ABB industrial drives

Firmware manual
ACS880 primary control program

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List of related manuals in English

Drive hardware manuals and guides	Code (English)
ACS880-01 hardware manual	*3AUA0000078093*
ACS880-01 quick installation guide for frames R1 to R3	*3AUA0000085966*
ACS880-01 quick installation guide for frames R4 and R5	*3AUA0000099663*
ACS880-01 quick installation guide for frames R6 to R9	*3AUA0000085966*
ACS-AP-I and ACS-AP-S assistant control panel user's manual	*3AUA0000085685*

Drive firmware manuals and guides	
ACS880 primary control program firmware manual	*3AUA0000085967*
ACS880 drives with primary control program, Quick start-up guide	*3AUA0000098062*

Option manuals and guides
Manuals and quick guides for I/O extension modules, fieldbus adapters, encoder interfaces, etc.

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.

Firmware manual

ACS880 primary control program

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1

Introduction to the manual

What this chapter contains

This chapter describes the contents of the manual. It also contains information on the compatibility, safety and intended audience.

Applicability

This manual applies to the ACS880 primary control program.

Safety instructions

Follow all safety instructions delivered with the drive.

- Read the **complete safety instructions** before you install, commission, or use the drive. The complete safety instructions are delivered with the drive as either part of the *Hardware manual*, or, in the case of ACS880 multidrives, as a separate document.
- Read the **firmware function-specific warnings and notes** before changing parameter values. These warnings and notes are included in the parameter descriptions presented in chapter *Parameters*.

Target audience

This manual is intended for people who design, commission, or operate the drive system.

Contents of the manual

This manual consists of the following chapters:

This manual consists of the following chapters:

- *Using the control panel* provides the basic instructions for use of the control panel.
- *Control locations and operating modes* describes the control locations and operating modes of the drive.
- *Program features* contains descriptions of the features of the ACS880 primary control program.
- *Application macros* contains a short description of each macro together with a connection diagram.
- *Parameters* describes the parameters of the drive.
- *Additional parameter data* contains further information on the parameters.
- *Fault tracing* lists the warning and fault messages with possible causes and remedies.
- *Fieldbus control through the embedded fieldbus interface (EFB)* describes the communication to and from a fieldbus network using the embedded fieldbus interface of the drive.
- *Fieldbus control through a fieldbus adapter* describes the communication to and from a fieldbus network using an optional fieldbus adapter module.
- *Drive-to-drive link* describes the communication between drives connected together by the drive-to-drive (D2D) link.
- *Control chain and drive logic diagrams*.

Related documents

Note: A quick start-up sequence for a speed control application is provided by *ACS880 drives with primary control program, Quick start-up guide* (3AUA0000098062), delivered with the drive.

A list of related manuals is printed on the inside of the front cover.

Terms and abbreviations

Term/abbreviation	Definition
ACS-AP-I	Type of control panel used with ACS880 drives
AI	Analog input; interface for analog input signals
AO	Analog output; interface for analog output signals
BCU	Type of control unit used in ACS880 drives.
DC link	DC circuit between rectifier and inverter
DI	Digital input; interface for digital input signals
DIO	Digital input/output; interface that can be used as a digital input or output
DO	Digital output; interface for digital output signals

Term/abbreviation	Definition
DTC	Direct torque control
EFB	Embedded fieldbus
FBA	Fieldbus adapter
FEN-01	Optional TTL encoder interface module
FEN-11	Optional absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL encoder interface module
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FIO-21	Optional analog/digital I/O extension module
FCAN-0x	Optional CANopen adapter
FDNA-0x	Optional DeviceNet adapter
FECA-01	Optional EtherCAT® adapter
FENA-0x	Optional Ethernet/IP adapter
FLON-0x	Optional LONWORKS® adapter
FPBA-0x	Optional PROFIBUS DP adapter
FSCA-0x	Optional Modbus adapter
HTL	High-threshold logic
IGBT	Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in inverters due to their easy controllability and high switching frequency
I/O	Input/Output
ID run	Motor identification run. During the identification run, the drive will identify the characteristics of the motor for optimum motor control.
LSB	Least significant bit
LSW	Least significant word
MSB	Most significant bit
MSW	Most significant word
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PID controller	Proportional–integral–derivative controller. Drive speed control is based on PID algorithm.
PLC	Programmable logic controller
Power unit	Contains the power electronics and connections of the drive. The drive control unit is connected to the power unit.
PTC	Positive temperature coefficient
RFG	Ramp function generator.
RO	Relay output; interface for a digital output signal. Implemented with a relay.

Term/abbreviation	Definition
SSI	Synchronous serial interface
STO	Safe torque off
TTL	Transistor-transistor logic
UPS	Uninterruptible power supply; power supply equipment with battery to maintain output voltage during power failure
ZCON	Type of control board used in ACS880 drives. The board is either integrated into the drive or fitted in a plastic housing (see *ZCU*).
ZCU	Type of control unit used in ACS880 drives that consists of a ZCON board built into a plastic housing. The control unit may be fitted onto the drive/inverter module, or installed separately.

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Using the control panel

Refer to *ACS-AP-I and ACS-AP-S assistant control panels user's manual* (3AUA0000085685 [English]).

3

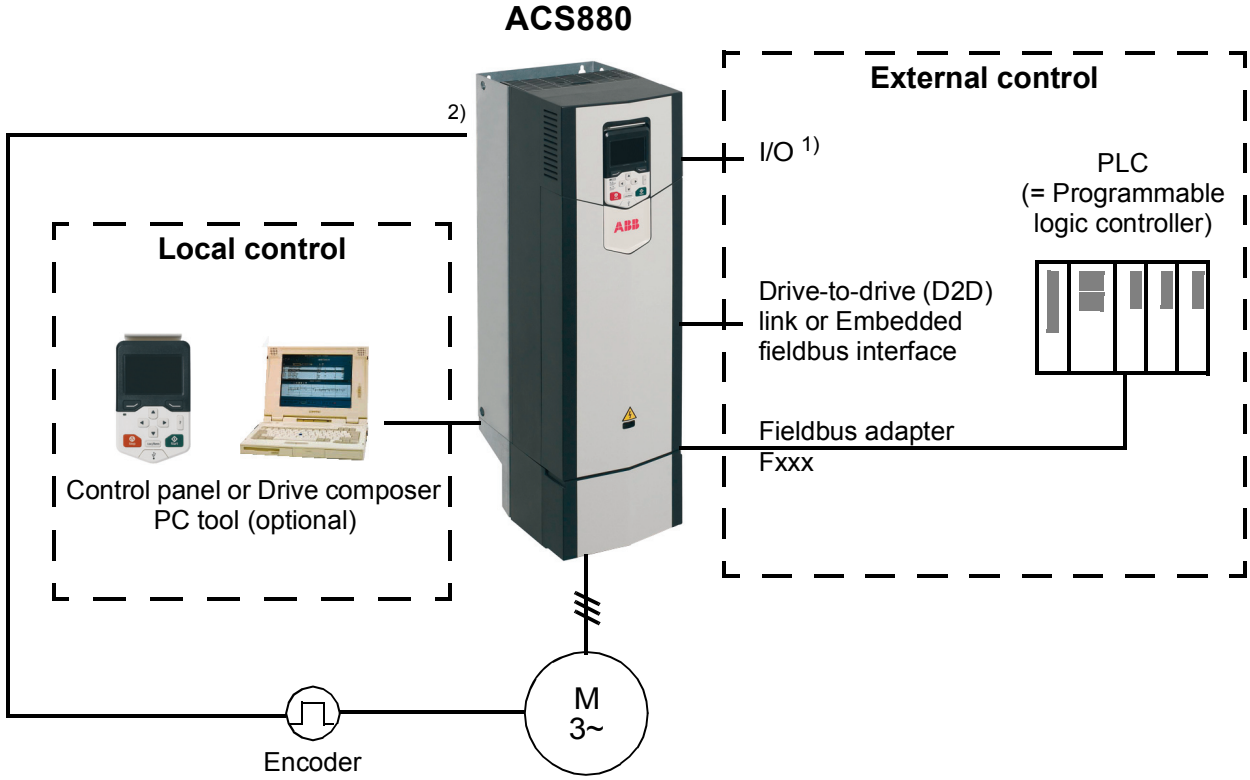
Control locations and operating modes

What this chapter contains

This chapter describes the control locations and operating modes supported by the control program.

Local control vs. external control

The ACS880 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 optional I/O extension modules (FIO-xx) in drive slots.

2) Encoder or resolver interface module(s) (FEN-xx) installed in drive slots.

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 for local control; frequency mode is available when scalar motor control mode is used.

Local control is mainly used during commissioning and maintenance. The control panel always overrides the external control signal sources when used in local control. Changing the control location to local can be disabled 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.

External control

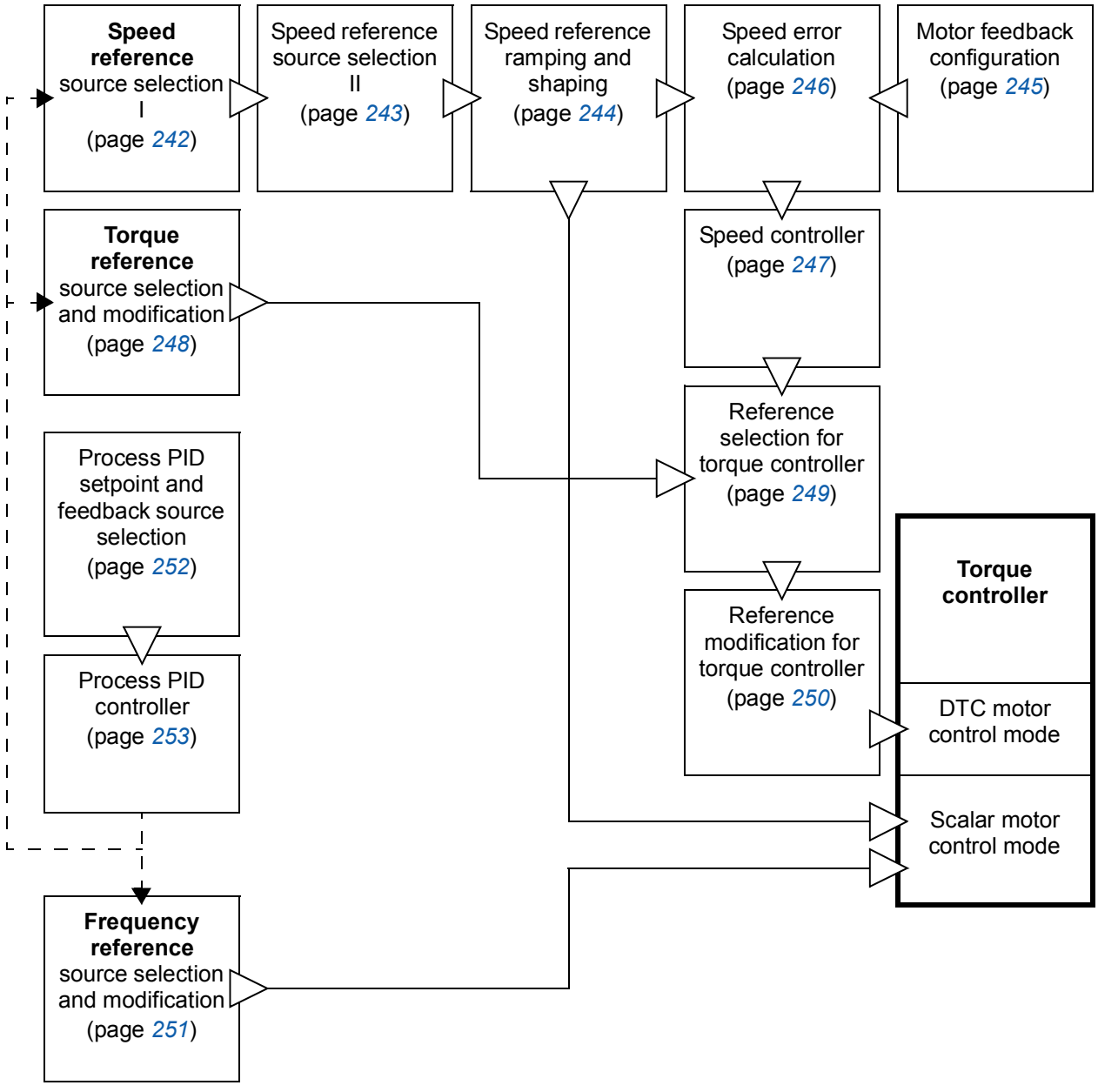
When the drive is in external control, control commands are given through the fieldbus interface (via the embedded fieldbus interface or an optional fieldbus adapter module), the I/O terminals (digital and analog inputs), optional I/O extension modules or the drive-to-drive link. External references are given through the fieldbus interface, analogue inputs, drive-to-drive link and encoder inputs.

Two external control locations, EXT1 and EXT2, are available. The user can select control signals (e.g. start and stop) and control modes for both external control locations. Depending on the user selection, either EXT1 or EXT2 is active at a time. Selection between EXT1/EXT2 is done via any binary source such as a digital input or fieldbus control word.

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 an overall representation of the reference types and control chains. The page numbers refer to detailed diagrams in chapter *Control chain and drive logic diagrams*.



Speed control mode

The motor rotates at a speed proportional to the speed reference given to the drive. This mode can be used either with estimated speed used as feedback, or with an encoder or resolver for better speed control accuracy.

Speed control mode is available in both local and external control. It is also available both in DTC (Direct Torque Control) and scalar motor control modes.

Torque control mode

Motor torque is proportional to a torque reference given to the drive. This mode can be used either with or without an encoder or resolver. When used with an encoder or resolver, this mode provides for more accurate and dynamic motor control.

Torque control mode is available in both local and external control.

Frequency control mode

Motor frequency is proportional to the 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 *34*).
- Emergency stop modes OFF1 and OFF3: Drive stops along the defined deceleration ramp and drive modulation stops.
- Jogging mode: Drive starts and accelerates to the defined speed when the jogging signal is activated. For more information, see section *Jogging* (page *28*).

4

Program features

What this chapter contains

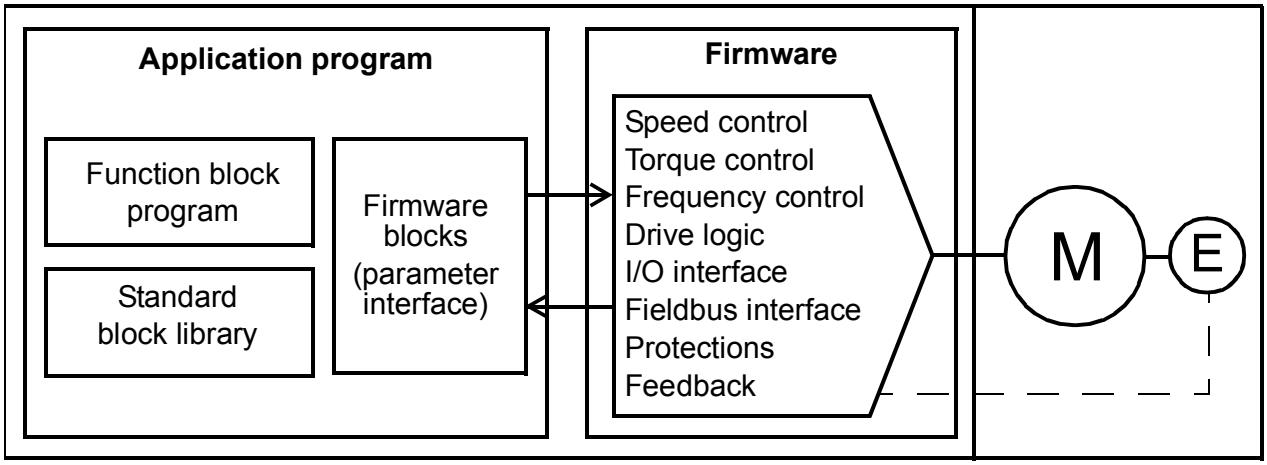
This chapter describes the features of the control program.

Drive configuration and programming

The drive control program is divided into two parts:

- firmware program
- application program.

Drive control program



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

Programming via parameters

Parameters can be set via

- the control panel, as described in chapter *Using the control panel*
- the Drive composer PC tool, 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 Param save* before powering down the control unit after any parameter changes.

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

Application programming

The functions of the firmware program can be extended with application programming. (A standard drive delivery does not include an application program.) Application programs can be built out of function blocks based on the IEC-61131

standard. Some drive parameters are used as firmware function block inputs and can therefore be modified also via the application program.

Control interfaces

Programmable analog inputs

The drive 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 jumper on the drive control unit. Each input can be filtered, inverted and scaled. The number of analog inputs can be increased by using FIO-xx I/O extensions.

Settings

Parameter group *12 Standard AI* (page *66*).

Programmable analog outputs

The drive control unit has two current (0…20 mA) analog outputs. Each output can be filtered, inverted and scaled. The number of analog outputs can be increased by using FIO-xx I/O extensions.

Settings

Parameter group *13 Standard AO* (page *68*).

