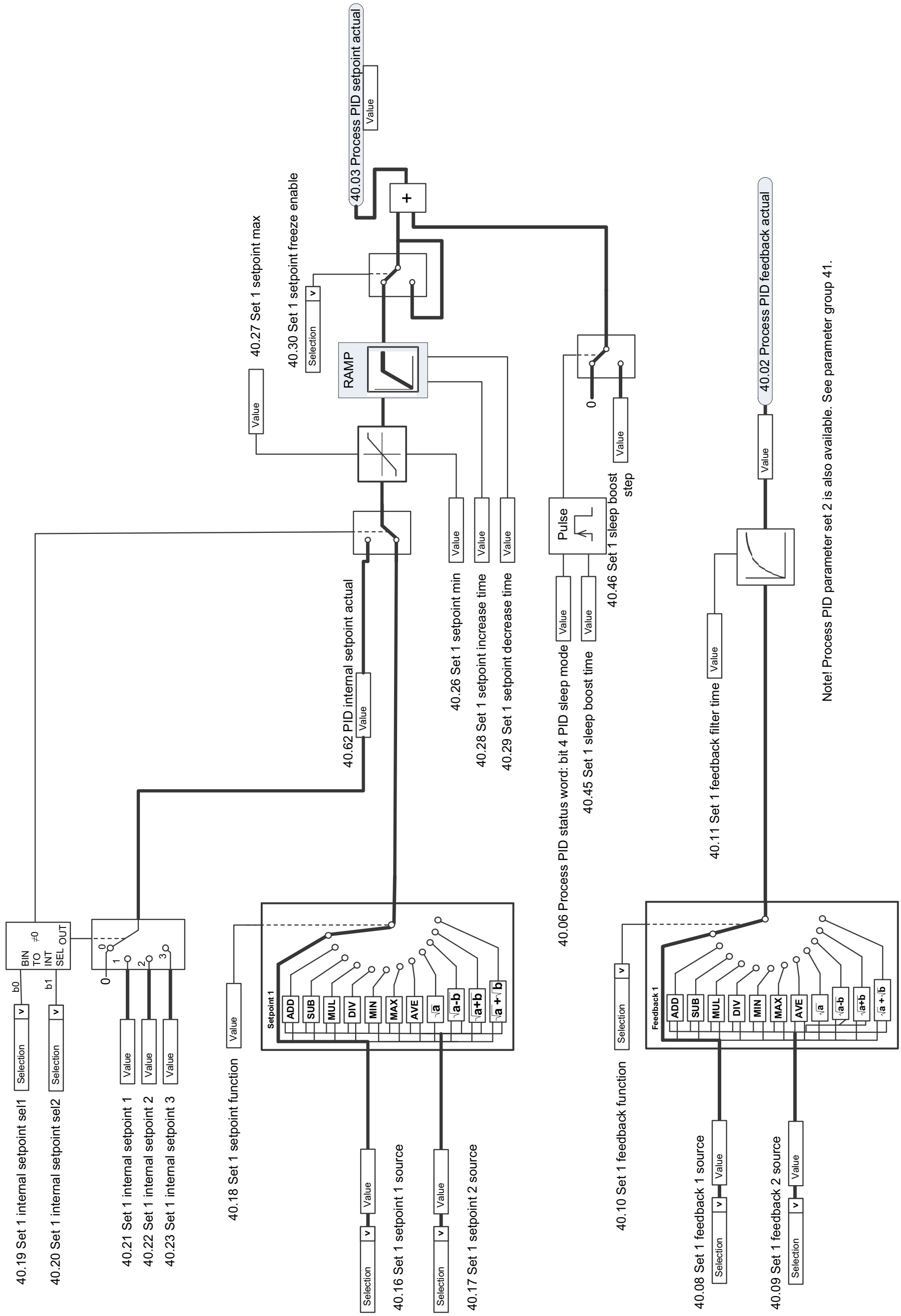
Reference selection for torque controller



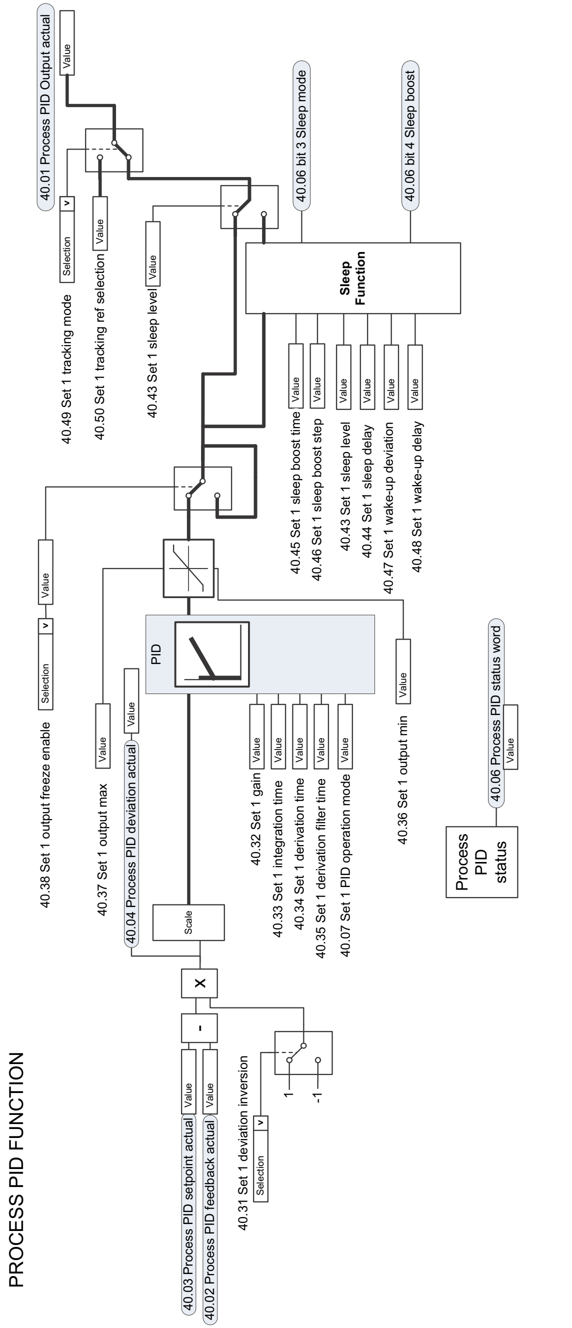
Torque limitation



Process PID setpoint and feedback source selection



Process PID controller



Note! Process PID parameter set 2 is also available. See parameter group 41.

22

Resistor braking

Contents of this chapter

The chapter describes how to select the brake resistor and cables, protect the system, connect the brake resistor and enable resistor braking.

Operation principle and hardware description

The brake chopper handles the energy generated by a decelerating motor. The chopper connects the brake resistor to the intermediate DC circuit whenever the voltage in the circuit exceeds the limit defined by the control program. Energy consumption by the resistor losses lowers the voltage until the resistor can be disconnected.

For frame R0…R3 internal brake choppers and resistors, see below. For R5…R9 external brake choppers and resistors, see *Resistor braking, frames R5…R9* on page *553*.

Resistor braking, frames R0…R3

Planning the braking system

Selecting the brake resistor

Frames R0…R3 have an built-in brake chopper as standard equipment. The brake resistor is selected using the table and equations presented in this section.

1. Determine the required maximum braking power P_{Rmax} for the application. P_{Rmax} must be smaller than P_{BRmax} given in the table on page *548* for the used drive type.
2. Calculate resistance R with Equation 1.
3. Calculate energy E_{Rpulse} with Equation 2.