Programmable digital inputs and outputs

The drive has six digital inputs, a digital start interlock input, and two digital input/outputs.

One digital input (DI6) doubles as a PTC thermistor input. See section *Thermal motor protection* (page *40*).

One of the digital input/outputs can be used as a frequency input, one as a frequency output.

The number of digital inputs/outputs can be increased by using FIO-xx I/O extensions.

Settings

Parameter groups *10 Standard DI, RO* (page *55*) and *11 Standard DIO, FI, FO* (page *61*).

Programmable relay outputs

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

Relay outputs can be added by using FIO-0x I/O extensions.

Settings

Parameter group *10 Standard DI, RO* (page *55*).

Programmable I/O extensions

The number of inputs and outputs can be increased by using FIO-xx I/O extensions. The I/O configuration parameters (parameter groups 10…13) include the maximum number of DI, DIO, AI, AO and RO that can be in use with different FIO-xx combinations.

The table below shows the possible I/O combinations:

Location	Digital inputs (DI)	Digital I/Os (DIO)	Analog inputs (AI)	Analog outputs (AO)	Relay outputs (RO)
Drive control unit	7	2	2	2	3
FIO-01	-	4	-	-	2
FIO-11	-	2	3	1	-
FIO-21	1	-	1	-	2

For example, with an FIO-01 and an FIO-21 connected to the drive, parameters controlling DI1…8, DIO1…6, AI1…3, AO1…2 and RO1…7 are in use.

Settings

Parameter groups *10 Standard DI, RO* (page *55*), *11 Standard DIO, FI, FO* (page *61*), *12 Standard AI* (page *66*) and *13 Standard AO* (page *68*).

Fieldbus control

The drive can be connected to several different automation systems through its fieldbus interfaces. See chapter *Fieldbus control through a fieldbus adapter* (page *227*)

Settings

Parameter groups *50 Fieldbus adapter (FBA)* (page *156*), *51 FBA A settings* (page *159*), *52 FBA A data In* (page *160*), and *53 FBA A data out* (page *161*).

Motor control

Direct torque control (DTC)

The motor control of the ACS880 is based on direct torque control (DTC). 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 DTC is that torque control has 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 *Scalar motor control* (page *30*).

Settings

Parameters *99.04 Motor ctrl mode* (page *178*) and *99.13 Identification run request* (page *180*).

Reference ramping

Acceleration and deceleration ramping times can be set individually for speed, torque and frequency reference.

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 a maximum value defined by a parameter. 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.

Special acceleration/deceleration ramps

The acceleration/deceleration times for the jogging function can be defined separately; see section *Jogging* (page *28*). Furthermore, an emergency stop ramp can be defined *Emergency stop* (page *40*).

Settings

- Parameters *23.11*…*23.19* and *46.10* (speed reference).
- Parameters *26.18*, *26.19* and *99.12* (torque reference).
- Parameters *28.71*…*28.75* and *46.11* (frequency reference).

Constant speeds (frequencies)

It is possible to predefine up to 7 constant speeds. Constant speeds can be activated, for example, through digital inputs. Constant speeds override the speed reference.

For frequency control, seven constant frequencies can be defined in the same way.

Settings

Parameter groups *22 Speed reference selection* (page *85*) and *28 Frequency reference chain* (page *107*).

Critical speeds (frequencies)

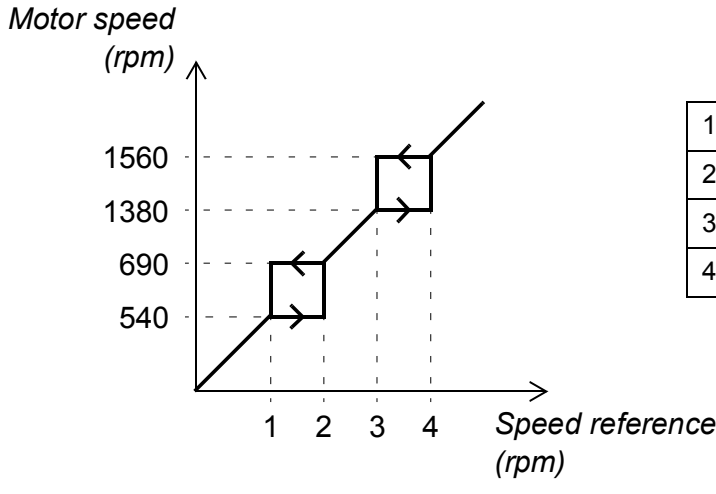
A critical speeds function is available for applications where it is necessary to avoid certain motor speeds or speed ranges because of, for example, mechanical resonance problems.

A similar function is available for scalar motor control with a frequency reference.

Example

A fan has vibrations in the range of 540 to 690 rpm and 1380 to 1560 rpm. To make the drive jump over 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

Parameter groups *22 Speed reference selection* (page *85*) and *28 Frequency reference chain* (page *107*).

Encoder support

- The program supports two single-turn or multiturn encoders (or resolvers). The following optional interface modules are available:
- Absolute encoder interface FEN-11: absolute encoder input, TTL input, TTL output (for encoder emulation and echo) and two digital inputs for position latching
- Resolver interface FEN-21: resolver input, TTL input, TTL output (for encoder emulation echo) and two digital inputs for position latching
- HTL encoder interface FEN-31: HTL encoder input, TTL output (for encoder emulation and echo) and two digital inputs for position latching.

The interface module is installed onto any option slot on the drive control unit, or onto a FEA-xx extension adapter. **Note:** Two interface modules of the same type are not allowed.

Settings

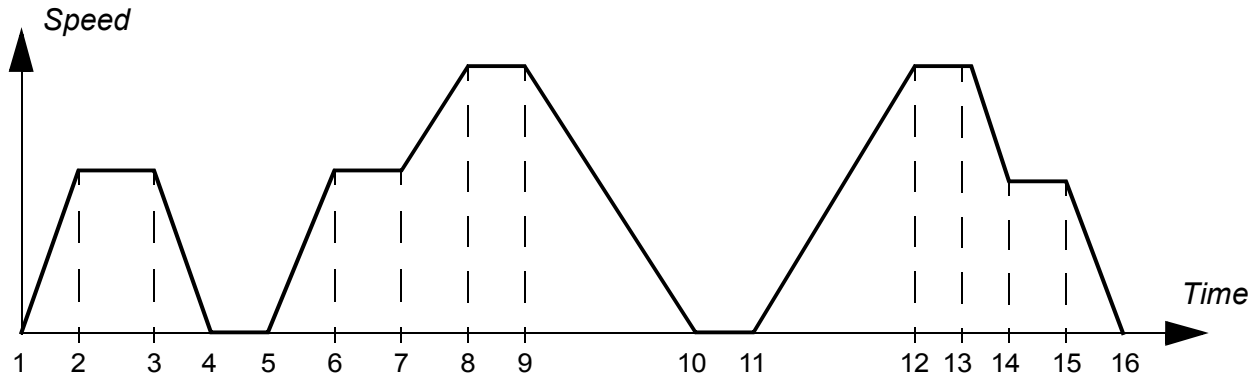
Parameter groups *90 Feedback selection* (page *161*), *91 Encoder module settings* (page *165*), *92 Encoder 1 configuration* (page *167*) and *93 Encoder 2 configuration* (page *171*).

Jogging

Two jogging functions (1 or 2) are available. When a jogging function is activated, the drive starts and accelerates to the defined jogging speed (parameter *22.42 Jogging 1 ref* or *22.43 Jogging 2 ref*) along the defined jogging acceleration ramp (*23.20 Acc time jogging*). When the function is deactivated, the drive decelerates to a stop along the defined jogging deceleration ramp (*23.21 Dec time jogging*). One push button can be used to start and stop the drive during jogging. The jogging function is typically used during servicing or commissioning to control the machinery locally.

Jogging functions 1 and 2 are activated by a parameter or through fieldbus. For activation through fieldbus, see parameter *06.01 Main control word*. If both jogging functions are activated simultaneously, jogging function 1 has priority.

The figure and table below describe the operation of the drive during jogging. (Note that they cannot be directly applied to jogging commands through fieldbus as those require no enable signal; see parameter *20.25 Jogging enable*.) They also represent how the drive shifts to normal operation (= jogging inactive) when the drive start command is switched on. Jog cmd = State of the jogging input (*20.26 Jogging 1 start* or *20.27 Jogging 2 start*); Jog enable = State of the source set by *20.25 Jogging enable*; Start cmd = State of the 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 runs at the jogging speed.
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 runs at the jogging speed.
7-8	x	0	1	Jog enable is not active; normal operation continues.
8-9	x	0	1	Normal operation overrides the jogging. Drive follows the speed reference.
9-10	x	0	0	Drive decelerates to zero speed along the active deceleration ramp.
10-11	x	0	0	Drive is stopped.
11-12	x	0	1	Normal operation overrides the jogging. Drive accelerates to the speed reference along the active acceleration ramp.
12-13	1	1	1	Start command overrides the jog enable signal.
13-14	1	1	0	Drive decelerates to the jogging speed along the deceleration ramp of the jogging function.
14-15	1	1	0	Drive runs at the jogging speed.
15-16	x	0	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.

Notes:

- Jogging is not operational when the drive start command is on, or if the drive is in local control.
- The ramp shape time is set to zero during jogging.

Settings

Parameters *20.25 Jogging enable* (page *80*), *20.26 Jogging 1 start* (page *80*), *20.27 Jogging 2 start* (page *81*), *22.42 Jogging 1 ref* (page *89*), *22.43 Jogging 2 ref* (page *89*), *23.20 Acc time jogging* (page *94*) and *23.21 Dec time jogging* (page *94*).

Scalar motor control

It is possible to select scalar control as the motor control method instead of DTC (Direct Torque Control). In scalar control mode, the drive is controlled with a speed or frequency reference. However, the outstanding performance of DTC is not achieved in scalar control.

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

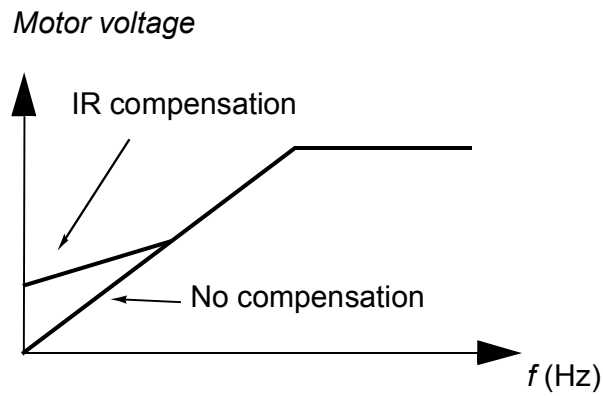
- In multimotor drives: 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after motor identification (ID run)
- If the nominal current of the motor is less than 1/6 of the nominal output current of the drive
-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

IR compensation for scalar motor control

IR compensation 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 Direct Torque Control (DTC), no IR compensation is possible or needed.



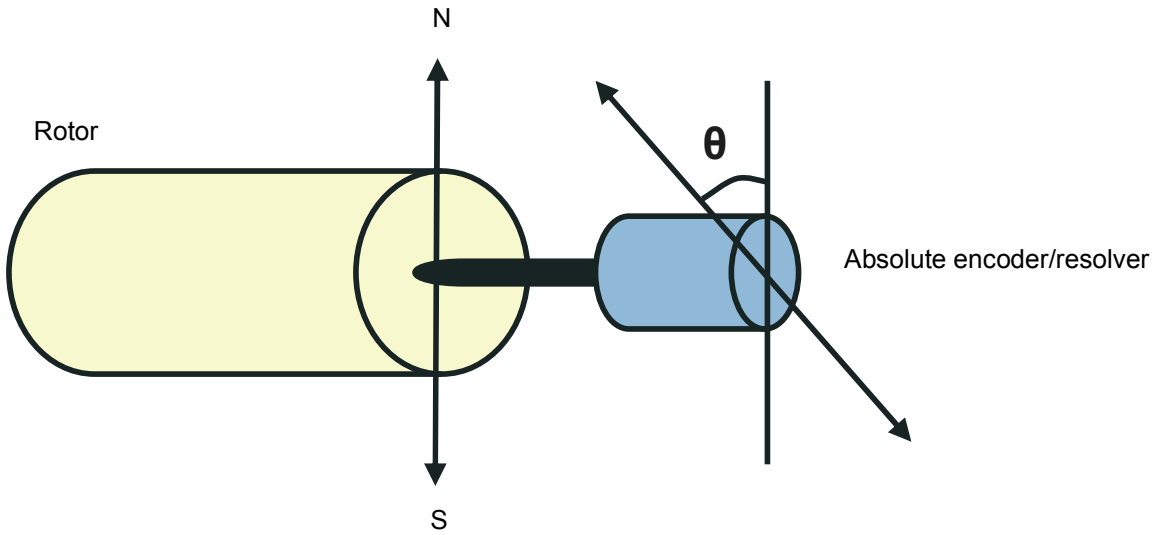
Settings

Parameters *97.13 IR compensation* (page *176*), *99.04 Motor ctrl mode* (page *178*) and parameter group *28 Frequency reference chain* (page *107*).

Autophasing

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

Sensors like absolute encoders and resolvers indicate the rotor position at all times after the offset between the zero angle of rotor and that of the sensor has been established. On the other hand, a standard pulse encoder determines the rotor position when it rotates but the initial position is not known. However, a pulse encoder can be used as an absolute encoder if it is equipped with Hall sensors, albeit with coarse initial position accuracy. The Hall sensors generate so-called commutation pulses that change their state six times during one revolution, so it is only known within which 60° sector of a complete revolution the initial position is.



The autophasing routine is performed with permanent magnet synchronous motors and synchronous reluctance motors in the following cases:

1. One-time measurement of the rotor and encoder position difference when an absolute encoder, a resolver, or an encoder with commutation signals is used
2. At every power-up when an incremental encoder is used
3. With open-loop motor control, repetitive measurement of the rotor position at every start.

Several autophasing modes are available (see parameter *21.13 Autophasing mode*).

The turning mode is recommended especially with case 1 as it is the most robust and accurate method. In turning mode, the motor shaft is turned back and forward (±360/polepairs)° in order to determine the rotor position. In case 3 (open-loop control), the shaft is turned only in one direction and the angle is smaller.

The standstill modes can be used if the motor cannot be turned (for example, when the load is connected). As the characteristics of motors and loads differ, testing must be done to find out the most suitable standstill mode.

A rotor position offset used in motor control can also be given by the user. See parameter *98.15 Position offset user*.

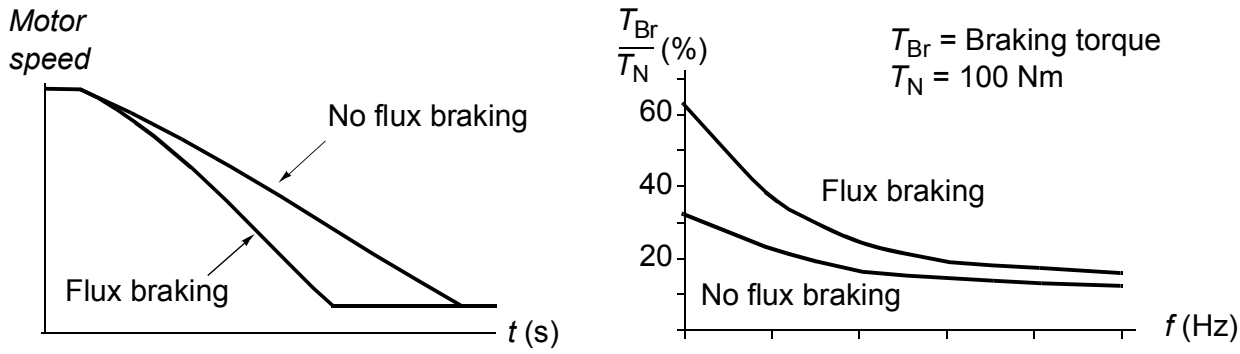
The drive is capable of determining the rotor position when started to a running motor in open-loop or closed-loop modes. In this situation, the setting of *21.13 Autophasing mode* has no effect.

Settings

Parameters *21.13 Autophasing mode* (page *85*), *98.15 Position offset user* (page *178*) and *99.13 Identification run request* (page *180*).

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.

Settings

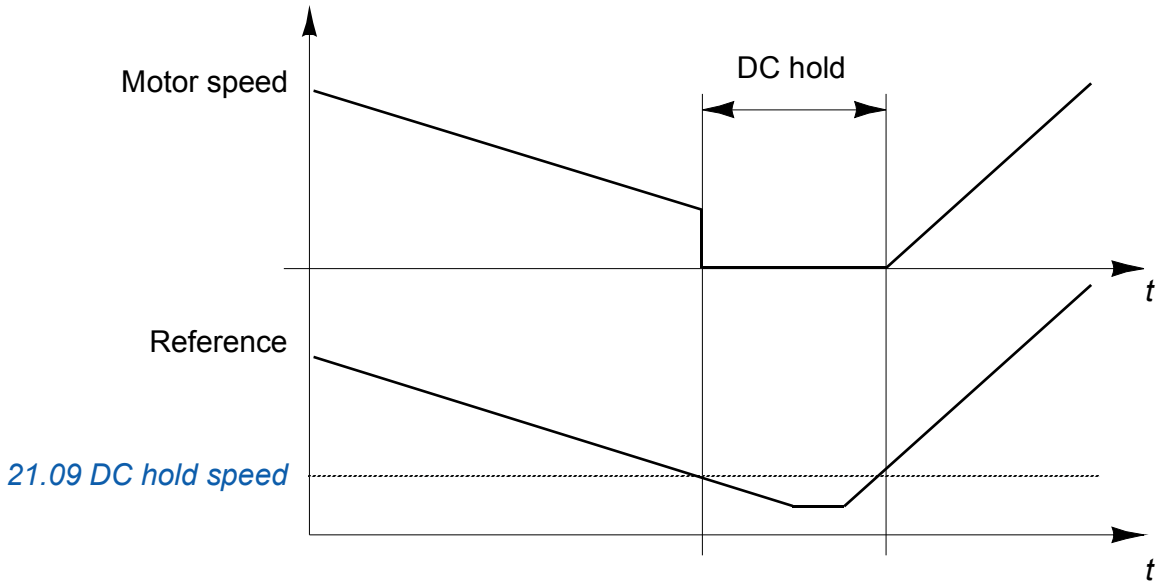
Parameter *97.05 Flux braking* (page *175*).

DC magnetization

DC magnetization can be applied to the motor to lock the rotor at or near zero speed. The following DC magnetization options are activated by parameter *21.08 DC current control*.

DC hold

The function makes it possible to lock the rotor at (near) zero speed in the middle of normal operation. 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.



Note: DC hold is only available in speed control.

Post-magnetization

This feature keeps the motor magnetized for a certain period (parameter *21.10 DC current reference*) after stopping. This is to prevent the machinery from moving under load, for example before a mechanical brake can be applied.

Settings

Parameters *21.09*…*21.11* (page *85*).

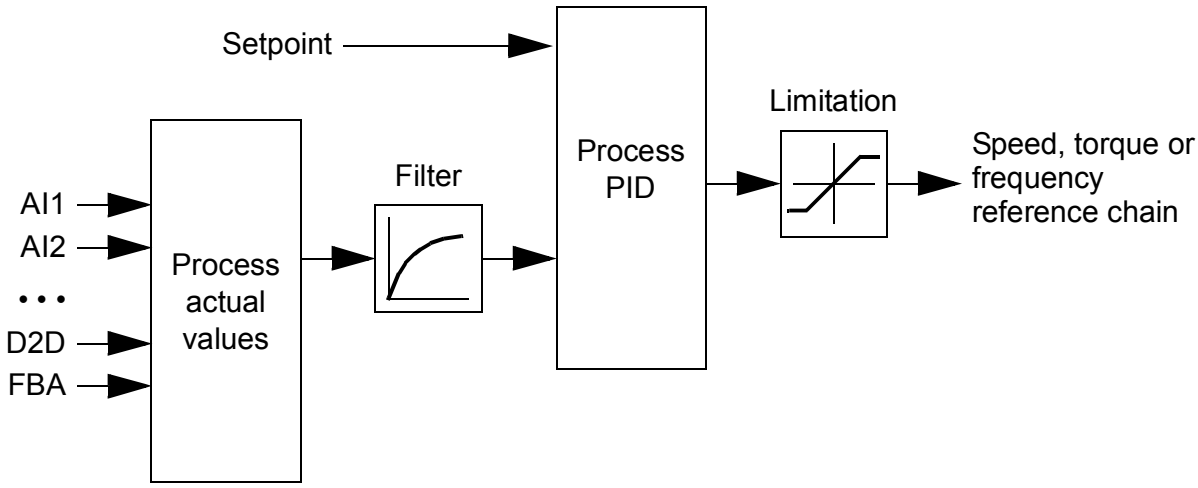
Application control

Process PID control

There is a built-in process PID controller in the drive. The controller can be used to control process variables such as pressure, flow or fluid level.

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).

The simplified block diagram below illustrates the process PID control. For a more detailed block diagram, see page 252.



The control program contains two complete sets of process PID controller settings that can be alternated whenever necessary; see parameter *40.57 Sel between set1 set2*.

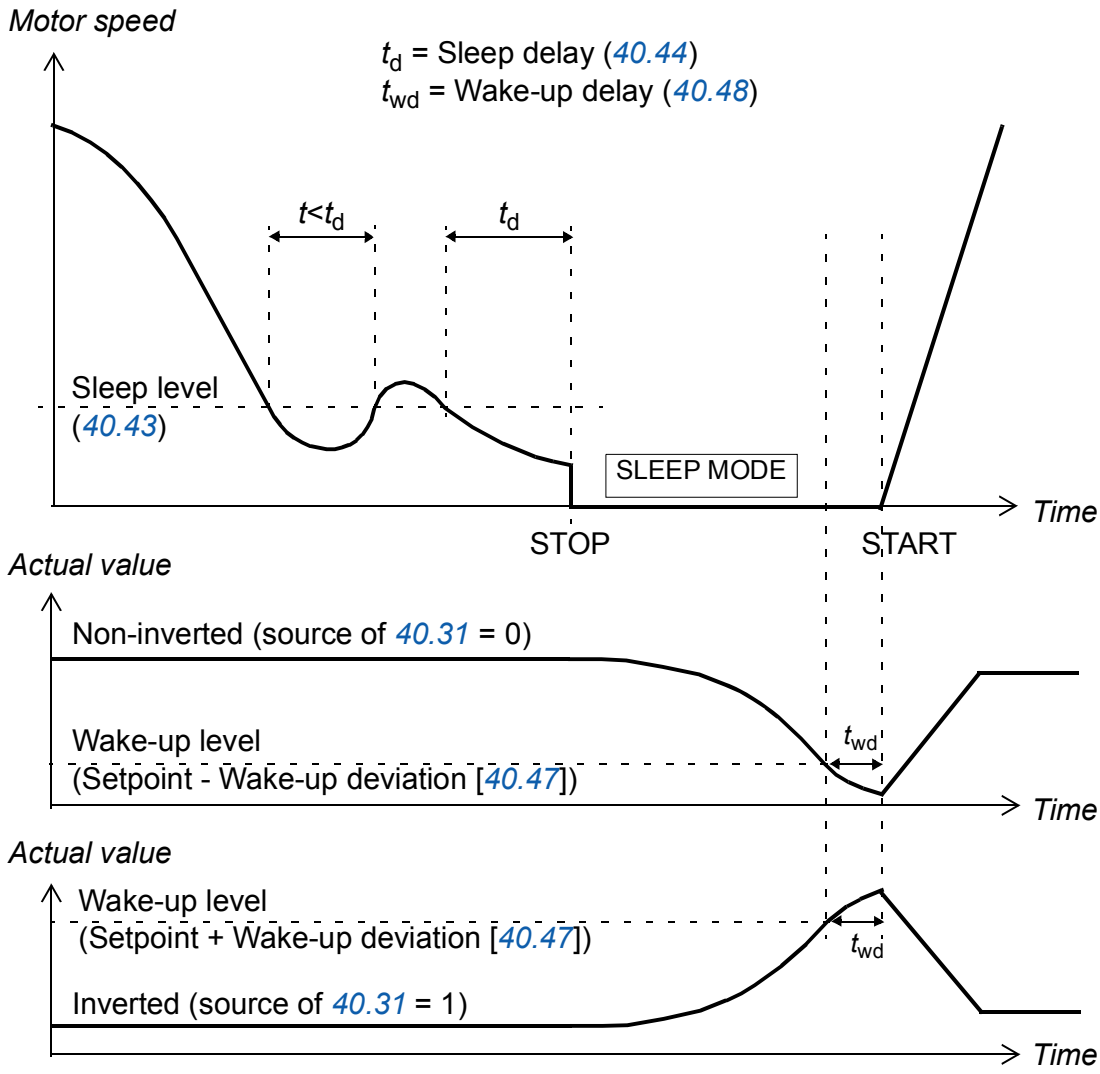
Quick configuration of the process PID controller

1. Activate the process PID controller (parameter *40.07 PID operation mode*).
2. Select a feedback source (parameters *40.08*…*40.11*).
3. Select a setpoint source (parameters *40.16*…*40.25*).
4. Set the gain, integration time, derivation time, and the PID output levels (*40.32 Gain*, *40.33 Integration time*, *40.34 Derivation time*, *40.36 Output min* and *40.37 Output max*).
5. The PID controller output is shown by parameter *40.01 Process PID actual value*. Select it as the source of, for example, *22.11 Speed ref1 selection*.

Sleep function for process PID control

The following example visualizes the operation of the sleep function.

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 wake-up level (setpoint - wake-up deviation) and the wake-up delay has passed.



Settings

Parameter groups *40 Process PID set1* (page *132*) and parameter *41 Process PID set2* (page *144*).

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 output of the internal brake

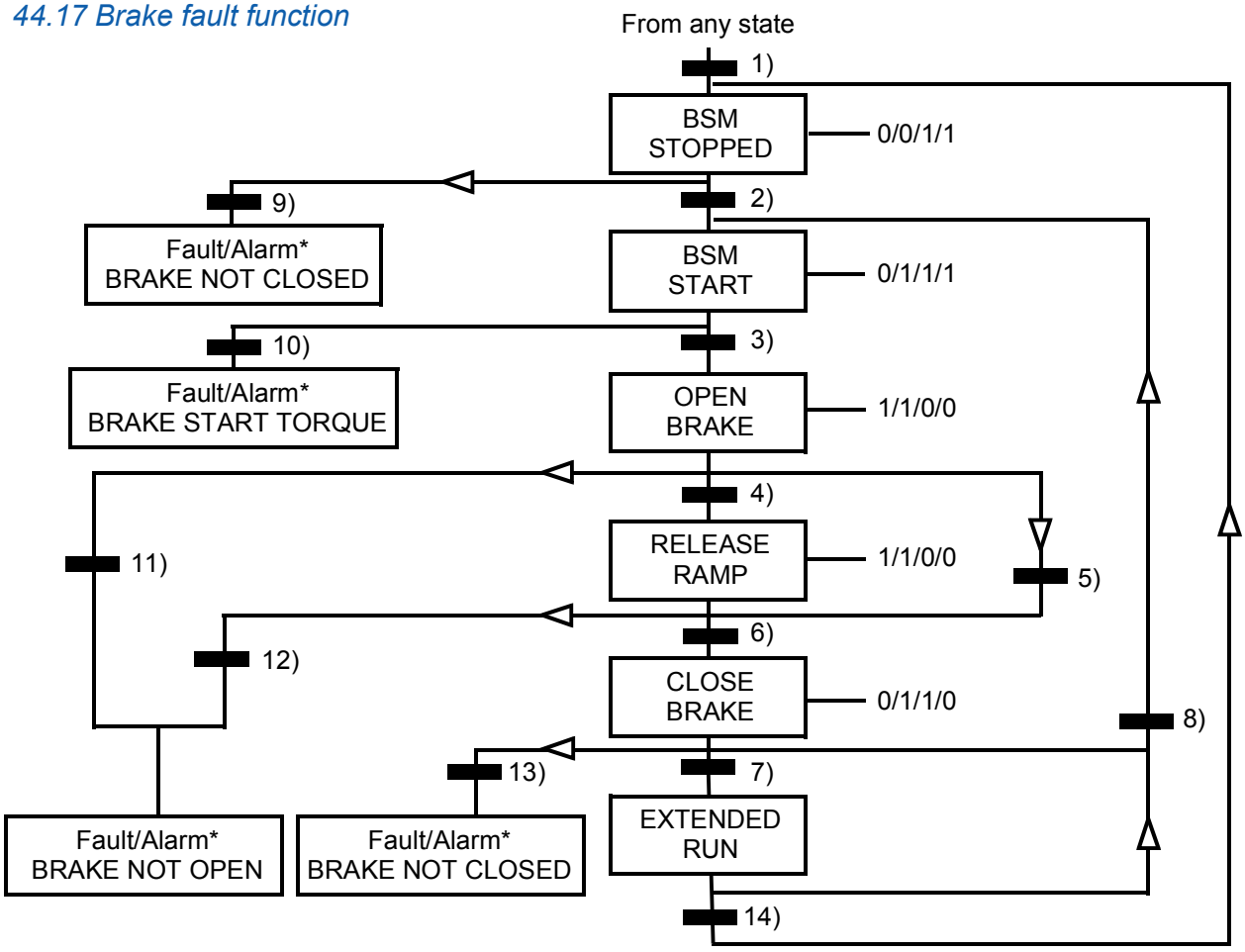
control logic is bit 0 of *44.01 Brake control status*, which is then selected as the source of a relay output or digital input/output (in output mode).

Settings

Parameter group *44 Mechanical brake control* (page *147*).

Brake state diagram

* Depending on setting of parameter *44.17 Brake fault function*



State (Symbol NN W/X/Y/Z)

- NN: State name
- W/X/Y/Z: State outputs/operations

W: 1 = Brake open command is active. 0 = Brake close command is active. (Controlled through selected digital/relay output by bit 0 of *44.01 Brake control status*.)

X: 1 = Forced start (inverter is modulating). The function keeps the internal start command on until the brake is closed in spite of the status of the external stop command. Effective only when ramp stop has been selected as the stop mode (*21.03 Stop mode*). Run enable and faults override the forced start. 0 = No forced start (normal operation).

Y: 1 = Drive control mode is forced to speed/scalar.

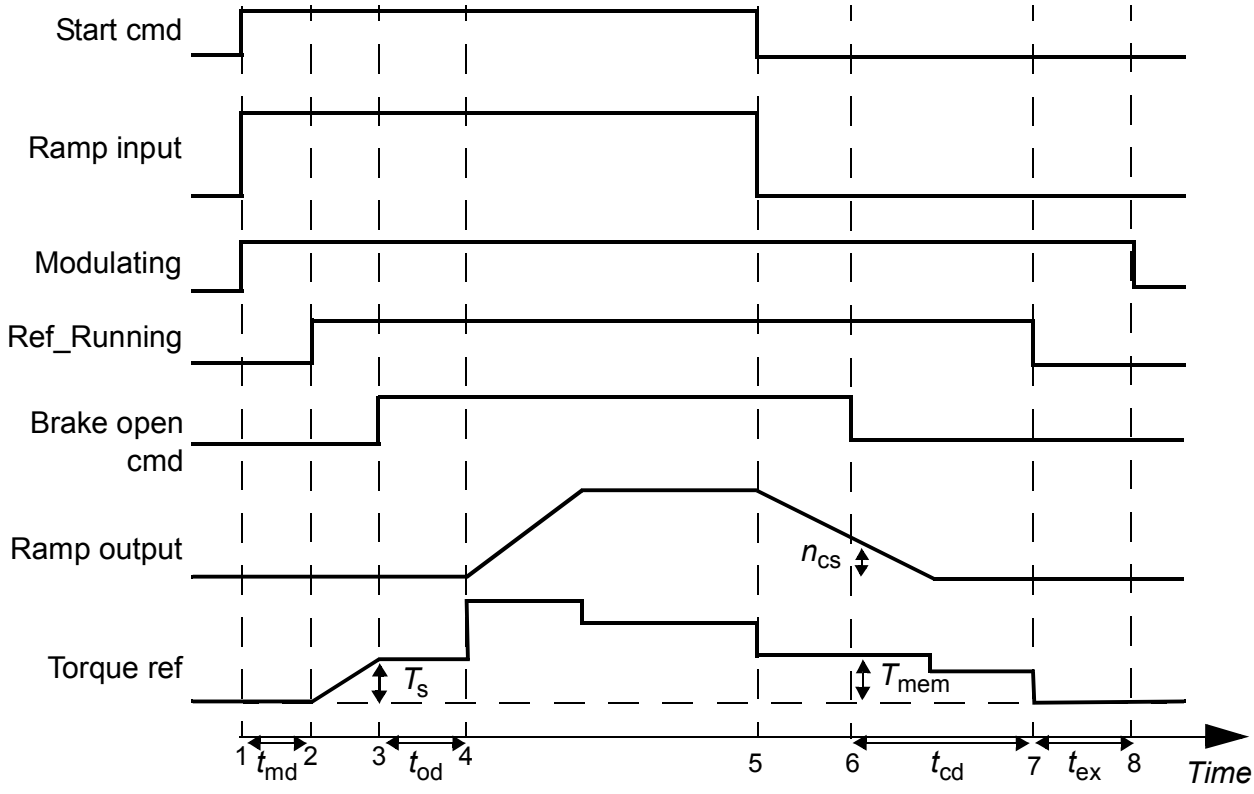
Z: 1 = Ramp generator output is forced to zero. 0 = Ramp generator output is enabled (normal operation).