4. Select the resistor so that the following conditions are met:
   - The rated power of the resistor must be greater than or equal to P_{Rmax}.
   - Resistance R must be between R_{min} and R_{max} given in the table for the used drive type.
   - The resistor must be able to dissipate energy E_{Rpulse} during the braking cycle T.

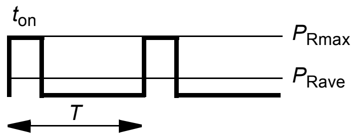
Equations for selecting the resistor:

Eq. 1. $U_N = 400\ \text{V}:\ R = \dfrac{450000}{P_{Rmax}}$

$U_N = 460\ \text{V}:\ R = \dfrac{615000}{P_{Rmax}}$

Eq. 2. $E_{Rpulse} = P_{Rmax} \cdot t_{on}$

Eq. 3. $P_{Rave} = P_{Rmax} \cdot \dfrac{t_{on}}{T}$



For conversion, use 1 hp = 746 W.

where R= selected brake resistor value (ohm)
P_{Rmax} = maximum power during the braking cycle (W)
P_{Rave} = average power during the braking cycle (W)
E_{Rpulse} = energy conducted into the resistor during a single braking pulse (J)
t_{on} = length of the braking pulse (s)
T = length of the braking cycle (s).

The table shows reference resistor types for the maximum braking power.

Type ACS580-01	R_{min}	R_{max}	P_{BRmax}		Reference resistor types
	ohm	ohm	kW	hp	Danotherm
3-phase U_N = 400 or 460 V (380…415 V, 440…480 V)					
0246-4	54	690	0.6	0.8	CBH 360 C T 406 210R or CAR 200 D T 406 210R
03A3-4	54	465	0.9	1.2	CBH 360 C T 406 210R or CAR 200 D T 406 210R
04A0-4	54	313	1.3	1.7	CBH 360 C T 406 210R or CAR 200 D T 406 210R
05A6-4	54	223	1.9	2.6	CBH 360 C T 406 210R or CAR 200 D T 406 210R
07A2-4	54	153	2.6	3.5	CBR-V 330 D T 406 78R UL
09A4-4	54	112	3.5	4.7	CBR-V 330 D T 406 78R UL
12A6-4	54	83	4.9	6.6	CBR-V 330 D T 406 78R UL
017A-4	32	60	6.8	9.0	CBR-V 560 D HT 406 39R UL
025A-4	23	42	10	13.6	CBR-V 560 D HT 406 39R UL
032A-4	16	29	14	18.5	CBT-H 560 D HT 406 19R
038A-4	11	21	17	22.8	CBT-H 760 D HT 406 16R
045A-4	11	17	20	27.4	CBT-H 760 D HT 406 16R

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Symbols

$\boldsymbol{R}_{\mathbf{min}}$ = minimum allowed brake resistor that can be connected to the brake chopper
$\boldsymbol{R}_{\mathbf{max}}$ = maximum allowed brake resistor that allows P_{BRmax}
$\boldsymbol{P}_{\mathbf{BRmax}}$ = maximum braking capacity of the drive, must exceed the desired braking power.

WARNING! Do not use a brake resistor with a resistance below the minimum value specified for the particular drive. The drive and the internal chopper are not able to handle the overcurrent caused by the low resistance.

Selecting and routing the brake resistor cables

Use a shielded cable with the conductor size specified in section *Terminal and lead-through data for the power cables* on page *506*.

Minimizing electromagnetic interference

Follow these rules in order to minimize electromagnetic interference caused by the rapid current changes in the resistor cables:

- Install the cables away from other cable routes.
- Avoid long parallel runs with other cables. The minimum parallel cabling separation distance should be 0.3 meters.
- Cross the other cables at right angles.
- Keep the cable as short as possible in order to minimize the radiated emissions and stress on chopper IGBTs. The longer the cable the higher the radiated emissions, inductive load and voltage peaks over the IGBT semiconductors of the brake chopper.

Maximum cable length

The maximum length of the resistor cable(s) is 10 m (33 ft).

EMC compliance of the complete installation

Note: ABB has not verified that the EMC requirements are fulfilled with external user-defined brake resistors and cabling. The EMC compliance of the complete installation must be considered by the customer.

Placing the brake resistor

Install the resistors outside the drive in a place where they will cool.

Arrange the cooling of the resistor in a way that:

- no danger of overheating is caused to the resistor or nearby materials
- the temperature of the room the resistor is located in does not exceed the allowed maximum.

Supply the resistor with cooling air/water according to the resistor manufacturer's instructions.

WARNING! The materials near the brake resistor must be non-flammable. The surface temperature of the resistor is high. Air flowing from the resistor is of hundreds of degrees Celsius. If the exhaust vents are connected to a ventilation system, ensure that the material withstands high temperatures. Protect the resistor against physical contact.

Protecting the system in brake circuit fault situations

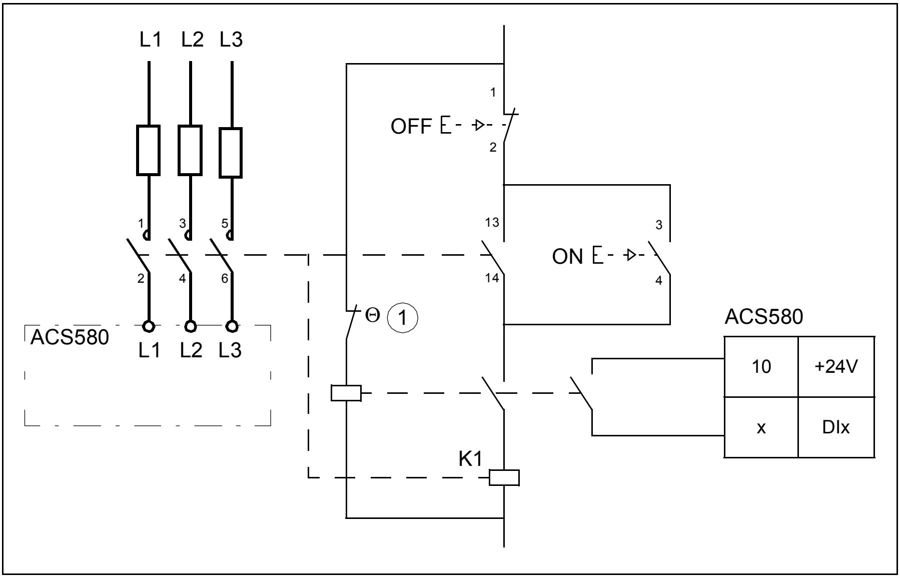
<u>Protecting the system in cable and brake resistor short-circuit situations</u>

The input fuses will also protect the resistor cable when it is identical with the input cable.

<u>Protecting the system against thermal overload</u>

Equipping the drive with a main contactor is highly recommended for safety reasons. Wire the contactor so that it opens in case the resistor overheats. This is essential for safety since the drive will not otherwise be able to interrupt the main supply if the chopper remains conductive in a fault situation. An example wiring diagram is shown below. We recommend that you use resistors equipped with a thermal switch (1) inside the resistor assembly. The switch indicates overtemperature and overload.

We recommend that you also wire the thermal switch to a digital input of the drive.



Mechanical installation

All brake resistors must be installed outside the drive. Follow the resistor manufacturer's instructions.

Electrical installation

<u>Checking the insulation of the assembly</u>

Follow the instructions given in section *Brake resistor assembly* on page *Brake resistor assembly*.

<u>Connection diagram</u>

See section *Connection diagram* page *80*.

<u>Connection procedure</u>

See section *Brake resistor cable (if used)* on page *85*.

Connect the thermal switch of the brake resistor as described in section *Protecting the system against thermal overload* on page *550*.

Start-up

Note: Protective oil on the brake resistors will burn off when the brake resistor is used for the first time. Make sure that the airflow is sufficient.

Set the following parameters:

1. Disable the overvoltage control of the drive with parameter *30.30 Overvoltage control*.
2. Set parameter *31.01 External event 1 source* source to point to the digital input where the thermal switch of the brake resistor is wired.
3. Set parameter *31.02 External event 1 type* to *Fault*.
4. Enable the brake chopper by parameter *43.06 Brake chopper enable*. If *Enabled with thermal model* is selected, set also the brake resistor overload protection parameters *43.08* and *43.09* according to the application.
5. Check the resistance value of parameter *43.10 Brake resistance*.

With these parameter settings, the drive generates a fault and coasts to a stop on brake resistor overtemperature.

WARNING! If the drive is equipped with a brake chopper but the chopper is not enabled by the parameter setting, the internal thermal protection of the drive against resistor overheating is not in use. In this case, the brake resistor must be disconnected.

Resistor braking, frames R5…R9

To be added

23

The Safe torque off function

What this chapter contains

This chapter describes the Safe torque off (STO) function of the drive and gives instructions for its use.

Description

The Safe torque off function can be used, for example, to construct safety or supervision circuits that stop the drive in case of danger. Another possible application is a prevention of unexpected start-up switch that enables short-time maintenance operations like cleaning or work on non-electrical parts of the machinery without switching off the power supply to the drive.

Note: The Safe torque off function does not disconnect the voltage from the drive, see the warning on page *562*.

When activated, the Safe torque off function disables the control voltage of the power semiconductors of the drive output stage (A, see diagram on page *558*), thus preventing the drive from generating the torque required to rotate the motor. If the motor is running when Safe torque off is activated, it coasts to a stop.

The Safe torque off function has a redundant architecture, that is, both channels must be used in the safety function implementation. The safety data given in this manual is calculated for redundant use, and does not apply if both channels are not used.

The Safe torque off function of the drive complies with these standards:

Standard	Name
EN 60204-1:2006 + AC:2010	*Safety of machinery – Electrical equipment of machines – Part 1: General requirements*
IEC 61326-3-1:2008	*Electrical equipment for measurement, control and laboratory use – EMC requirements – Part 3-1: Immunity requirements for safety-related systems and for equipment intended to perform safety-related functions (functional safety) – General industrial applications*
IEC 61508-1:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*
IEC 61508-2:2010	*Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*
IEC 61511:2003	*Functional safety – Safety instrumented systems for the process industry sector*
IEC/EN 61800-5-2:2007	*Adjustable speed electrical power drive systems – Part 5-2: Safety requirements – Functional*
IEC/EN 62061:2005 + AC:2010	*Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
EN ISO 13849-1:2008 + AC:2009	*Safety of machinery – Safety-related parts of control systems – Part 1: General principles for design*
EN ISO 13849-2:2012	*Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

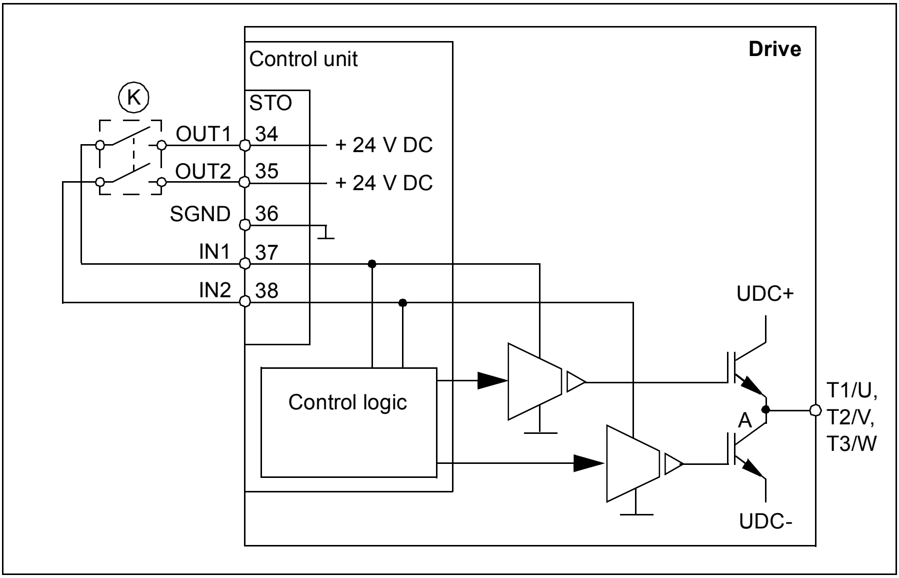
The function also corresponds to Prevention of unexpected start-up as specified by EN 1037:1995 + A1:2008 and Uncontrolled stop (stop category 0) as specified in EN 60204-1:2006 + AC:2010.

Compliance with the European Machinery Directive

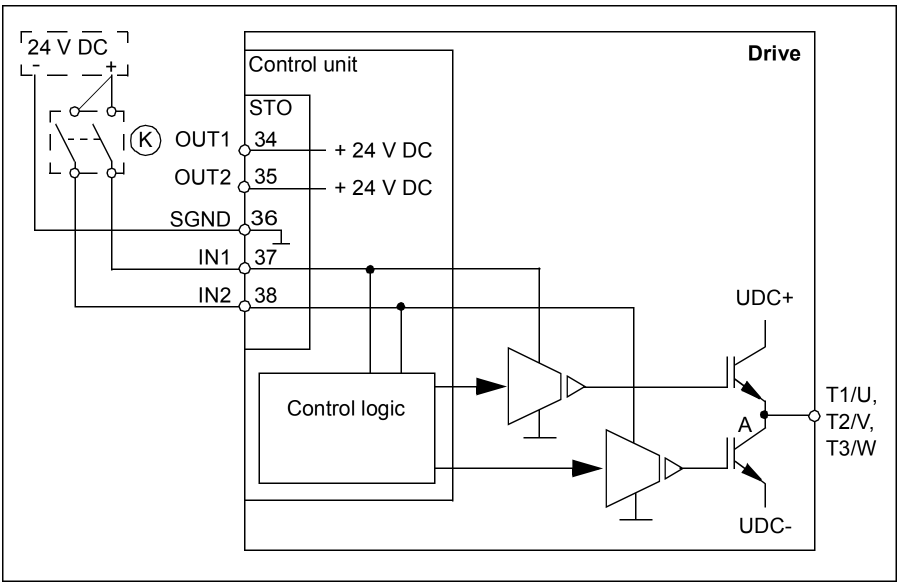
See section *Compliance with the European Machinery Directive 2006/42/EC 2nd Edition – June 2010* on page 518.