State change conditions (Symbol ▬)

1) Brake control is active (source of *44.17 Brake fault function* = 1) OR modulation of the drive is requested to stop. The drive control mode is forced to speed/scalar.
2) External start command is on AND brake open request is on (source selected by *44.12 Brake close request* is 0) AND reopen delay (*44.16 Brake reopen delay*) has elapsed.
3) Starting torque required at brake release (*44.10 Brake open torque*) is reached AND brake hold is not active. **Note:** With scalar control, the defined starting torque has no effect.
4) Brake is open (acknowledgement source selected by *44.07 Brake acknowledge selection* is 1) AND the brake open delay has elapsed (*44.08 Brake open delay*). Start = 1.
5) 6) Start = 0 OR brake close command is active AND actual motor speed < brake close speed (*44.14 Brake close level*) AND close command delay (*44.13 Brake close delay*) has elapsed.
7) Brake is closed (acknowledgement = 0) AND brake close level delay (*44.15 Brake close level delay*) has elapsed. Start = 0.
8) Start = 1 AND brake open request is on (source selected by *44.12 Brake close request* is 0) AND reopen delay has elapsed.
9) Brake is open (acknowledgement = 1) AND brake close delay has elapsed.
10) Defined starting torque at brake release is not reached.
11) Brake is closed (acknowledgement = 0) AND brake open delay has elapsed.
12) Brake is closed (acknowledgement = 0).
13) Brake is open (acknowledgement = 1) AND brake close delay has elapsed. Fault is generated after the brake fault delay (*44.18 Brake fault delay*) has elapsed.
14) Brake is closed (acknowledgement = 1). Start = 0.

Operation time scheme

The simplified time scheme below illustrates the operation of the brake control function.



T_s	Start torque at brake release (parameter *44.10 Brake open torque*)
T_{mem}	Stored torque value at brake close (signal *44.02 Brake torque memory*)
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_{ccd}	Brake close command delay (parameter *44.13 Brake close delay*)
t_{cd}	Brake close delay (parameter *44.15 Brake close level delay*)
t_{ex}	Extended run time

Example

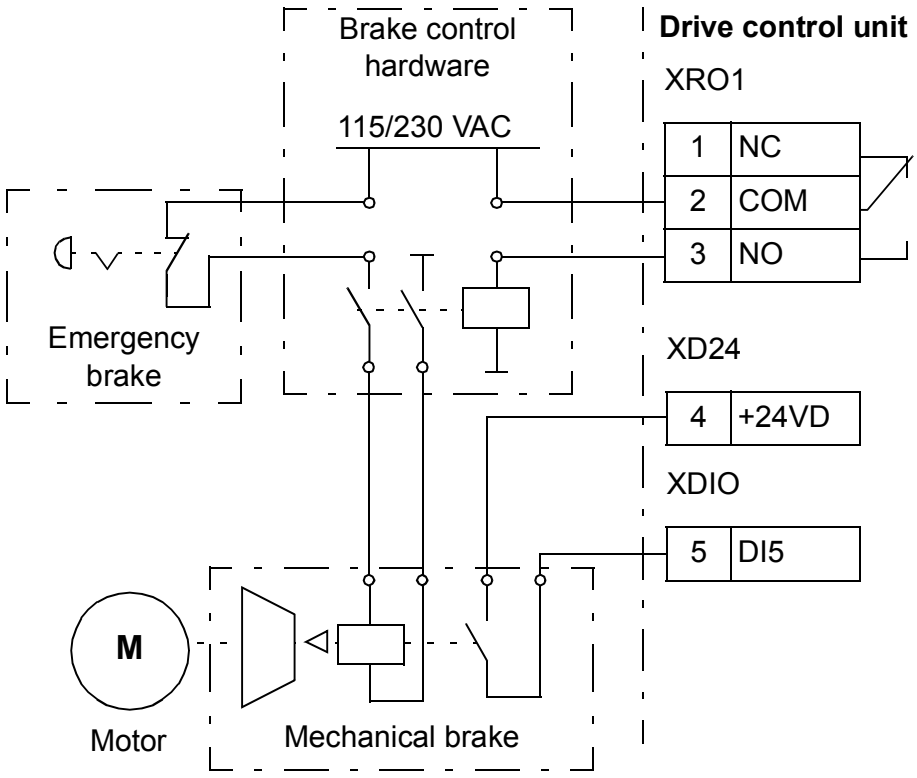
The figure below shows a brake control application example.

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 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 on/off is controlled via *44.01 Brake control status*. The source for the brake supervision is selected by parameter *44.07 Brake acknowledge selection*.

The brake control hardware and wirings need to be done by the user.

- Brake on/off control through selected relay/digital output.
- Brake supervision through selected digital input.
- Emergency brake switch in the brake control circuit.
- Brake on/off control through relay output (i.e. parameter *10.24 RO1 source* is set to bit 0 of *44.01 Brake control status*).
- Brake supervision through digital input DI5 (i.e. parameter *44.07 Brake acknowledge selection* is set to DI5).



Safety and protections

Emergency stop

The emergency stop signal is connected to the input selected by parameter *21.05 Emergency stop source*. The mode of the emergency stop is selected by parameter *21.04 Emergency stop mode*.

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.

Thermal motor protection

The motor can be protected against overheating by

- the motor thermal protection model
- measuring the motor temperature with sensors. This will result in a more accurate motor model.

Thermal motor 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 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.

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

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

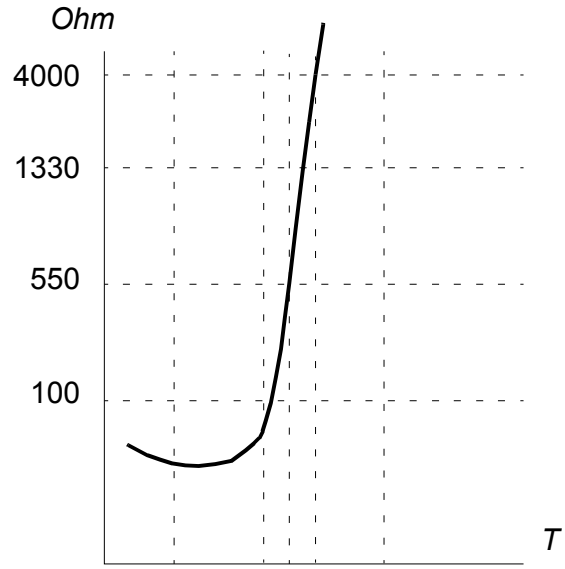
Temperature monitoring using PTC sensors

1…3 PTC sensors can be connected between +24 V and digital input DI6 of the drive.

The resistance of the sensor increases as the motor temperature rises over the sensor reference temperature T_{ref}, as does the voltage over the resistor. The temperature measurement function reads the voltage and converts it into ohms.

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

Temperature	PTC resistance
Normal	0…1 kohm
Excessive	≥ 1 kohm



For the wiring of the sensor, refer to the *Hardware Manual* of the drive.

Settings

Parameter group *35 Motor thermal protection* (page *127*).

Programmable protection functions

External events (parameters *31.01* and *31.02*)

An external event signal can be connected to a selectable input. When the signal is lost, an external event (fault, warning, or a mere log entry) is generated.

Motor phase loss detection (parameter *31.19*)

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

Earth fault detection (parameter *31.20*)

The earth fault detection function is based on sum current measurement. Note that

- an earth fault in the supply cable does not activate the protection
- in a grounded supply, the protection activates in 200 milliseconds
- in an ungrounded supply, the supply capacitance should 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. For more information on the Safe torque off function, see the *Hardware manual*.

Switched supply and motor cabling (parameter *31.23*)

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

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

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

Overspeed protection (parameters *31.30* and *31.31*)

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

Local control loss detection (parameter *49.05*)

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

Automatic fault resets

The drive can automatically reset itself after overcurrent, overvoltage, undervoltage, external and “analog input below minimum” 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

Parameters *31.12*…*31.16* (page *118*).

Diagnostics

Maintenance timers and counters

The program has six different maintenance timers or counters that can be configured to generate an alarm when a pre-defined limit is reached. The timer/counter can be set to monitor any parameter. This feature is especially useful as a service reminder.

There are three types of counters:

- On-time timers. Measures the time a binary source (for example, a bit in a status word) is on.
- Signal edge counters. The counter is incremented whenever the monitored binary source changes state.
- Value counters. The counter measures, by integration, the monitored parameter. An alarm is given when the calculated area below the signal peak exceeds a user-defined limit.

Settings

Parameter group *33 Maintenance timer & counter* (page *121*).

Energy savings calculator

This feature consists of the following functionalities:

- An energy optimizer that adjusts the motor flux in such a way that the total 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.

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

Settings

Parameter group *45 Energy savings* (page *151*).

Miscellaneous

Data storage parameters

Eight parameters are reserved for data storage. These parameters are unconnected and can be used for linking, testing and commissioning purposes. They can be written to and read from using other parameters' pointer settings.

Settings

Parameter group *47 Data storage* (page *155*).

5

Application macros

Application macros are not supported by the current firmware version.

6

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.
FbEq	(In the following table, shown on the same row as the parameter range, or for each selection) Fieldbus equivalent. The scaling between the value shown on the panel and the integer used in serial communication.
Other [bit]	The value is taken from a specific bit in another parameter. The source is selected from a parameter list.
Parameter	Either an user-adjustable operating instruction for the drive, or an *actual signal*.
p.u.	Per unit

Parameter listing

No.	Name/Value	Description	Def/FbEq
01 Actual values		Basic signals for monitoring of the drive. All parameters in this group are read-only unless otherwise noted.	
01.01	Motor speed used	Measured or estimated motor speed depending on which type of feedback is used (see parameter 90.41 Motor feedback selection). A filter time constant for this signal can be defined by parameter 46.04 Filter time motor speed.	100 = 1 rpm
01.02	Motor speed estimated	Estimated motor speed in rpm. A filter time constant for this signal can be defined by parameter 46.04 Filter time motor speed.	100 = 1 rpm
01.04	Encoder 1 speed filtered	Speed of encoder 1 in rpm.A filter time constant for this signal can be defined by parameter 46.04 Filter time motor speed.	100 = 1 rpm
01.05	Encoder 2 speed filtered	Speed of encoder 2 in rpm.A filter time constant for this signal can be defined by parameter 46.04 Filter time motor speed.	100 = 1 rpm
01.06	Output frequency	Estimated drive output frequency in Hz. A filter time constant for this signal can be defined by parameter 46.05 Filter time output frequency.	100 = 1 Hz
01.07	Motor current	Measured motor current in A.	100 = 1 A
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 46.06 Filter time motor torque.	10 = 1%
01.11	DC voltage	Measured intermediate circuit voltage.	100 = 1 V
01.14	Output power	Drive output power in kW. A filter time constant for this signal can be defined by parameter 46.07 Filter time power out.	100 = 1 kW
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.	1 = 1 GWh
01.19	Inverter MWh counter	Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. Whenever the counter rolls over, 01.18 Inverter GWh counter is incremented.The minimum value is zero.	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.	1 = 1 kWh
01.24	Flux actual %	Used flux reference in percent of nominal flux of motor.	1 = 1%
01.30	Nominal torque scale	Torque that corresponds to 100% of nominal motor torque. **Note:** This value is copied from parameter 99.12 Motor nominal torque if entered. Otherwise the value is calculated from other motor data.	1 = 1 N•m
01.31	Ambient temperature	Measured temperature of incoming cooling air in °C.	10 = 1 °C
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.	100 = 1
03.05	FB A reference 1	Reference 1 received through fieldbus adapter A.	100 = 1
03.06	FB A reference 2	Reference 2 received through fieldbus adapter A.	100 = 1

No.	Name/Value	Description	Def/FbEq
03.15	Application reference 1	Reference 1 received from the application program (if present).	
03.16	Application reference 2	Reference 2 received from the application program (if present).	

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).	1 = 1
04.02	Active fault 2	Code of the 2nd active fault.	1 = 1
04.03	Active fault 3	Code of the 3rd active fault.	1 = 1
04.04	Active fault 4	Code of the 4th active fault.	1 = 1
04.05	Active fault 5	Code of the 5th active fault.	1 = 1
04.06	Active warning 1	Code of the 1st active warning.	1 = 1
04.07	Active warning 2	Code of the 2nd active warning.	1 = 1
04.08	Active warning 3	Code of the 3rd active warning.	1 = 1
04.09	Active warning 4	Code of the 4th active warning.	1 = 1
04.10	Active warning 5	Code of the 5th active warning.	1 = 1
04.11	Latest fault	Code of the 1st stored (non-active) fault.	1 = 1
04.12	2nd latest fault	Code of the 2nd stored (non-active) fault.	1 = 1
04.13	3rd latest fault	Code of the 3rd stored (non-active) fault.	1 = 1
04.14	4th latest fault	Code of the 4th stored (non-active) fault.	1 = 1
04.15	5th latest fault	Code of the 5th stored (non-active) fault.	1 = 1
04.16	Latest warning	Code of the 1st stored (non-active) warning.	1 = 1
04.17	2nd latest warning	Code of the 2nd stored (non-active) warning.	1 = 1
04.18	3rd latest warning	Code of the 3rd stored (non-active) warning.	1 = 1
04.19	4th latest warning	Code of the 4th stored (non-active) warning.	1 = 1
04.20	5th latest warning	Code of the 5th stored (non-active) 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.	1 = 1 d
05.02	Run-time counter	Motor run-time counter. The counter runs when the inverter modulates.	1 = 1 d
05.04	Fan on-time counter	Running time of the drive cooling fan. Can be reset on the control panel by keeping Reset depressed for over 3 seconds.	1 = 1 d
05.11	Inverter temperature %	Estimated drive temperature in percent of fault limit.	10 = 1%

No.	Name/Value	Description	Def/FbEq
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 interface and the application program). The bit assignments of the word are as described on page 233. The related status word and state diagram are presented on pages 234 and 235 respectively. This parameter is read-only.	-
06.02	Application control word	The drive control word received from the application program (if any). The bit assignments are described on page 233. This parameter is read-only.	-
06.11	Main status word	Main status word of the drive. The bit assignments are described on page 234. The related control word and state diagram are presented on pages 233 and 235 respectively. This parameter is read-only.	-
06.12	Status word 1	Status word 1. This parameter is read-only.	-

Bit	Name	Description
0	Enabled	1 = Run enable and start enable signals present
1	Ready on	1 = Drive is ready to receive a start command
2	Ready run	1 = Drive is ready to operate
3	Ready ref	1 = Drive is following given reference
4	Started	1 = Drive has been started
5	Modulating	1 = Drive is modulating (output stage is being controlled)
6	Warning	1 = A warning is active
7	Faulted	1 = A fault is active
8	Local ctrl	1 = Drive is in local control
9	Network ctrl	1 = Drive is in network (fieldbus) control
10	Ext2 active	1 = Control location Ext2 active
11	Inhibited	1 = Start inhibited
12	Limiting	1 = Any operating limit (speed, torque, etc.) is active
13…15	Reserved	

No.	Name/Value	Description	Def/FbEq
06.20	*Control status word 1*	Control status word 1. This parameter is read-only.	-

Bit	Name	Description
0	First start not done	1 = First start has not been done
1	Identification run done	1 = Identification (ID) run has been performed
2	Enabled	1 = Run enable and start enable signals present
3	Inhibited	1 = Start inhibited
4	Started	1 = Drive has been started
5	Magnetized	1 = Magnetized
6	Modulating	1 = Drive is modulating (output stage is being controlled)
7	Warning	1 = A warning is active
8	Faulted	1 = A fault is active
9	Limiting	1 = Any operating limit (speed, torque, etc.) is active
10	Torque control	1 = Torque control mode active
11	Speed control	1 = Speed control mode active
12	Power control	1 = Power control mode active
13	Emergency stop failed	1 = Emergency stop failed
14	Loss of reference	1 = Reference signal lost
15	Reserved	

06.21	*Control status word 2*	Control status word 2. This parameter is read-only.	-

Bit	Name	Description
0	Local control	1 = Drive is in local control
1	Network control	1 = Drive is in network (fieldbus) control
2	Ext1 active	1 = Control location Ext1 active
3	Ext2 active	1 = Control location Ext2 active
4…15	Reserved	

No.	Name/Value	Description	Def/FbEq
06.22	Speed control status word	Speed control status word. This parameter is read-only.	-

Bit	Name	Description
0	Reverse	1 = Drive is running in reverse direction
1	Forward	1 = Drive is running in forward direction
2	Zero speed	1 = Drive is running at zero speed
3	Out of window	1 = Motor speed outside speed window (see par. group 24 Speed reference conditioning)
4	Internal speed feedback	1 = Estimated speed feedback used (see par. 90.41)
5	Encoder 1 feedback	1 = Encoder 1 used for speed feedback (see par. 90.41)
6	Encoder 2 feedback	1 = Encoder 2 used for speed feedback (see par. 90.41)
7	Any speed limit	1 = Speed is being limited
8	Constant speed 1	1 = Constant speed n active (see parameter group 22 Speed reference selection)
9	Constant speed 2	
10	Constant speed 3	
11	Constant speed 4	
12	Constant speed 5	
13	Constant speed 6	
14	Constant speed 7	
15	Reserved	