Connection principle

Connection with internal +24 V DC power supply

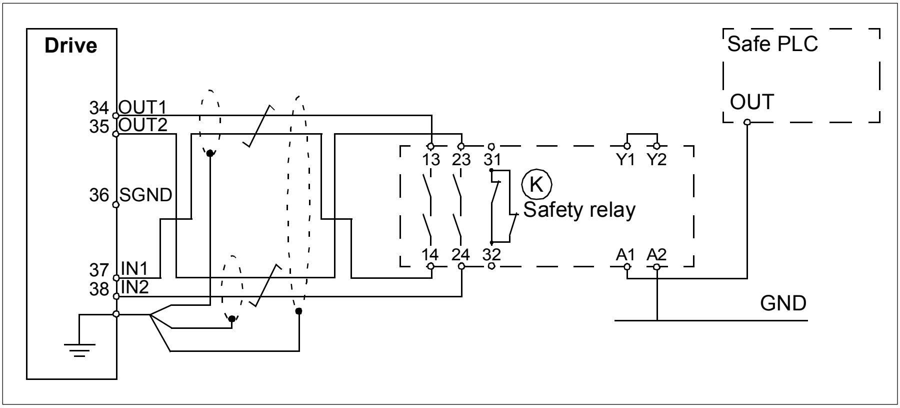


Connection with external +24 V DC power supply

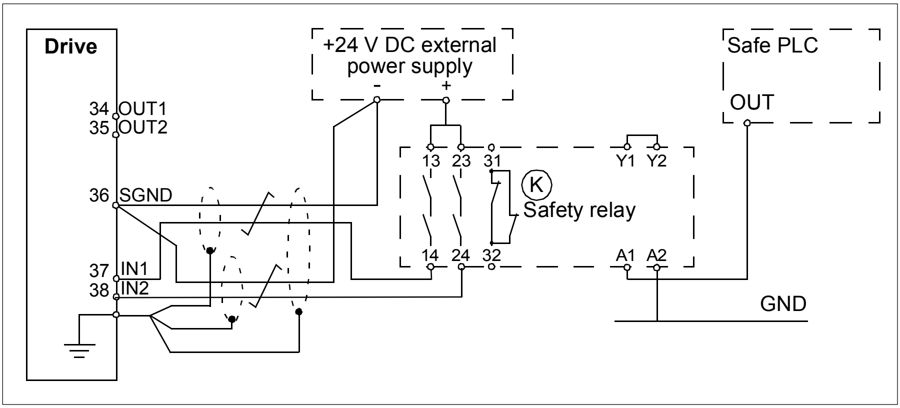


Wiring examples

An example of a Safe torque off wiring with internal +24 V DC power supply is shown below.



An example of a Safe torque off wiring with external +24 V DC power supply is shown below.



For information on the specifications of the STO input, see chapter *Control connection data* (page *511*).

Activation switch

In the wiring diagram above (page *558*), the activation switch has the designation (K). This represents a component such as a manually operated switch, an emergency stop push button switch, or the contacts of a safety relay or safety PLC.

- In case a manually operated activation switch is used, the switch must be of a type that can be locked out to the open position.
- Inputs IN1 and IN2 must open/close within 200 ms of each other.

Cable types and lengths

- Double-shielded twisted-pair cable is recommended.
- Maximum cable length 300 m (984 ft) between activation switch (K) and drive control unit.

Note: A short-circuit in the wiring between the switch and an STO terminal causes a dangerous fault and therefore it is recommended to use a safety relay (including wiring diagnostics), or a wiring method (shield grounding, channel separation) which reduces or eliminates the risk caused by the short-circuit.

Note: The voltage at the INx terminals of each drive must be at least 13 V DC to be interpreted as “1”. Pulse tolerance of input channels is 1 ms.

Grounding of protective shields

- Ground the shield in the cabling between the activation switch and the control board at the control board.
- Ground the shield in the cabling between two control boards at one control board only.

Operation principle

1. The Safe torque off activates (the activation switch is opened, or safety relay contacts open).
2. The STO inputs IN1 and IN2 on the drive control board de-energize.
3. The STO cuts off the control voltage from the drive IGBTs.
4. The control program generates an indication as defined by parameter *31.22 STO indication run/stop*.

   The parameter 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.

   Note: This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.

   Note: The loss of only one STO signal always generates a fault as it is interpreted as a malfunction of STO hardware or wiring.
5. Motor coasts to a stop (if running). The drive cannot restart while the activation switch or safety relay contacts are open. After the contacts close, a new start command is required to start the drive.

Start-up including acceptance test

To ensure the safe operation of a safety function, validation is required. The final assembler of the machine must validate the function by performing an acceptance test. The acceptance test must be performed

- at initial start-up of the safety function
- after any changes related to the safety function (circuit boards, wiring, components, settings, etc.)
- after any maintenance work related to the safety function.

Authorized person

The acceptance test of the safety function must be carried out by an authorized person with expertise and knowledge of the safety function. The test must be documented and signed by the authorized person.

An authorized person is an individual with authorization from the machine builder or end user to carry out, report and sign off the safety function validation / acceptance testing on behalf of the machine builder or end user.

Acceptance test reports

Signed acceptance test reports must be stored in the logbook of the machine. The report shall include documentation of start-up activities and test results, references to failure reports and resolution of failures. Any new acceptance tests performed due to changes or maintenance shall be logged into the logbook.

Acceptance test procedure

After wiring the Safe torque off function, validate its operation as follows.

Action	☑
WARNING! Follow the *Safety instructions*, page *17*. Ignoring the instructions can cause physical injury or death, or damage to the equipment.	☐
Ensure that the drive can be run and stopped freely during start-up.	☐
Stop the drive (if running), switch the input power off and isolate the drive from the power line by a disconnector.	☐
Check the Safe torque off circuit connections against the wiring diagram.	☐
Close the disconnector and switch the power on.	☐
Test the operation of the STO function when the motor is stopped. • Give a stop command for the drive (if running) and wait until the motor shaft is at a standstill. Ensure that the drive operates as follows: • Open the STO circuit. The drive generates an indication if one is defined for the 'stopped' state in parameter *31.22 STO indication run/stop*. For description of the warning, see chapter *Fault tracing* on page *423*. • Give a start command to verify that the STO function blocks the drive's operation. The drive displays a warning. The motor should not start. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Test the operation of the STO function when the motor is running. • Start the drive and ensure the motor is running. • Open the STO circuit. The motor should stop. The drive generates an indication if one is defined for the 'running' state in parameter *31.22 STO indication run/stop*. For description of the warning, see chapter *Fault tracing* on page *423*. • Reset any active faults and try to start the drive. • Ensure that the motor stays at a standstill and the drive operates as described above in testing the operation when the motor is stopped. • Close the STO circuit. • Reset any active faults. Restart the drive and check that the motor runs normally.	☐
Document and sign the acceptance test report which verifies that the safety function is safe and accepted for operation.	☐

Use

1. Open the activation switch, or activate the safety functionality that is wired to the STO connection.
2. STO inputs on the drive control unit de-energize, and the drive control unit cuts off the control voltage from the drive IGBTs.
3. The control program generates an indication as defined by parameter *31.22 STO indication run/stop*.
4. The motor coasts to a stop (if running). The drive will not restart while the activation switch or safety relay contacts are open.
5. Deactivate the STO by closing the activation switch, or resetting the safety functionality that is wired to the STO connection.
6. Reset any faults before restarting.

WARNING! The Safe torque off function does not disconnect the voltage of the main and auxiliary circuits from the drive. Therefore maintenance work on electrical parts of the drive or the motor can only be carried out after isolating the drive from the main supply.

WARNING! (With permanent magnet motors only) In case of a multiple IGBT power semiconductor failure, the drive system can produce an alignment torque which maximally rotates the motor shaft by 180/*p* degrees regardless of the activation of the Safe torque off function. *p* denotes the number of pole pairs.

Notes:

- If a running drive is stopped by using the Safe torque off function, the drive will cut off the motor supply voltage and the motor will coast to a stop. If this causes danger or is not otherwise acceptable, stop the drive and machinery using the appropriate stop mode before activating the Safe torque off function.
- The Safe torque off function overrides all other functions of the drive unit.
- The Safe torque off function is ineffective against deliberate sabotage or misuse.
- The Safe torque off function has been designed to reduce the recognized hazardous conditions. In spite of this, it is not always possible to eliminate all potential hazards. The assembler of the machine must inform the final user about the residual risks.

Maintenance

After the operation of the circuit is validated at start-up, the STO function shall be maintained by periodic proof testing. In high demand mode of operation, the maximum proof test interval is 20 years. In low demand mode of operation, the maximum proof test interval is 2 years. The test procedure is given in section *Acceptance test procedure* (page *561*).

In addition to proof testing, it is a good practice to check the operation of the function when other maintenance procedures are carried out on the machinery.

Include the Safe torque off operation test described above in the routine maintenance program of the machinery that the drive runs.

If any wiring or component change is needed after start up, or the parameters are restored, follow the test given in section *Acceptance test procedure* (page *561*).

Use only ABB approved spare parts.

Fault tracing

The indications given during the normal operation of the Safe torque off function are selected by parameter *31.22 STO indication run/stop*.

The diagnostics of the Safe torque off function cross-compare the status of the two STO channels. In case the channels are not in the same state, a fault reaction function is performed and the drive trips on an “STO hardware failure” fault. An attempt to use the STO in a non-redundant manner, for example activating only one channel, will trigger the same reaction.

See the drive firmware manual for the indications generated by the drive, and for details on directing fault and warning indications to an output on the control unit for external diagnostics.

Any failures of the Safe torque off function must be reported to ABB.

Safety data

The safety data for the Safe torque off function is given below.

Note: The safety data is calculated for redundant use, and does not apply if both STO channels are not used.

Frame size	IEC 61508 and IEC/EN 61800-5-2					
	SIL	PFH_d (1/h)	HFT	SFF (%)	T1 (a)	PFD
R0	3	2.34E-09	1	99.8	20	4.91E-06
R1	3	2.34E-09	1	99.8	20	4.91E-06
R2	3	2.34E-09	1	99.8	20	4.91E-06
R3	3	2.34E-09	1	99.8	20	4.92E-06
R5	3	6.23E-10	1	99.9	20	9.98E-06
R6	3	9.28E-10	1	99.8	20	1.49E-05
R7	3	9.28E-10	1	99.8	20	1.49E-05
R8	3	7.71E-10	1	99.7	20	1.66E-05
R9	3	7.71E-10	1	99.7	20	1.66E-05

Frame size	EN ISO 13849-1					IEC/EN 62061	IEC 61511
	PL	CCF (%)	$MTTF_d$[1] (a)	DC[2] (%)	Category	SILCL	SIL
R0	e	80	2973	>90	3	3	3
R1	e	80	2973	>90	3	3	3
R2	e	80	2973	>90	3	3	3
R3	e	80	2972	>90	3	3	3
R5	e	80	18190	>90	3	3	3
R6	e	80	12253	>90	3	3	3
R7	e	80	12253	>90	3	3	3
R8	e	80	2757	>90	3	3	3
R9	e	80	2757	>90	3	3	3

[1] 100 years must be used for calculation of a safety loop.

3AXD00000586715.xls E

[2] According to standard EN ISO 13849-1 table E.1

- The following temperature profile is used in safety value calculations:
  - 670 on/off cycles per year with $\triangle T$ = 71.66 °C
  - 1340 on/off cycles per year with $\triangle T$ = 61.66 °C
  - 30 on/off cycles per year with $\triangle T$ = 10.0 °C
  - 32 °C board temperature at 2.0% of time
  - 60 °C board temperature at 1.5% of time
  - 85 °C board temperature at 2.3% of time.

- The STO is a type A safety component as defined in IEC 61508-2.
- Relevant failure modes:
  - The STO trips spuriously (safe failure)
  - The STO does not activate when requested

  A fault exclusion on the failure mode “short circuit on printed circuit board” has been made (EN 13849-2, table D.5). The analysis is based on an assumption that one failure occurs at one time. No accumulated failures have been analyzed.
- STO reaction time (shortest detectable break): 1 ms
- STO response time: 2 ms (typical), 5 ms (maximum)
- Fault detection time: Channels in different states for longer than 200 ms
- Fault reaction time: Fault detection time + 10 ms
- STO fault indication (parameter 31.22) delay: < 500 ms
- STO warning indication (parameter 31.22) delay: < 1000 ms
- Maximum cable length 300 m (984 ft) between activation switch (K) and drive control unit.
- The voltage at the INx terminals of each drive must be at least 13 V DC to be interpreted as “1”. Pulse tolerance of input channels is 1 ms.

Abbreviations

Abbr.	Reference	Description
CCF	EN ISO 13849-1	Common cause failure (%)
DC	EN ISO 13849-1	Diagnostic coverage
FIT	IEC 61508	Failure in time: 1E-9 hours
HFT	IEC 61508	Hardware fault tolerance
$MTTF_d$	EN ISO 13849-1	Mean time to dangerous failure: (The total number of life units) / (the number of dangerous, undetected failures) during a particular measurement interval under stated conditions
PFD	IEC 61508	Probability of failure on demand
PFH_D	IEC 61508	Probability of dangerous failures per hour
PL	EN ISO 13849-1	Performance level. Levels a…e correspond to SIL
SC	IEC 61508	Systematic capability
SFF	IEC 61508	Safe failure fraction (%)
SIL	IEC 61508	Safety integrity level (1…3)
SILCL	EN 62061	Maximum SIL (level 1…3) that can be claimed for a safety function or subsystem
STO	IEC/EN 61800-5-2	Safe torque off
T1	IEC 61508	Proof test interval

Declaration of conformity

Declaration of conformity (3AXD10000302783) is available on the Internet. See section *Document library on the Internet* on the inside of the back cover.

Certificate

TÜV certificate (3AXD10000302787) is available on the Internet. See section *Document library on the Internet* on the inside of the back cover.

24

Optional I/O extension modules

What this chapter contains

This chapter describes how to install and start up the optional CMOD-01 and CMOD-01 multifunction extension modules. The chapter also contains diagnostics and technical data.

CMOD-01 multifunction extension module (external 24 V AC/DC and digital I/O)

Safety instructions

WARNING! Obey the safety instructions for the drive. If you ignore the safety instructions, injury or death can occur.

Hardware description

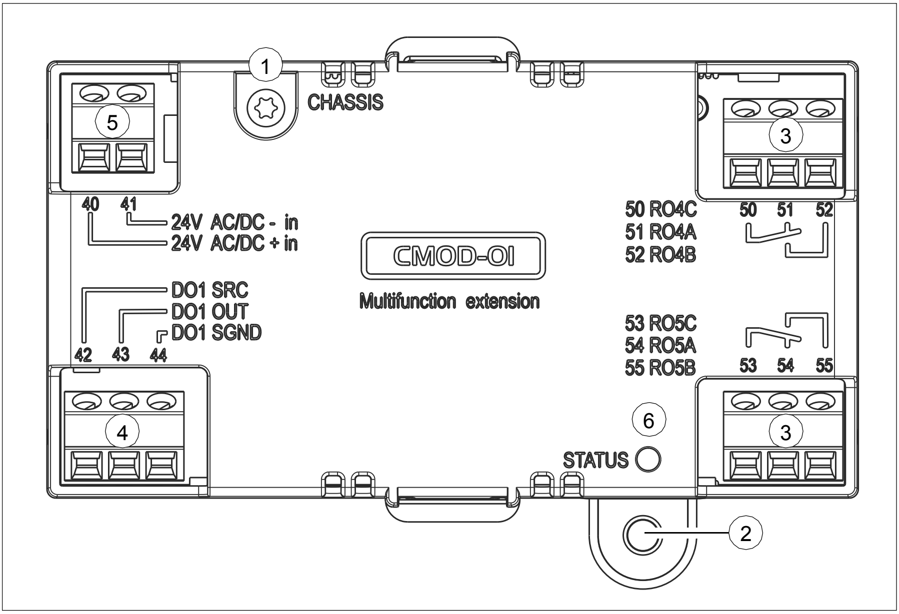
Product overview

The CMOD-01 multifunction extension module (external 24 V AC/DC and digital I/O) expands the outputs of the drive control unit. It has two relay outputs and one transistor output, which can function as a digital or frequency output.