06.30	User bit 0 selection	Selects a binary source whose status is transmitted as bit 11 of 06.11 Main status word.	False
	False	0.	1
	True	1.	2
	Other [bit]	A specific bit in another parameter.	3
06.31	User bit 1 selection	Selects a binary source whose status is transmitted as bit 12 of 06.11 Main status word.	False
	False	0.	1
	True	1.	2
	Other [bit]	A specific bit in another parameter.	3
06.32	User bit 2 selection	Selects a binary source whose status is transmitted as bit 13 of 06.11 Main status word.	False
	False	0.	1
	True	1.	2
	Other [bit]	A specific bit in another parameter.	3
06.33	User bit 3 selection	Selects a binary source whose status is transmitted as bit 14 of 06.11 Main status word.	False
	False	0.	1
	True	1.	2
	Other [bit]	A specific bit in another parameter.	3

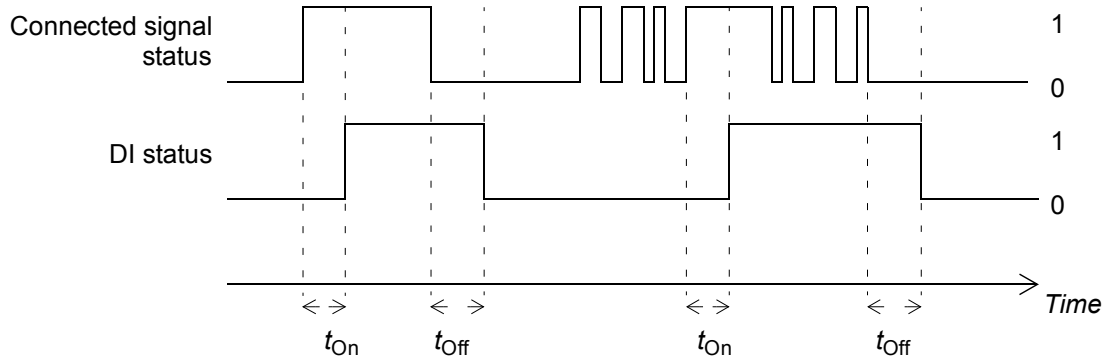
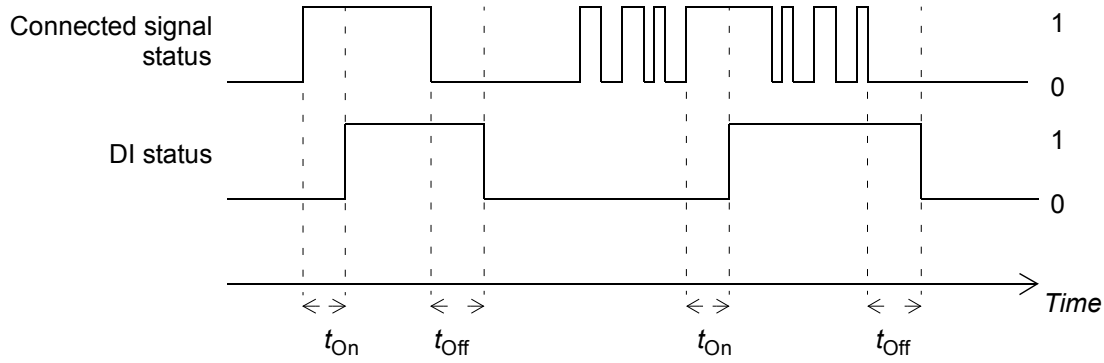
07 System info		Drive hardware and firmware information. All parameters in this group are read-only.	
07.03	Drive rating id	Type of the drive/inverter unit.	-
07.04	Firmware name	Firmware identification.	-

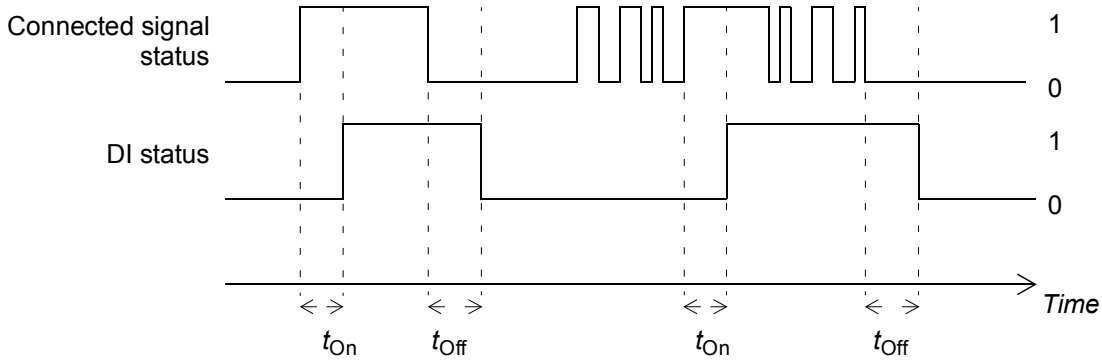
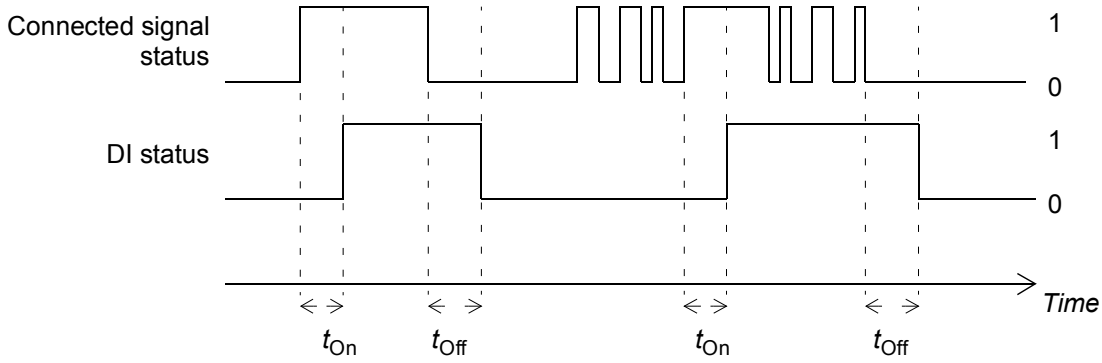
No.	Name/Value	Description	Def/FbEq
07.05	Firmware version	Version number of the firmware.	-
07.11	Cpu usage	Microprocessor load in percent.	-

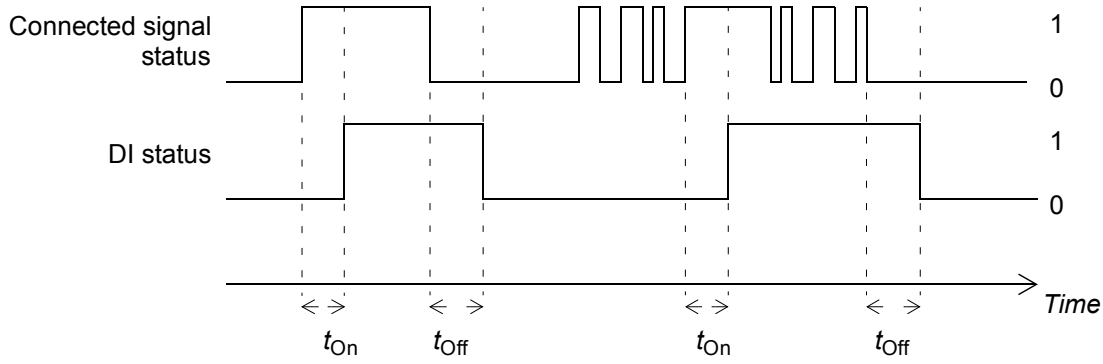
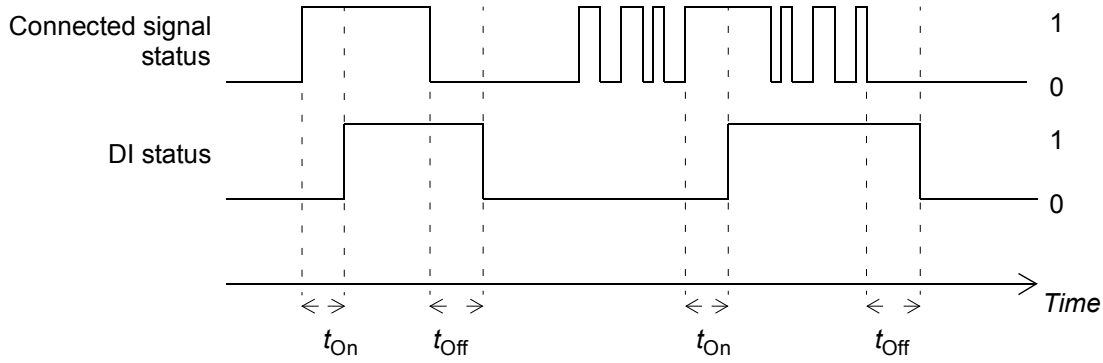
10 Standard DI, RO		Configuration of digital inputs and relay outputs.	
10.01	DI status	Displays the electrical status of digital inputs DIIL and DI8…DI1. The activation/deactivation delays of the inputs (if any are specified) are ignored. Bits 0…7 reflect the status of DI1…DI8; bit 15 reflects the status of the DIIL input. **Example:** 1000000001000011 = DIIL, DI7, DI2 and DI1 are on, DI3…DI6 and DI8 are off. This parameter is read-only.	-
	0000h…FFFFh	Status of digital inputs.	1 = 1
10.02	DI delayed status	Displays the status of digital inputs DIIL and DI8…DI1. This word is updated only after activation/deactivation delays. Bits 0…7 reflect the delayed status of DI1…DI8; bit 15 reflects the delayed status of the DIIL input. 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 force data is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1.	0000h

Bit	Value
0	1 = Force DI1 to value of bit 0 of parameter 10.04 DI force data.
1	1 = Force DI2 to value of bit 1 of parameter 10.04 DI force data.
2	1 = Force DI3 to value of bit 2 of parameter 10.04 DI force data.
3	1 = Force DI4 to value of bit 3 of parameter 10.04 DI force data.
4	1 = Force DI5 to value of bit 4 of parameter 10.04 DI force data.
5	1 = Force DI6 to value of bit 5 of parameter 10.04 DI force data.
6	1 = Force DI7 to value of bit 6 of parameter 10.04 DI force data.
7	1 = Force DI8 to value of bit 7 of parameter 10.04 DI force data.
8…14	Reserved
15	1 = Force DIL to value of bit 15 of parameter 10.04 DI force data.

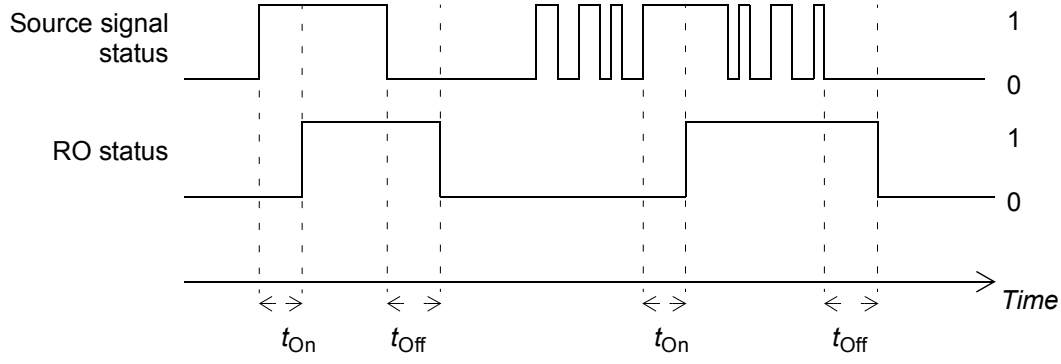
10.04	DI force data	Contains the values of digital inputs that are used instead of the electrical statuses if selected in parameter 10.03 DI force selection. Bit 0 is the forced value for DI1; bit 15 is the forced value for the DIIL input.	0000h
	0000h…FFFFh	Forced values of digital inputs.	1 = 1

No.	Name/Value	Description	Def/FbEq
10.05	*DI1 ON delay*	Defines the activation delay for digital input DI1.	0.0 s
		 t_{On} *10.05 DI1 ON delay* t_{Off} *10.06 DI1 OFF delay*	
	0.0 … 3000.0 s	Activation delay for DI1.	10 = 1 s
10.06	*DI1 OFF delay*	Defines the deactivation delay for digital input DI1. See parameter *10.05 DI1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI1.	10 = 1 s
10.07	*DI2 ON delay*	Defines the activation delay for digital input DI2.	0.0 s
		 t_{On} *10.07 DI2 ON delay* t_{Off} *10.08 DI2 OFF delay*	
	0.0 … 3000.0 s	Activation delay for DI2.	10 = 1 s
10.08	*DI2 OFF delay*	Defines the deactivation delay for digital input DI2. See parameter *10.07 DI2 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI2.	10 = 1 s

No.	Name/Value	Description	Def/FbEq
10.09	*DI3 ON delay*	Defines the activation delay for digital input DI3.	0.0 s
		 t_{On} *10.09 DI3 ON delay* t_{Off} *10.10 DI3 OFF delay*	
	0.0 … 3000.0 s	Activation delay for DI3.	10 = 1 s
10.10	*DI3 OFF delay*	Defines the deactivation delay for digital input DI3. See parameter *10.09 DI3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI3.	10 = 1 s
10.11	*DI4 ON delay*	Defines the activation delay for digital input DI4.	0.0 s
		 t_{On} *10.11 DI4 ON delay* t_{Off} *10.12 DI4 OFF delay*	
	0.0 … 3000.0 s	Activation delay for DI4.	10 = 1 s
10.12	*DI4 OFF delay*	Defines the deactivation delay for digital input DI4. See parameter *10.11 DI4 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI4.	10 = 1 s

No.	Name/Value	Description	Def/FbEq
10.13	DI5 ON delay	Defines the activation delay for digital input DI5.	0.0 s
		 t_{On} 10.13 DI5 ON delay t_{Off} 10.14 DI5 OFF delay	
	0.0 … 3000.0 s	Activation delay for DI5.	10 = 1 s
10.14	DI5 OFF delay	Defines the deactivation delay for digital input DI5. See parameter 10.13 DI5 ON delay.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI5.	10 = 1 s
10.15	DI6 ON delay	Defines the activation delay for digital input DI6.	0.0 s
		 t_{On} 10.15 DI6 ON delay t_{Off} 10.16 DI6 OFF delay	
	0.0 … 3000.0 s	Activation delay for DI6.	10 = 1 s
10.16	DI6 OFF delay	Defines the deactivation delay for digital input DI6. See parameter 10.15 DI6 ON delay.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI6.	10 = 1 s
10.21	RO status	Status of relay outputs RO8…RO1. **Example:** 00000001b = RO1 is energized, RO2…RO8 are de-energized.	-
	0000h…FFFFh	Status of relay outputs.	1 = 1
10.24	RO1 source	Selects a drive signal to be connected to relay output RO1.	Ready run
	Not energized	Relay output is not energized.	0
	Energized	Relay output is energized.	1

No.	Name/Value	Description	Def/FbEq
	Ready run	Bit 2 of *06.12 Status word 1* (see page *52*).	2
	Enabled	Bit 0 of *06.12 Status word 1* (see page *52*).	4
	Started	Bit 4 of *06.12 Status word 1* (see page *52*).	5
	Flux ready	Bit 5 of *06.20 Control status word 1* (see page *53*).	6
	Running	Bit 5 of *06.12 Status word 1* (see page *52*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *52*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *52*).	9
	Neg speed	Bit 0 of *06.22 Speed control status word* (see page *54*).	10
	Zero speed	Bit 2 of *06.22 Speed control status word* (see page *54*).	11
	Above speed limit	Bit 10 of *06.11 Main status word* (see page *52*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *52*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *52*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *52*).	15
	Brake cmd	Bit 0 of *44.01 Brake control status* (see page *147*).	22
	Ext2 active	Bit 10 of *06.12 Status word 1* (see page *52*).	23
	Ext control	Bit 9 of *06.11 Main status word* (see page *52*).	24
	Other [bit]	A specific bit in another parameter.	-
10.25	*RO1 ON delay*	Defines the activation delay for relay output RO1.	0.0 s