In addition, the extension module has an external power supply interface, which can be used to power up the drive control unit in case the drive power supply fails. If you do not need the back-up power supply, you do not have to connect it because the module is powered from the drive control unit by default.

Note: In frames R5…R9, you do not need a CMOD-01 module to use external 24 V AC/DC supply. The external supply is connected directly to terminals 40 and 41 on the control unit.

Layout



Item	Description	Additional information
1	Grounding screw	Page 568
2	Hole for mounting screw	Page 568
3	3-pin terminal blocks for relay outputs	Page 569
4	3-pin terminal block for transistor output	Page 569
5	2-pin terminal block for external power supply	Page 569
6	Diagnostic LED	Page 573

Mechanical installation

Necessary tools and instructions

- Screwdriver and a set of suitable bits.

Unpacking and checking the delivery

1. Open the option package.
2. Make sure that the package contains:
   - CMOD-01 multifunction extension module
   - mounting screw.
3. Make sure that there are no signs of damage.

Installing the module

See chapter *Installing optional modules* on page *110*.

Electrical installation

Warnings

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do electrical work.

Make sure that the drive is disconnected from the input power during installation. If the drive is already connected to the input power, wait for 5 minutes after disconnecting the input power.

Necessary tools and instructions

- Screwdriver and a set of suitable bits
- Cabling tools

Terminal designations

For more detailed information on the connectors, see section *Technical data* on page *573*.

Relay outputs

Marking		**Description**
50	RO4C	Common, C
51	RO4A	Normally closed, NC
52	RO4B	Normally open, NO
53	RO5C	Common, C
54	RO5A	Normally closed, NC
55	RO5B	Normally open, NO

Transistor output

Marking		Description
42	DO1 SRC	Source input
43	DO1 OUT	Digital or frequency output
44	DO1 SGND	Ground (earth) potential

External power supply6

The external power supply is needed only if you want to connect an external back-up power supply for the drive control unit

Note: Only frames R0…R3 need CMOD-01 (or CMOD-02) for connecting external power supply, frames R5…R9 have corresponding terminals 40 and 41 on the control unit.

Marking		Description
40	24V AC/DC + in	External 24 V (AC/DC) input
41	24V AC/DC - in	External 24 V (AC/DC) input

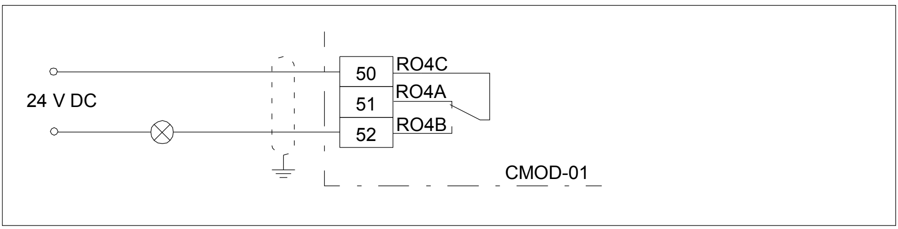
General cabling instructions

Obey the instructions given in chapter *Planning the electrical installation* on page 59.

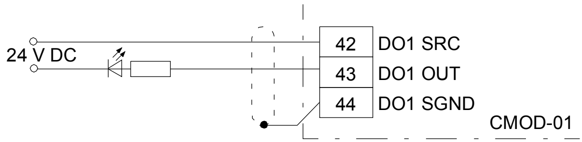
Wiring

Connect the external control cables to the applicable module terminals. Ground the outer shield of the cables 360 degrees under a grounding clamp on the grounding shelf of the control cables.

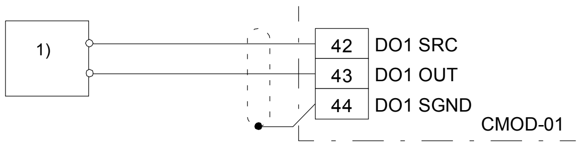
Relay output connection example



Digital output connection example



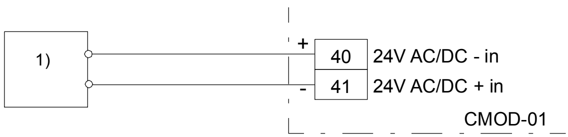
Frequency output connection example



1) An externally supplied frequency indicator which provides, for example:

- a 40 mA / 12 V DC power supply for the sensor circuit (CMOD frequency output)
- suitable voltage pulse input (10 Hz … 16 kHz).

External power supply connection example



1) External power supply, 24 V AC/DC

Start-up

Setting the parameters

1. Power up the drive.
2. If no warning is shown,
   - make sure that the value of both parameter *15.02 Detected extension module* and parameter *15.01Extension module type* is CMOD-01.

   If warning *A7AB Extension I/O configuration failure* is shown,
   - make sure that the value of parameter *15.02 Detected extension module* is CMOD-01.
   - set parameter *15.01 Extension module type* to CMOD-01.

You can now see the parameters of the extension module in parameter group *15 I/O extension module* (page *252*).

3. Set the parameters of the extension module to applicable values.

   Examples are given below.

Parameter setting example for relay output

This example shows how make relay output RO4 of the extension module indicate the reverse direction of rotation of the motor with a one-second delay.

Parameter	Setting
15.07 RO4 source	*Reverse*
15.08 RO4 ON delay	1 s
15.09 RO4 OFF delay	1 s

Parameter setting example for digital output

This example shows how to make digital output DO1 of the extension module indicate the reverse direction of rotation of the motor with a one-second delay.

Parameter	Setting
15.22 DO1 configuration	*Digital output*
15.23 DO1 source	*Reverse*
15.24 DO1 ON delay	1 s
15.25 DO1 OFF delay	1 s

Parameter setting example for frequency output

This example shows how to make digital output DO1 of the extension module indicate the motor speed 0... 1500 rpm with a frequency range of 0...10000 Hz.

Parameter	Setting
15.22 DO1 configuration	*Frequency output*
15.33 Freq out 1 source	01.01
15.34 Freq out 1 src min	0
15.35 Freq out 1 src max	1500.00
15.36 Freq out 1 at src min	1000 Hz
15.37 Freq out 1 at src max	10000 Hz

Diagnostics

Faults and warning messages

Warning *A7AB Extension I/O configuration failure*, see page *429*.

LEDs

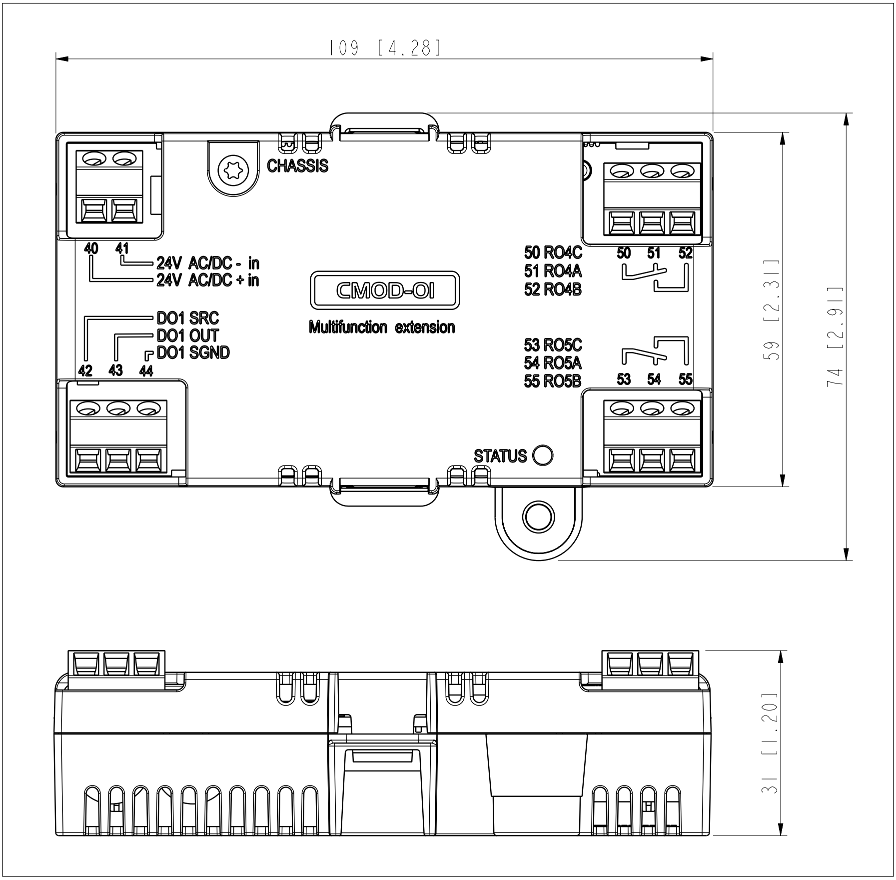
The extension module has one diagnostic LED.