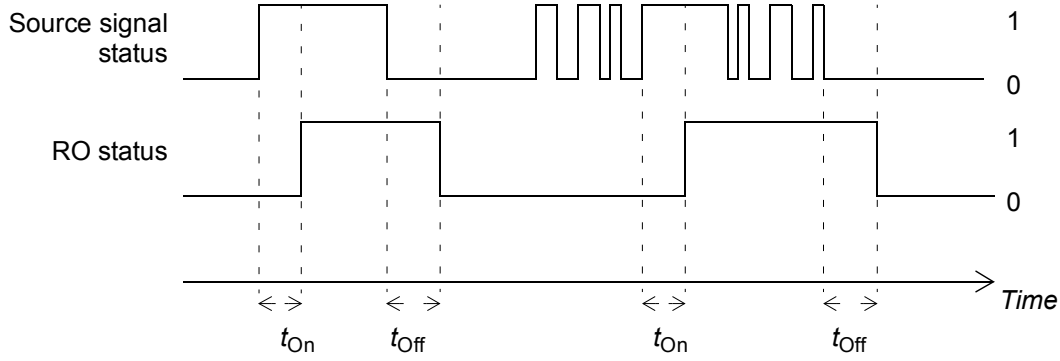


t_{On} *10.25 RO1 ON delay*

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

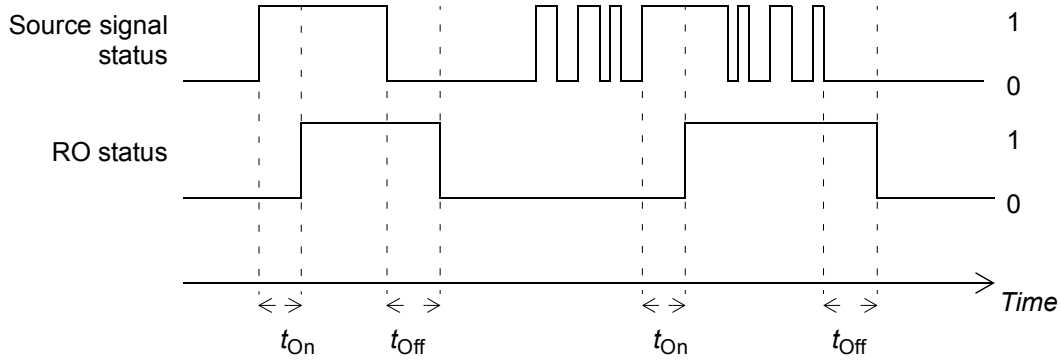
No.	Name/Value	Description	Def/FbEq
10.27	RO2 source	Selects a drive signal to be connected to relay output RO2. For the available selections, see parameter 10.24 RO1 source.	Running
10.28	RO2 ON delay	Defines the activation delay for relay output RO2.	0.0 s



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.	Not energized
10.31	RO3 ON delay	Defines the activation delay for relay output RO3.	0.0 s



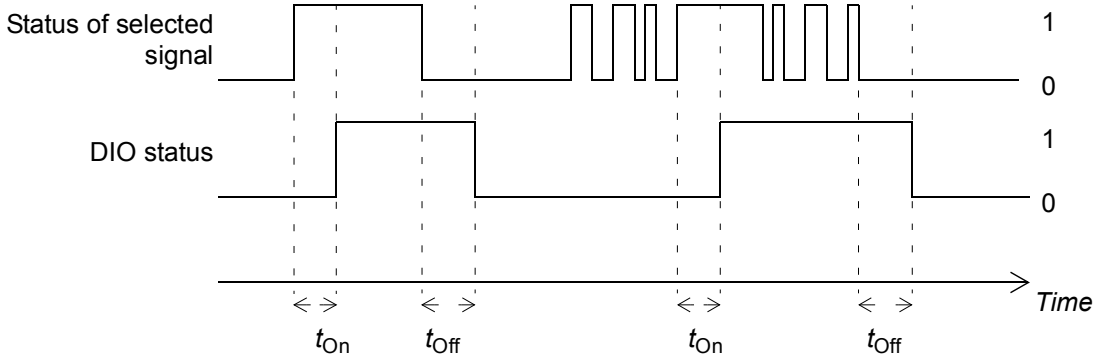
t_{On} 10.31 RO3 ON delay

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

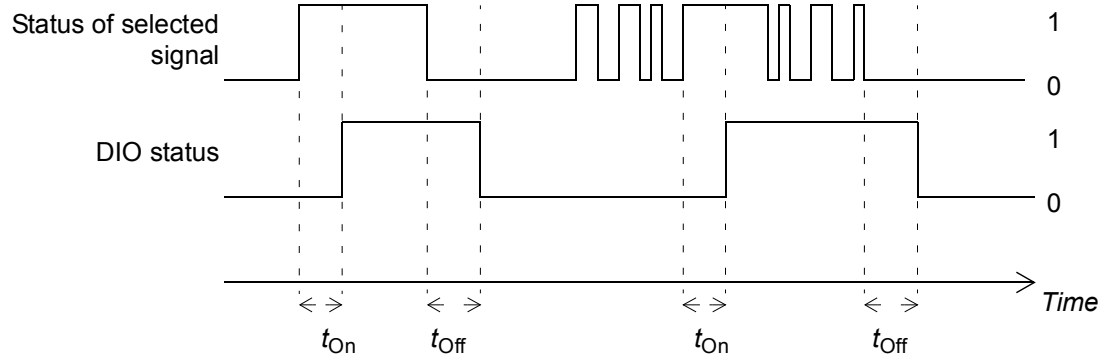
No.	Name/Value	Description	Def/FbEq
11 Standard DIO, FI, FO		Configuration of digital input/outputs and frequency inputs/outputs.	
11.01	DIO status	Displays the electrical status of digital input/outputs DIO8…DIO1. The activation/deactivation delays (if any are specified) are ignored. **Example:** 0000001001 = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	-
	0000h…FFFFh	Status of digital input/outputs.	1 = 1
11.02	DIO delayed status	Displays the status of digital input/outputs DIO8…DIO1. This word is updated only after activation/deactivation (if any) delays. **Example:** 0000001001 = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	-
	0000h…FFFFh	Delayed status of digital input/outputs.	1 = 1
11.05	DIO1 configuration	Selects whether DIO1 is used as a digital output or input, or a frequency input.	Output
	Output	DIO1 is used as a digital output.	0
	Input	DIO1 is used as a digital input.	1
	Frequency	DIO1 is used as a frequency input.	2
11.06	DIO1 output source	Selects a drive signal to be connected to digital input/output DIO1 when parameter 11.05 DIO1 configuration is set to Output.	Ready run
	Not energized	Relay output is not energized.	0
	Energized	Relay output is energized.	1
	Ready run	Bit 2 of 06.12 Status word 1 (see page 52).	2
	Enabled	Bit 0 of 06.12 Status word 1 (see page 52).	4
	Started	Bit 4 of 06.12 Status word 1 (see page 52).	5
	Flux ready	Bit 5 of 06.20 Control status word 1 (see page 53).	6
	Running	Bit 5 of 06.12 Status word 1 (see page 52).	7
	Ready ref	Bit 2 of 06.11 Main status word (see page 52).	8
	At setpoint	Bit 8 of 06.11 Main status word (see page 52).	9
	Neg speed	Bit 0 of 06.22 Speed control status word (see page 54).	10
	Zero speed	Bit 2 of 06.22 Speed control status word (see page 54).	11
	Above speed limit	Bit 10 of 06.11 Main status word (see page 52).	12
	Warning	Bit 7 of 06.11 Main status word (see page 52).	13
	Fault	Bit 3 of 06.11 Main status word (see page 52).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (see page 52).	15
	Brake cmd	Bit 0 of 44.01 Brake control status (see page 147).	22
	Ext2 active	Bit 10 of 06.12 Status word 1 (see page 52).	23
	Ext control	Bit 9 of 06.11 Main status word (see page 52).	24
	Other [bit]	A specific bit in another parameter.	-

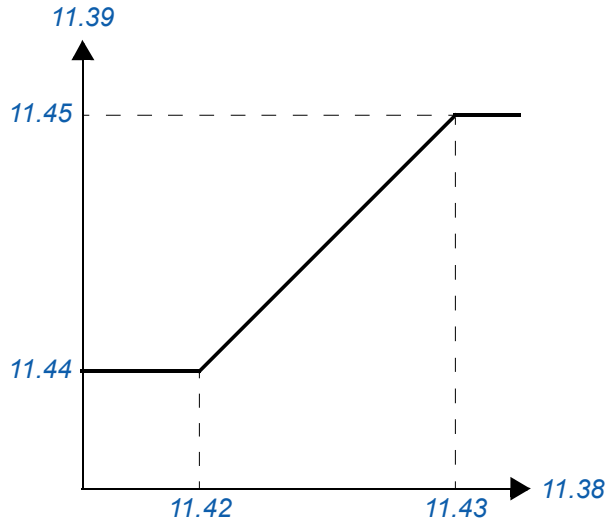
No.	Name/Value	Description	Def/FbEq
11.07	*DIO1 ON delay*	Defines the activation delay for digital input/output DIO1 when parameter *11.05 DIO1 configuration* is set to *Output*.	0.0 s
	0.0 … 3000.0 s	Activation delay for DIO1 when set as an output.	10 = 1 s
11.08	*DIO1 OFF delay*	Defines the deactivation delay for digital input/output DIO1 when parameter *11.05 DIO1 configuration* is set to *Output*. See parameter *11.07 DIO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DIO1 when set as an output.	10 = 1 s
11.09	*DIO2 configuration*	Selects whether DIO2 is used as a digital output or input, or a frequency output.	*Output*
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
	Frequency	DIO2 is used as a frequency output.	2
11.10	*DIO2 output source*	Selects a drive signal to be connected to digital input/output DIO2 when parameter *11.09 DIO2 configuration* is set to *Output*. For the available selections, see parameter *11.06 DIO1 output source*.	*Running*

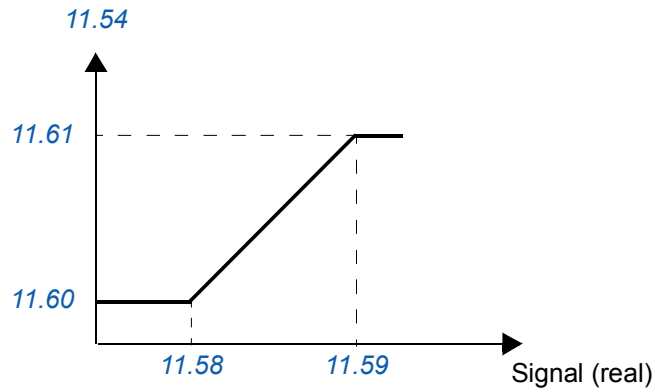
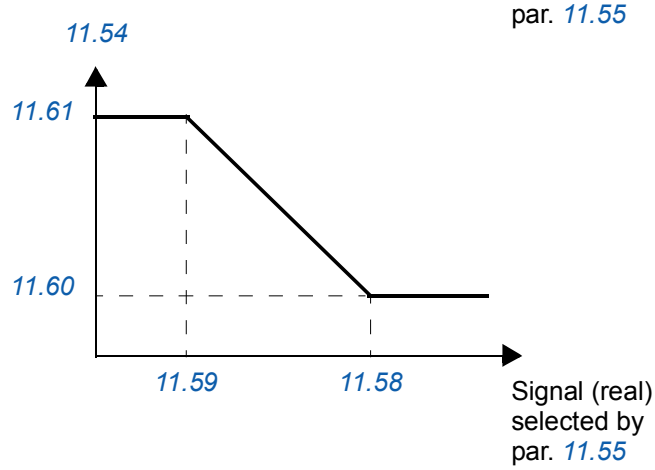


t_{On} *11.07 DIO1 ON delay*

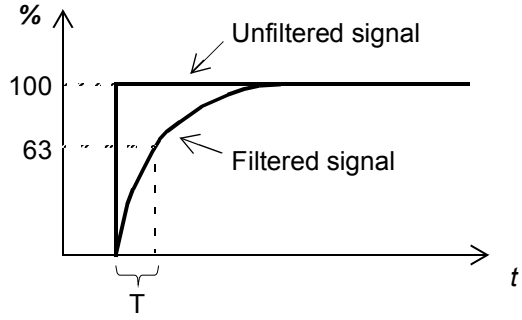
t_{Off} *11.08 DIO1 OFF delay*

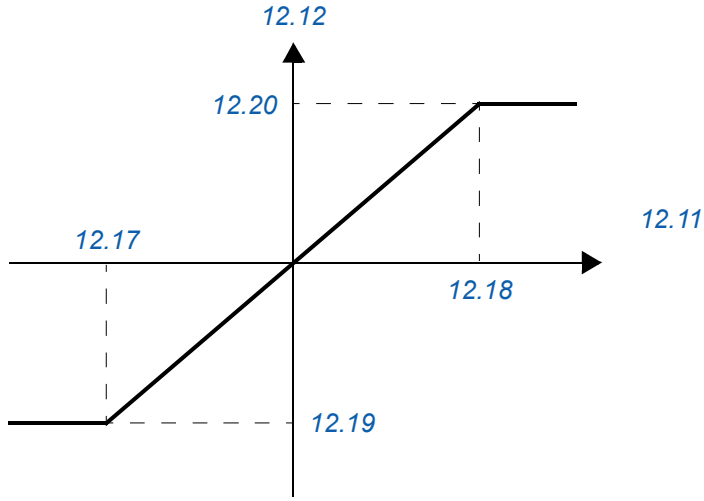
No.	Name/Value	Description	Def/FbEq
11.11	DIO2 ON delay	Defines the activation delay for digital input/output DIO2 when parameter 11.09 DIO2 configuration is set to Output.	0.0 s
		 t_{On} 11.11 DIO2 ON delay t_{Off} 11.12 DIO2 OFF delay	
	0.0 … 3000.0 s	Activation delay for DIO2 when set as an output.	10 = 1 s
11.12	DIO2 OFF delay	Defines the deactivation delay for digital input/output DIO2 when parameter 11.09 DIO2 configuration is set to Output. See parameter 11.11 DIO2 ON delay.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DIO2 when set as an output.	10 = 1 s
11.38	Freq in 1 actual value	Displays the value of frequency input 1 before scaling. See parameter 11.42 Freq in 1 min. This parameter is read-only.	-
	0 … 30000 Hz	Unscaled value of frequency input 1.	1 = 1 Hz
11.39	Freq in 1 scaled	Displays the value of frequency input 1 after scaling. See parameter 11.42 Freq in 1 min. This parameter is read-only.	-
	0 … 30000	Scaled value of frequency input 1.	1 = 1

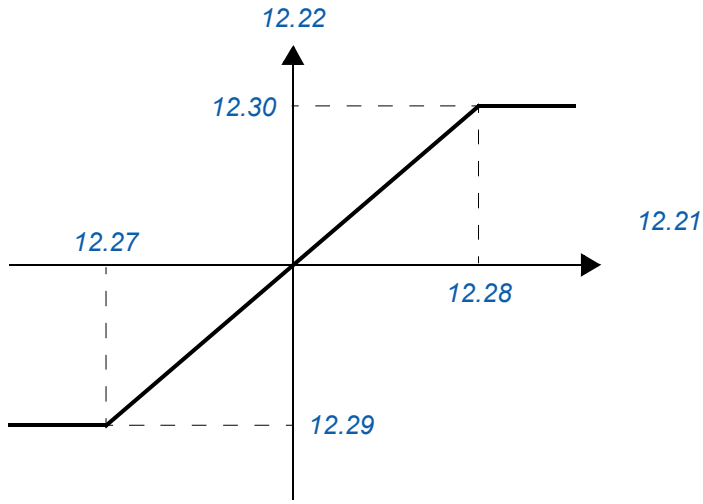
No.	Name/Value	Description	Def/FbEq
11.42	*Freq in 1 min*	Defines the minimum input frequency for frequency input 1 (DIO1 when it is used as a frequency input). The incoming frequency signal (*11.38 Freq in 1 actual value*) is scaled into an internal signal (*11.39 Freq in 1 scaled*) by parameters *11.42*…*11.45* as follows:  	0 Hz
	0 … 16000 Hz	Minimum frequency of frequency input 1 (DIO1).	1 = 1 Hz
11.43	*Freq in 1 max*	Defines the maximum input frequency for frequency input 1 (DIO1 when it is used as a frequency input). See parameter *11.42 Freq in 1 min*.	16000 Hz
	0 … 16000 Hz	Maximum frequency for frequency input 1 (DIO1).	1 = 1 Hz
11.44	*Freq in 1 scaled at min*	Defines the value that corresponds 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.	1000 = 1
11.45	*Freq in 1 scaled at max*	Defines the value that corresponds to the maximum input frequency defined by parameter *11.43 Freq in 1 max*. See diagram at parameter *11.42 Freq in 1 min*.	0.000
	-32768.000 … 32767.000	Value corresponding to maximum of frequency input 1.	1000 = 1
11.54	*Freq out 1 actual value*	Displays the value of frequency output 1 before scaling. See parameter *11.58 Freq out 1 src min*. This parameter is read-only.	0 Hz
	0 … 30000 Hz	Unscaled value of frequency output 1.	1 = 1
11.55	*Freq out 1 source*	Selects a signal to be connected to frequency output 1.	*Zero*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *50*).	1
	Output frequency	*01.06 Output frequency* (page *50*).	3
	Motor current	*01.07 Motor current* (page *50*).	4
	Motor torque	*01.10 Motor torque %* (page *50*).	6
	DC voltage	*01.11 DC voltage* (page *50*).	7
	Power inu out	*01.14 Output power* (page *50*).	8
	Speed ref ramp in	*23.01 Speed ref ramp in* (page *91*).	10