Color	Description
Green	The extension module is powered up.

Technical data

Dimension drawing:

The dimensions are in millimeters and [inches].



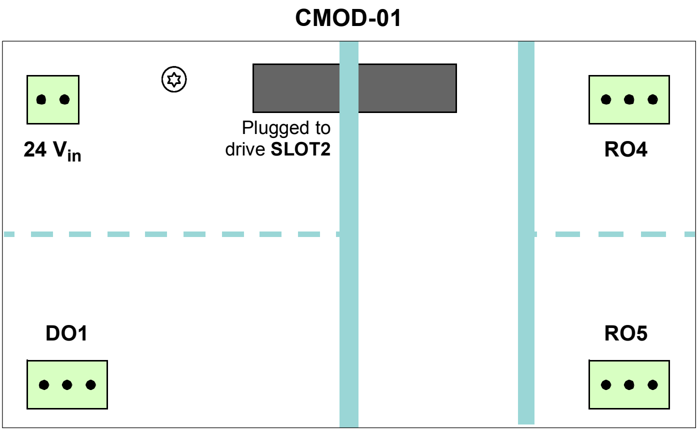
Installation: Into an option slot on the drive control unit

Degree of protection: IP20

Ambient conditions: See the drive technical data.

Package: Cardboard

Isolation areas:



Symbol	Description
	Reinforced insulation (IEC 61800-5-1:2007)
	Functional insulation (IEC 61800-5-1:2007)

Relay outputs (50…52, 53…55):

- Wire size max. 1.5 mm^2
- Minimum contact rating: 12 V / 10 mA
- Maximum contact rating: 250 V AC / 30 V DC / 2 A
- Maximum breaking capacity: 1500 VA

Transistor output (42…44):

- Wire size max. 1.5 mm^2
- Type: Transistor output PNP
- Maximum switching voltage: 30 V DC
- Maximum switching current: 100 mA / 30 V DC, short-circuit protected
- Frequency: 10 Hz … 16 kHz
- Resolution: 1 Hz
- Accuracy: 0.2%

External power supply (40…41):

- Wire size max. 1.5 mm^2
- 24 V AC / V DC ±10% (GND, user potential)
- Maximum current consumption: 25 W, 1.04 A at 24 V DC

CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)

Safety instructions

WARNING! Obey the safety instructions for the drive. If you ignore the safety instructions, injury or death can occur.

Hardware description

Product overview

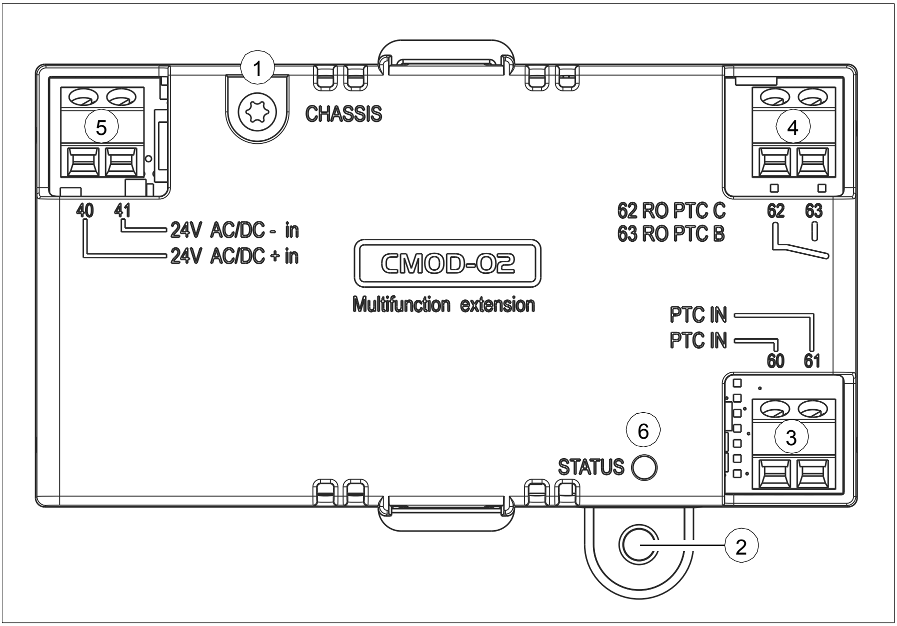
The CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface) has a motor thermistor connection for supervising the motor temperature and one relay output, which indicates the thermistor status. To trip the drive, the user must connect this overtemperature indication back to the drive, for example, to its Safe torque off input.

In addition, the extension module has an external power supply interface, which can be used to power up the drive control unit in case the drive power supply fails. If you do not need the back-up power supply, you do not have to connect it because the module is powered from the drive control unit by default.

There is reinforced insulation between the motor thermistor connection, the relay output and the drive control unit interface. Thus, you can connect a motor thermistor to the drive through the extension module.

Note: In frames R5…R9, you do not need a CMOD-01 module to use external 24 V AC/DC supply. The external supply is connected directly to terminals 40 and 41 on the control unit.

Layout



Item	Description	Additional information
1	Grounding screw	Page *577*
2	Hole for mounting screw	Page *577*
3	2-pin terminal block for motor thermistor connection	Page *578*
4	2-pin terminal block for relay output	Page *578*
5	2-pin terminal block for external power supply	Page *578*
6	Diagnostic LED	Page *581*

Mechanical installation

Necessary tools and instructions

- Screwdriver and a set of suitable bits

Unpacking and checking the delivery

1. Open the option package.
2. Make sure that the package contains:
   - CMOD-02 multifunction extension module
   - mounting screw
3. Make sure that there are no signs of damage.

Installing the module

See chapter *Installing optional modules* on page *110*.

Electrical installation

Warnings

WARNING! Obey the instructions in chapter *Safety instructions* on page *17*. If you ignore them, injury or death, or damage to the equipment can occur. If you are not a qualified electrician, do not do electrical work.

Make sure that the drive is disconnected from the input power during installation. If the drive is already connected to the input power, wait for 5 minutes after disconnecting the input power.

Necessary tools and instructions

- Screwdriver and a set of suitable bits
- Cabling tools

Terminal designations

For more detailed information on the connectors, see section *Technical data* on page *582*.

Motor thermistor connection

Marking		Description
60	PTC IN	PTC connection
61	PTC IN	Ground (earth) potential

Relay output

Marking		Description
62	RO PTC C	Common, C
63	RO PTC B	Normally open, NO

External power supply

The external power supply is needed only if you want to connect an external back-up power supply for the drive control unit.

Note: Only frames R0…R3 need CMOD-01 (or CMOD-02) for connecting external power supply, frames R5…R9 have corresponding terminals 40 and 41 on the control unit.

Marking		**Description**
40	24V AC/DC + in	External 24 V (AC/DC) input
41	24V AC/DC - in	External 24 V (AC/DC) input

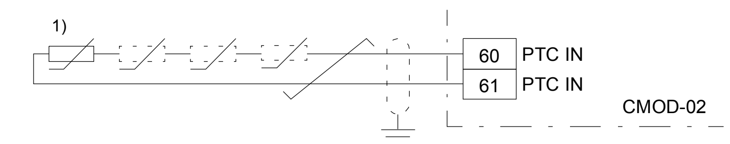
General cabling instructions

Obey the instructions given in chapter *Planning the electrical installation* on page 59.

Wiring

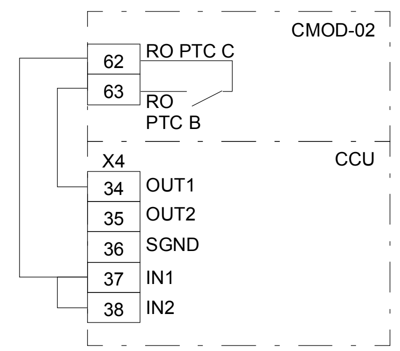
Connect the external control cables to the applicable module terminals. Ground the outer shield of the cables 360 degrees under a grounding clamp on the grounding shelf of the control cables

Motor thermistor connection example

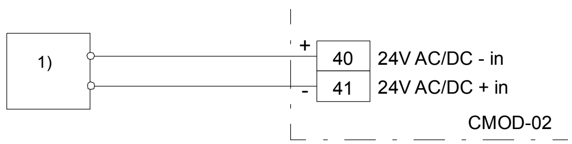


1) One or 3…6 PTC thermistors connected in series.

Relay output connection example



Power supply connection example



1) External power supply, 24 V AC/DC

Start-up

Setting the parameters

1. Power up the drive.
2. If no warning is shown,
   - make sure that the value of both parameter *15.02 Detected extension module* and parameter *15.01Extension module type* is CMOD-02.

   If warning *A7AB Extension I/O configuration failure* is shown,

   - make sure that the value of parameter *15.02 Detected extension module* is CMOD-02.
   - set parameter *15.01 Extension module type* to CMOD-02.

   You can now see the parameters of the extension module in parameter group *15 I/O extension module* (page *252*).

Diagnostics

Faults and warning messages

Warning *A7AB Extension I/O configuration failure*, see page 429.

LEDs

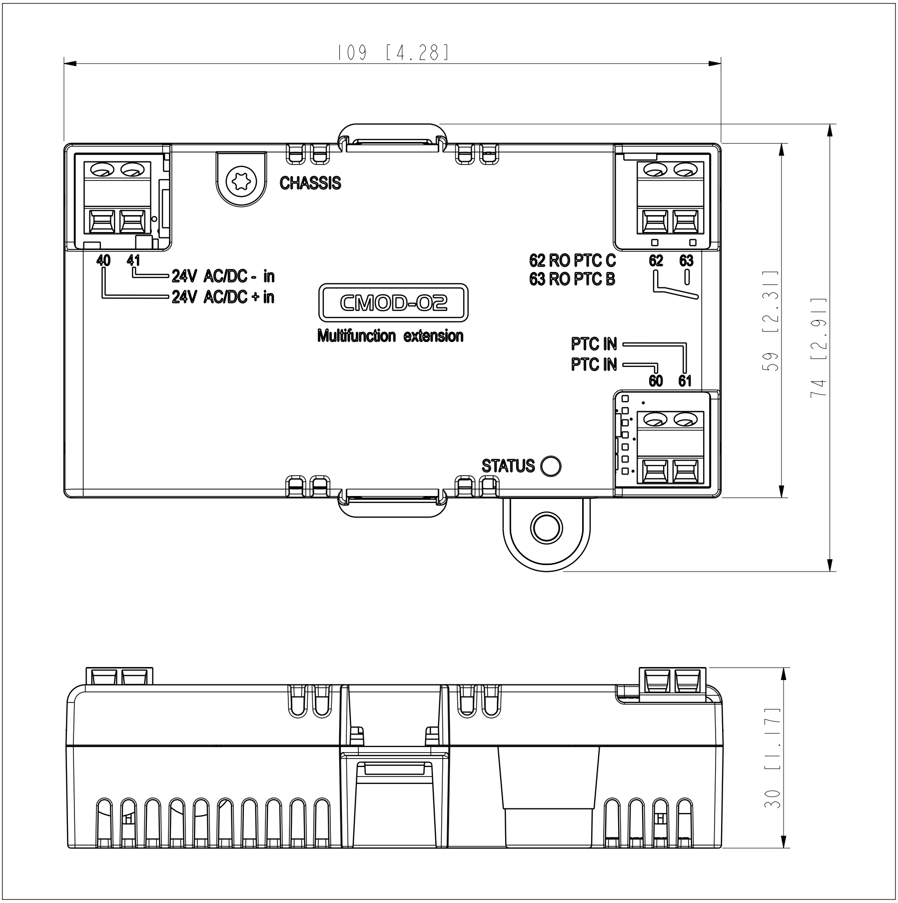
The extension module has one diagnostic LED.

Color	Description
Green	The extension module is powered up.

Technical data

Dimension drawing:

The dimensions are in millimeters and [inches].



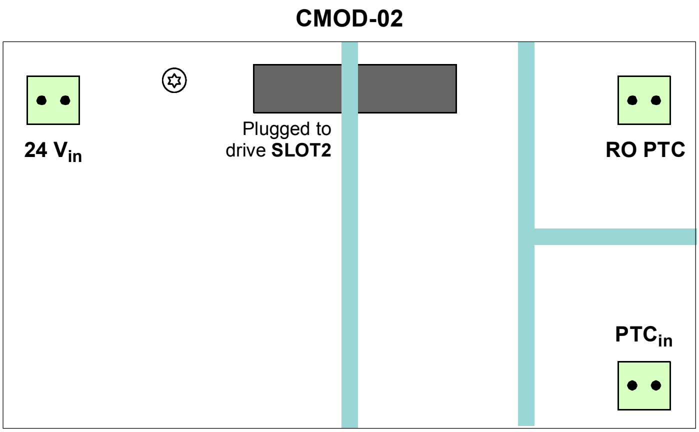
Installation: Into an option slot on the drive control unit

Degree of protection: IP20

Ambient conditions: See the drive technical data.

Package: Cardboard

Isolation areas:



Symbol	Description
	Reinforced insulation (IEC 61800-5-1:2007)
	Functional insulation (IEC 61800-5-1:2007)

Motor thermistor connection (60…61):

- Wire size max. 1.5 mm^2
- Supported standards: DIN 44081 and DIN 44082
- Number of PTC thermistor relays: 1 or 3…6 in series
- Triggering threshold: 3.6 kohm
- Recovery threshold: 1.6 kohm
- PTC terminal voltage: $\leq$ 5.0 V
- PTC terminal current: < 1 mA
- Short-circuit detection: < 50 ohm

Relay output (62…63):

- Wire size max. 1.5 mm^2
- Maximum contact rating: 250 V AC / 30 V DC / 5 A
- Maximum breaking capacity: 1000 VA

External power supply (40…41):

- Wire size max. 1.5 mm^2
- 24 V AC / V DC ±10% (GND, user potential)
- Maximum current consumption: 25 W, 1.04 A at 24 V DC

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 www.abb.com/drives and select *Training courses*.

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Your comments on our manuals are welcome. Go to www.abb.com/drives and select *Document Library – Manuals feedback form (LV AC drives)*.

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