No.	Name/Value	Description	Def/FbEq
	Speed ref ramp out	*23.02 Speed ref ramp out* (page *91*).	11
	Speed ref used	*24.01 Used speed reference* (page *96*).	12
	Torq ref used	*26.02 Torque ref used* (page *104*).	13
	Freq ref used	*28.02 Frequency ref ramped* (page *108*).	14
	Process PID out	*40.01 Process PID actual value* (page *132*).	16
	Process PID fbk	*40.02 Feedback actual value* (page *132*).	17
	Process PID act	*40.03 Setpoint actual value* (page *133*).	18
	Process PID dev	*40.04 Deviation actual value* (page *133*).	19
	Other	The value is taken from another parameter.	-
11.58	*Freq out 1 src min*	Defines the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the minimum value of frequency output 1 (defined by parameter *11.60 Freq out 1 at src min*.  	0.000
	-32768.000 … 32767.000	Real signal value corresponding to minimum value of frequency output 1.	1000 = 1
11.59	*Freq out 1 src max*	Defines the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the maximum value of frequency output 1 (defined by parameter *11.61 Freq out 1 at src max*). See parameter *11.58 Freq out 1 src min*.	0.000
	-32768.000 … 32767.000	Real signal value corresponding to maximum value of frequency output 1.	1000 = 1

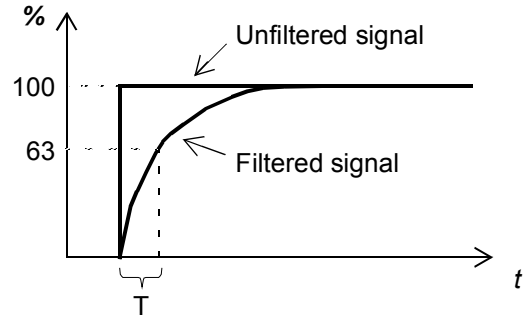
No.	Name/Value	Description	Def/FbEq
11.60	*Freq out 1 at src min*	Defines the minimum value of frequency output 1. See diagrams at parameter *11.58 Freq out 1 src min*.	0 Hz
	0…16000 Hz	Minimum value of frequency output 1.	1 = 1 Hz
11.61	*Freq out 1 at src max*	Defines the maximum value of frequency output 1. See diagrams at parameter *11.58 Freq out 1 src min*.	16000 Hz
	0…16000 Hz	Maximum value of frequency output 1.	1 = 1 Hz

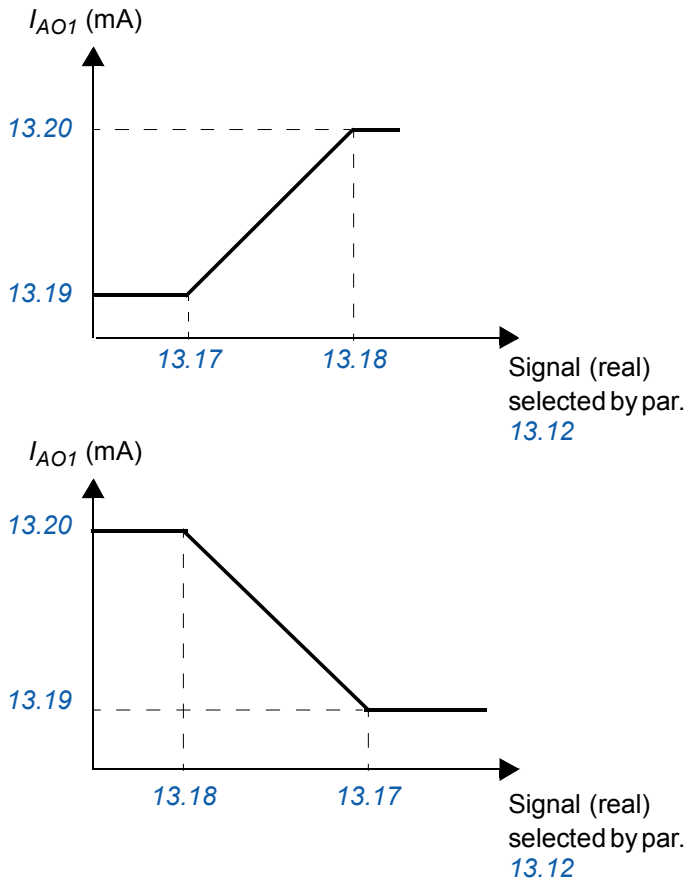
12 Standard AI		Configuration of analog inputs.	
12.11	*AI1 actual value*	Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by jumper J1). This parameter is read-only.	-
	-22.0 … 22.0 mA or V	Value of analog input AI1.	10 = 1 mA or V
12.12	*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.	-
	-32768.0 … 32767.0	Scaled value of analog input AI1.	10 = 1
12.15	*AI1 unit selection*	Selects the unit for readings and settings related to analog input AI1. **Note:** This setting must match the corresponding jumper setting on the drive control unit (see the hardware manual of the drive). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the jumper settings.	*mA*
	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.	0.1 s
	0.0 … 30.0 s	Filter time constant.	10 = 1 s

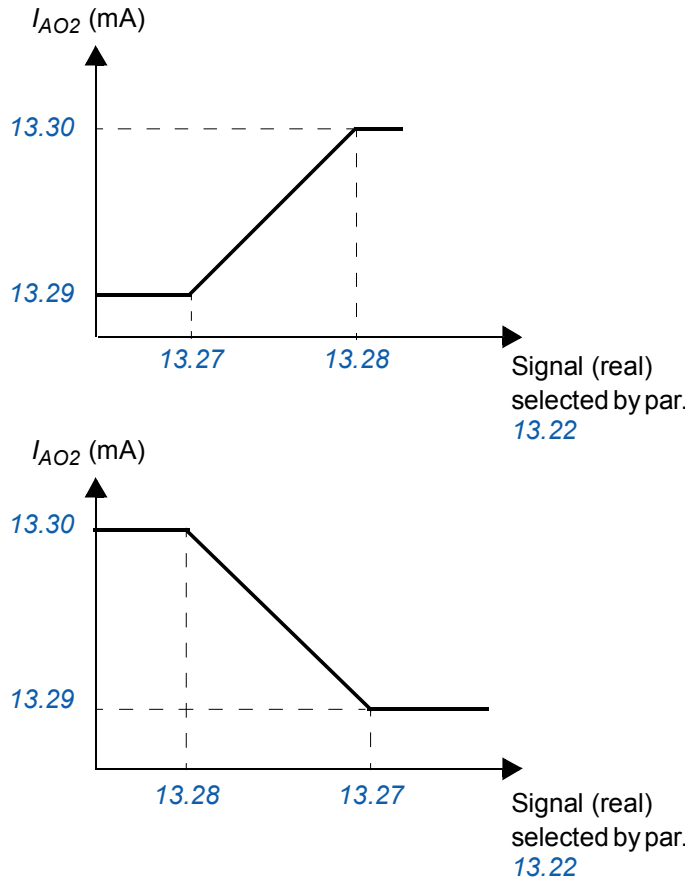
No.	Name/Value	Description	Def/FbEq
12.17	AI1 min	Defines the minimum value for analog input AI1.	0.0 mA or V
	-22.0 … 22.0 mA or V	Minimum value of AI1.	10 = 1 mA or V
12.18	AI1 max	Defines the maximum value for analog input AI1.	20.0 mA or V
	-22.0 … 22.0 mA or V	Maximum value of AI1.	10 = 1 mA or V
12.19	AI1 scaled at AI1 min	Defines the real value that corresponds to the minimum analog input AI1 value defined by parameter 12.17 AI1 min. 	0.0
	-32768.0 … 32767.0	Real value corresponding to minimum AI1 value.	10 = 1
12.20	AI1 scaled at AI1 max	Defines the real 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.	100.0
	-32768.0 … 32767.0	Real value corresponding to maximum AI1 value.	10 = 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 jumper J2). This parameter is read-only.	-
	-22.0 … 22.0 mA or V	Value of analog input AI2.	10 = 1 mA or V
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.	-
	-32768.0 … 32767.0	Scaled value of analog input AI2.	10 = 1
12.25	AI2 unit selection	Selects the unit for readings and settings related to analog input AI2. **Note:** This setting must match the corresponding jumper setting on the drive control unit (see the hardware manual of the drive). Control board reboot (either by cycling the power or through parameter 96.08 Control board boot) is required to validate any changes in the jumper settings.	mA
	V	Volts.	2
	mA	Milliamperes.	10

No.	Name/Value	Description	Def/FbEq
12.26	AI2 filter time	Defines the filter time constant for analog input AI2. See parameter 12.16 AI1 filter time.	0.1 s
	0.0 … 30.0 s	Filter time constant.	10 = 1 s
12.27	AI2 min	Defines the minimum value for analog input AI2.	0.0 mA or V
	-22.0 … 22.0 mA or V	Minimum value of AI2.	10 = 1 mA or V
12.28	AI2 max	Defines the maximum value for analog input AI2.	20.0 mA or V
	-22.0 … 22.0 mA or V	Maximum value of AI2.	10 = 1 mA or V
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. 	0.0
	-32768.0 … 32767.0	Real value corresponding to minimum AI2 value.	10 = 1
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.	100.0
	-32768.0 … 32767.0	Real value corresponding to maximum AI2 value.	10 = 1

13 Standard AO		Configuration of analog outputs.	
13.11	AO1 actual value	Displays the value of AO1 in mA. This parameter is read-only.	-
	0 … 22.0 mA	Value of AO1.	10 = 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 50).	1
	Output frequency	01.06 Output frequency (page 50).	3
	Motor current	01.07 Motor current (page 50).	4
	Motor torque	01.10 Motor torque % (page 50).	6
	DC voltage	01.11 DC voltage (page 50).	7
	Power inu out	01.14 Output power (page 50).	8
	Speed ref ramp in	23.01 Speed ref ramp in (page 91).	10

No.	Name/Value	Description	Def/FbEq
	Speed ref ramp out	*23.02 Speed ref ramp out* (page *91*).	11
	Speed ref used	*24.01 Used speed reference* (page *96*).	12
	Torq ref used	*26.02 Torque ref used* (page *104*).	13
	Freq ref used	*28.02 Frequency ref ramped* (page *108*).	14
	Process PID out	*40.01 Process PID actual value* (page *132*).	16
	Process PID fbk	*40.02 Feedback actual value* (page *132*).	17
	Process PID act	*40.03 Setpoint actual value* (page *133*).	18
	Process PID dev	*40.04 Deviation actual value* (page *133*).	19
	Other	The value is taken from another parameter.	-
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	0.1 s
	0.0 … 30.0 s	Filter time constant.	10 = 1 s

No.	Name/Value	Description	Def/FbEq
13.17	AO1 source min	Defines the real value of the signal (selected by parameter 13.12 AO1 source) that corresponds to the minimum AO1 output value (defined by parameter 13.19 AO1 out at AO1 src min). 	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO1 output value.	10 = 1
13.18	AO1 source max	Defines the real value of the signal (selected by parameter 13.12 AO1 source) that corresponds to the maximum AO1 output value (defined by parameter 13.20 AO1 out at AO1 src max). See parameter 13.17 AO1 source min.	1500.0
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO1 output value.	10 = 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.	0.0 mA
	0.0 … 22.0 mA	Minimum AO1 output value.	10 = 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.	20.0 mA
	0.0 … 22.0 mA	Maximum AO1 output value.	10 = 1 mA
13.21	AO2 actual value	Displays the value of AO2 in mA. This parameter is read-only.	-
	0.0 … 22.0 mA	Value of AO2.	10 = 1 mA
13.22	AO2 source	Selects a signal to be connected to analog output AO2. For the selections, see parameter 13.12 AO1 source.	Motor current

No.	Name/Value	Description	Def/FbEq
13.26	AO2 filter time	Defines the filtering time constant for analog output AO2. See parameter 13.16 AO1 filter time.	0.1 s
	0.0 … 30.0 s	Filter time constant.	10 = 1 s
13.27	AO2 source min	Defines the real value of the signal (selected by parameter 13.22 AO2 source) that corresponds to the minimum AO2 output value (defined by parameter 13.29 AO2 out at AO2 src min). 	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO2 output value.	10 = 1
13.28	AO2 source max	Defines the real value of the signal (selected by parameter 13.22 AO2 source) that corresponds to the maximum AO2 output value (defined by parameter 13.30 AO2 out at AO2 src max). See parameter 13.27 AO2 source min.	100.0
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO2 output value.	10 = 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.	0.0 mA
	0.0 … 22.0 mA	Minimum AO2 output value.	10 = 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.	20.0 mA
	0.0 … 22.0 mA	Maximum AO2 output value.	10 = 1 mA

No.	Name/Value	Description	Def/FbEq
19 Operation mode		Selection of external control location sources and operating modes.	
19.01	Actual operation mode	Displays the operation mode currently used. See parameters 19.11…19.14. This parameter is read-only.	-
	Zero	None.	1
	Speed	Speed control (in DTC motor control mode).	2
	Torque	Torque control (in DTC motor control mode).	3
	Min	The torque selector is comparing the speed (25.01 Torque reference speed control) and torque (26.74 Torque ref ramped) references and the smaller of the two is used.	4
	Max	The torque selector is comparing the speed (25.01 Torque reference speed control) and torque (26.74 Torque ref ramped) references and the greater of the two is used.	5
	Add	The speed reference 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.	0
	EXT2	EXT2.	1
	MCW bit11: Ext ctrl loc	06.01 Main control word (page 52), bit 11.	2
	DI1	Digital input DI1 (as indicated by 10.01 DI status, bit 0).	3
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	4
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	5
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	6
	DI5	Digital input DI5 (as indicated by 10.01 DI status, bit 4).	7
	DI6	Digital input DI6 (as indicated by 10.01 DI status, bit 5).	8
	DIO1	Digital input/output DIO1 (as indicated by 11.01 DIO status, bit 0).	11
	DIO2	Digital input/output DIO2 (as indicated by 11.01 DIO status, bit 1).	12
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
19.12	Ext1 control mode 1	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 ramped (output of the torque reference chain).	3

No.	Name/Value	Description	Def/FbEq
	Minimum	Combination of selections *Speed* and *Torque*: the torque selector compares the speed (*25.01 Torque reference speed control*) and torque (*26.74 Torque ref ramped*) references 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 (*25.01 Torque reference speed control*) and torque (*26.74 Torque ref ramped*) references 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
	Add	Combination of selections *Speed* and *Torque*: Torque selector adds the speed reference chain output to the torque reference chain output.	6
19.14	*Ext2 control mode 1*	Selects the operating mode for external control location EXT2. For the selections, see parameter *19.12 Ext1 control mode 1*.	*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 ramped* (output of the torque reference chain).	1
19.17	*Local control disable*	Enables/disables local control. **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
19.20	*Scalar control reference unit*	Selects the unit that is used when reference is given in scalar motor control mode (see also parameter *99.04 Motor ctrl mode*).	*Hz*
	Hz	Hz.	0
	Rpm	Rpm.	1

20 Start/stop/direction		Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection.	
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 sel	No start or stop command sources selected.	0

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</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. 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 is the start signal; the source selected by 20.04 Ext1 in2 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 is the forward start signal; the source selected by 20.04 Ext1 in2 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 and 20.04 Ext1 in2. 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 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/FbEq</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 and 20.04 Ext1 in2. The source selected by 20.05 Ext1 in3 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 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, 20.04 Ext1 in2 and 20.05 Ext1 in3. The source selected by 20.05 Ext1 in3 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>0</td><td>1</td><td>Start forward</td></tr><tr><td>0</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 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.</td><td>12</td></tr>
<tr><td></td><td>Application Program</td><td>The start and stop commands are taken from the application program control word (parameter 06.02 Application control word).</td><td>21</td></tr>
<tr><td>20.02</td><td>Ext1 start trigger</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>Edge</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</td><td>Selects source 1 for parameter 20.01 Ext1 commands.</td><td>Off</td></tr>
<tr><td></td><td>Off</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>On</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (as indicated by 10.01 DI status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (as indicated by 10.01 DI status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (as indicated by 10.01 DI status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (as indicated by 10.01 DI status, bit 3).</td><td>5</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (as indicated by 10.01 DI status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (as indicated by 10.01 DI status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>DIO1</td><td>Digital input/output DIO1 (as indicated by 11.01 DIO status, bit 0).</td><td>10</td></tr>
<tr><td></td><td>DIO2</td><td>Digital input/output DIO2 (as indicated by 11.01 DIO status, bit 1).</td><td>11</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 49).</td><td>-</td></tr>
<tr><td>20.04</td><td>Ext1 in2</td><td>Selects source 2 for parameter 20.01 Ext1 commands.
For the available selections, see parameter 20.03 Ext1 in1.</td><td>Off</td></tr>
<tr><td>20.05</td><td>Ext1 in3</td><td>Selects source 3 for parameter 20.01 Ext1 commands.
For the available selections, see parameter 20.03 Ext1 in1.</td><td>Off</td></tr>
<tr><td>20.06</td><td>Ext2 commands</td><td>Selects the source of start, stop and direction commands for external control location 2 (EXT2).
See also parameters 20.07…20.10.</td><td>Not sel</td></tr>
<tr><td></td><td>Not sel</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. 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 is the start signal; the source selected by 20.09 Ext2 in2 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>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by 20.08 Ext2 in1 is the forward start signal; the source selected by 20.09 Ext2 in2 is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table><tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr><tr><td>0</td><td>0</td><td>Stop</td></tr><tr><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr><tr><td>0</td><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start reverse</td></tr><tr><td>1</td><td>1</td><td>Stop</td></tr></table></td><td>3</td></tr>
</table>

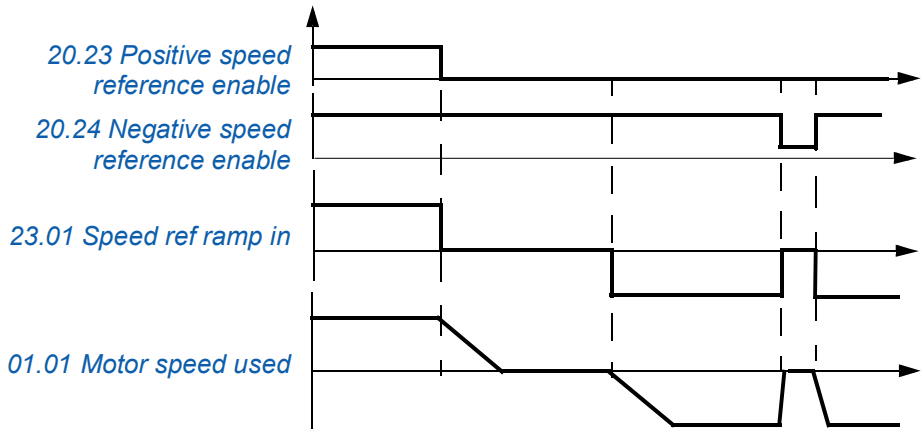
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 and 20.09 Ext2 in2. The state transitions of the source bits are interpreted as follows:

<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 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 and 20.09 Ext2 in2. The source selected by 20.10 Ext2 in3 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 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 20.08 Ext2 in1, 20.09 Ext2 in2 and 20.10 Ext2 in3. The source selected by 20.10 Ext2 in3 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>0</td><td>1</td><td>Start forward</td></tr><tr><td>0</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 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.</td><td>12</td></tr>
<tr><td></td><td>Application Program</td><td>The start and stop commands are taken from the application program control word (parameter 06.02 Application control word).</td><td>21</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq
20.07	Ext2 start trigger	Defines whether the start signal for external control location EXT2 is edge-triggered or level-triggered. **Note:** In case the settings of parameters 20.06 and 20.07 are in conflict, the setting of parameter 20.06 takes preference.	Edge
	Edge	The start signal is edge-triggered.	0
	Level	The start signal is level-triggered.	1
20.08	Ext2 in1	Selects source 1 for parameter 20.06 Ext2 commands. For the available selections, see parameter 20.03 Ext1 in1.	Off
20.09	Ext2 in2	Selects source 2 for parameter 20.06 Ext2 commands. For the available selections, see parameter 20.03 Ext1 in1.	Off
20.10	Ext2 in3	Selects source 3 for parameter 20.06 Ext2 commands. For the available selections, see parameter 20.03 Ext1 in1.	Off
20.12	Run enable 1	Selects the source of the external run enable signal. If the run enable signal is switched off, the drive will not start, or coasts to a stop if running. 1 = Run enable. **Note:** This parameter cannot be changed while the drive is running.	On
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	4
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	5
	DI5	Digital input DI5 (as indicated by 10.01 DI status, bit 4).	6
	DI6	Digital input DI6 (as indicated by 10.01 DI status, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by 11.01 DIO status, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by 11.01 DIO status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
20.19	Enable start command	Selects the source for the start enable signal. 1 = Start enable. With the signal switched off, the drive will not start. (Switching the signal off while the drive is running will not stop the drive.)	On
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	4
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	5
	DI5	Digital input DI5 (as indicated by 10.01 DI status, bit 4).	6
	DI6	Digital input DI6 (as indicated by 10.01 DI status, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by 11.01 DIO status, bit 0).	10

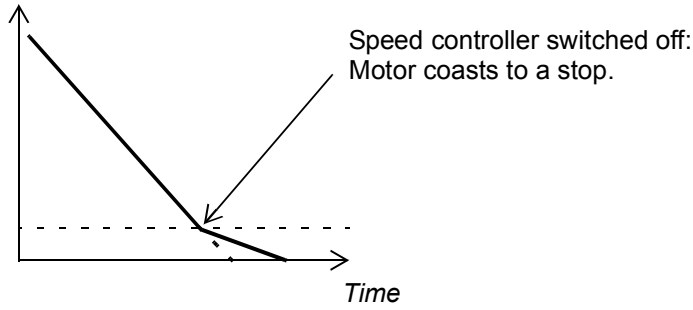
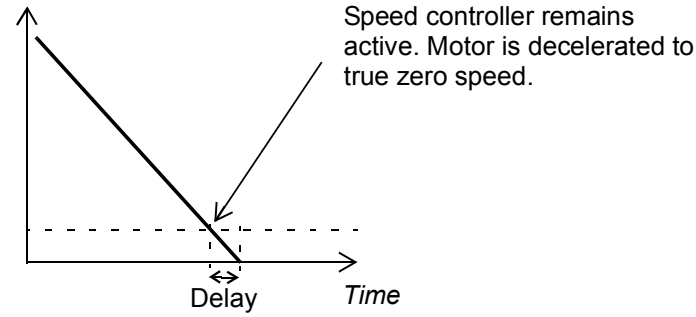
No.	Name/Value	Description	Def/FbEq
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
20.23	*Positive speed reference enable*	Selects the source of the positive speed enable command. 1 = Positive speed enabled. 0 = Positive speed interpreted as zero speed reference. In the figure below, *23.01 Speed ref ramp in* is set to zero after the positive speed enable signal has cleared. Actions in different control modes: Speed control: Speed reference is set to zero and the motor is stopped along the currently active deceleration ramp. The rush controller prevents additional torque terms from running the motor in the positive direction. Torque control: The rush controller monitors the rotation direction of the motor.	*On*
			
		Example: The motor is rotating in the forward direction. To stop the motor, the positive speed enable signal is deactivated by a hardware limit switch (e.g. via digital input). If the positive speed enable signal remains deactivated and the negative speed enable signal is active, only reverse rotation of the motor is allowed.	
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
20.24	*Negative speed reference enable*	Selects the source of the negative speed reference enable command. See parameter *20.23 Positive speed reference enable*.	*On*

No.	Name/Value	Description	Def/FbEq
20.25	*Jogging enable*	Selects the source for enabling parameters *20.26 Jogging 1 start* and *20.27 Jogging 2 start*. 1 = Jogging is enabled. 0 = Jogging is disabled. **Note:** Jogging can be enabled using this parameter 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 jog commands through fieldbus.	*Off*
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
20.26	*Jogging 1 start*	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 = Active. **Notes:** • The jogging functions can only be used in speed and frequency (scalar) control. • This parameter cannot be changed while the drive is running.	*Off*
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-

No.	Name/Value	Description	Def/FbEq
20.27	Jogging 2 start	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 = Active. For the selections, see parameter 20.26 Jogging 1 start. **Notes:** • Jogging function 1 has priority over jogging function 2. • This parameter cannot be changed while the drive is running.	Off
21 Start/stop mode		Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings;	
21.01	Start mode	Selects the motor start function. **Notes**: • Selections Fast and Const time are ignored if parameter 99.04 Motor ctrl mode is set to Scalar. • Starting to a rotating machine 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.	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 to a rotating machine) 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 ctrl 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/FbEq</th></tr>
<tr><td>21.02</td><td>Magnetization time</td><td>Defines the constant DC magnetizing time. After the start command, the drive automatically premagnetizes the motor the set time.
To ensure full magnetizing, set this value 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 motor stop function.</td><td>Coast</td></tr>
<tr><td></td><td>Coast</td><td>Stop by cutting off the motor power supply. 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 ramp. See parameter group 23 Speed reference ramp on page 91.</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>21.04</td><td>Emergency stop mode</td><td>Selects the way the motor is stopped when an emergency stop command is received.
The source of the emergency stop signal is selected by parameter 21.05 Emergency stop source.</td><td>Ramp stop (Off1)</td></tr>
<tr><td></td><td>Ramp stop (Off1)</td><td>With the drive running:
• 1 = Normal operation.
• 0 = Normal stop (along currently active deceleration ramp). The drive can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1.
With the drive stopped:
• 1 = Starting allowed.
• 0 = Starting not allowed.</td><td>0</td></tr>
<tr><td></td><td>Coast stop (Off2)</td><td>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.</td><td>1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq
	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*. The drive can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed • 0 = Starting not allowed	2
21.05	*Emergency stop source*	Selects the source of the emergency stop signal. The stop mode is selected by parameter *21.04* . 0 = Emergency stop active 1 = Normal operation **Note:** This parameter cannot be changed while the drive is running.	*Inactive*
	Forced	0.	0
	Inactive	1.	1
	DIIL	DIIL input (as indicated by *10.01 DI status*, bit 15).	
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
21.06	*Zero speed limit*	Defines the zero speed limit. The motor is stopped along a speed ramp 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.	100 = 1 rpm

No.	Name/Value	Description	Def/FbEq
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 , inverter modulation is stopped and the motor coasts to a standstill. *Speed*  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 , 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. *Speed*  	0 ms
	0 … 30000 ms	Zero speed delay.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq
21.08	DC current control	Activates/deactivates DC magnetization functions. See section DC magnetization (page 33). **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 = Enable DC hold. See section DC hold (page 33). **Notes:** • The DC hold function has no effect if the start signal is switched off. • The DC hold function can only be activated in speed control mode. • The DC hold function cannot be activated if parameter 99.04 Motor ctrl mode is set to Scalar.
1	1 = Enable post-magnetization. See section Post-magnetization (page 33).
2…15	Reserved

21.09	DC hold speed	Defines the DC hold speed. See parameter 21.08 DC current control, and section DC hold (page 33).	5.0 rpm
	0.0 … 1000.0 rpm	DC hold speed.	10 = 1 rpm
21.10	DC current reference	Defines the DC hold current in percent of the motor nominal current. See parameter 21.08 DC current control, and section DC hold (page 33).	30.0%
	0.0 … 100.0%	DC hold current.	10 = 1%
21.11	Post magnetization time	Defines the length of time for which post-magnetization is active after stopping the motor. See parameter 21.08 DC current control, and section Post-magnetization (page 33).	0 ms
	0…3000 ms	Post-magnetization time.	1 = 1 ms
21.13	Autophasing mode	Selects the way autophasing is performed during the ID run. See section Autophasing on page 30.	Turning
	Turning	This mode gives the most accurate autophasing result. This mode can be used, and is recommended, if the motor is allowed to rotate during the ID run and the start-up is not time-critical. **Note:** This mode will cause the motor to rotate during the ID run.	0
	Standstill 1	Faster than the Turning mode, but not as accurate. The motor will not rotate.	1
	Standstill 2	An alternative standstill autophasing mode that can be used if the Turning mode cannot be used, and the Standstill 1 mode gives erratic results. However, this mode is considerably slower than Standstill 1.	2

22 Speed reference selection		Speed reference selection. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241).	
22.01	Speed ref unlimited	Displays the output of the speed reference selection block. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of the selected speed reference.	100 = 1 rpm

No.	Name/Value	Description	Def/FbEq
22.11	Speed ref1 selection	Selects speed reference source 1. See also parameter 22.13 Speed ref1 function.	AI1 scaled
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (see page 66).	1
	AI2 scaled	12.22 AI2 scaled value (see page 67).	2
	Control panel	Control panel.	3
	FB A ref1	Fieldbus adapter A reference 1.	4
	FB A ref2	Fieldbus adapter A reference 2.	5
	Application program	03.15 Application reference 1 (see page 51).	13
	PID	40.01 Process PID actual value (output of the process PID controller).	15
	Other	The value is taken from another parameter.	-
22.12	Speed ref2 selection	Selects speed reference source 2. For the selections, see parameter 22.11 Speed ref1 selection.	Zero
22.13	Speed ref1 function	Selects a mathematical function between the reference sources selected by parameters 22.11 Speed ref1 selection and 22.12 Speed ref2 selection. The result is available as Speed reference 1 in parameter 22.14 Speed ref1/2 selection.	Ref 1
	Ref 1	Signal selected by 22.11 Speed ref1 selection is used as speed reference 1 as such.	0
	Add	The sum of the reference sources is used as speed reference 1.	1
	Sub	The subtraction ([22.11 Speed ref1 selection] - [22.12 Speed ref2 selection]) of the reference sources is used as speed reference 1.	2
	Mul	The multiplication of the reference sources is used as speed reference 1.	3
	Min	The smaller of the reference sources is used as speed reference 1.	4
	Max	The greater of the reference sources is used as speed reference 1.	5
22.14	Speed ref1/2 selection	Configures the selection between speed references 1 and 2. (The sources for the references are defined by parameters 22.11 Speed ref1 selection and 22.12 Speed ref2 selection respectively.) 0 = Speed reference 1 1 = Speed reference 2	Speed reference 1
	Speed reference 1	0.	0
	Speed reference 2	1.	1
	Other [bit]	A specific bit in another parameter.	
22.15	Additive speed ref1	Defines a reference to be added to speed reference 1 after reference selection. For the selections, see parameter 22.11 Speed ref1 selection. **Note:** For safety reasons, the additive is not applied when any of the stop functions are active.	Zero

No.	Name/Value	Description	Def/FbEq
22.16	Speed share	Defines the scaling factor for speed reference 1/2 (speed reference 1 or 2 is multiplied by the defined value). Speed reference 1 or 2 is selected by parameter 22.14 Speed ref1/2 selection.	1.000
	-8.000 …8.000	Speed reference scaling factor.	1000 = 1
22.17	Additive speed ref2	Defines a reference to be added to speed reference 2 after the speed share. For the selections, see parameter 22.11 Speed ref1 selection. **Note:** For safety reasons, the additive is not applied when any of the stop functions are active.	Zero
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	Const 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	Dir ena	1 = Start dir: To determine running direction for a constant speed, the sign of the constant speed setting (parameters 22.26…22.32) is multiplied by the direction signal (forward: +1, reverse: -1). For example, if the direction signal is reverse and the active constant speed is negative, the drive will run in the forward direction.
		0 = Accord Par: The running direction for the constant speed is determined by the sign of the constant speed setting (parameters 22.26…22.32).
2…15	Reserved	

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:	DI6

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

Off	0.	0
On	1.	1
DI1	Digital input DI1 (as indicated by 10.01 DI status, bit 0).	2

No.	Name/Value	Description	Def/FbEq
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
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*.	*Off*
22.24	*Constant speed sel3*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 3. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.23 Constant speed sel2* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*.	*Off*
22.26	*Constant speed 1*	Defines constant speed 1.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 1.	1 = 1 rpm
22.27	*Constant speed 2*	Defines constant speed 2.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 2.	1 = 1 rpm
22.28	*Constant speed 3*	Defines constant speed 3.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 3.	1 = 1 rpm
22.29	*Constant speed 4*	Defines constant speed 4.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 4.	1 = 1 rpm
22.30	*Constant speed 5*	Defines constant speed 5.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 5.	1 = 1 rpm
22.31	*Constant speed 6*	Defines constant speed 6.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 6.	1 = 1 rpm
22.32	*Constant speed 7*	Defines constant speed 7.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 7.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq
22.41	Speed ref safe	Defines a safe speed reference that is used with supervision parameters such as • 49.05 Communication loss action • 50.02 FBA A comm loss func.	0.00 rpm
	-30000.00 … 30000.00 rpm	Safe speed reference.	1 = 1 rpm
22.42	Jogging 1 ref	Defines the speed reference for jogging function 1. For more information on jogging, see page 28.	0.00 rpm
	-30000.00 … 30000.00 rpm	Speed reference for jogging function 1.	1 = 1 rpm
22.43	Jogging 2 ref	Defines the speed reference for jogging function 2. For more information on jogging, see page 28.	0.00 rpm
	-30000.00 … 30000.00 rpm	Speed reference for jogging function 2.	1 = 1 rpm
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 27).	00b

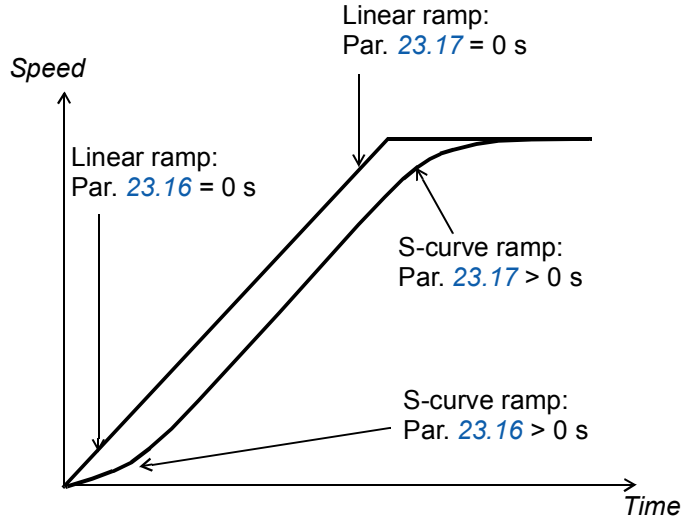
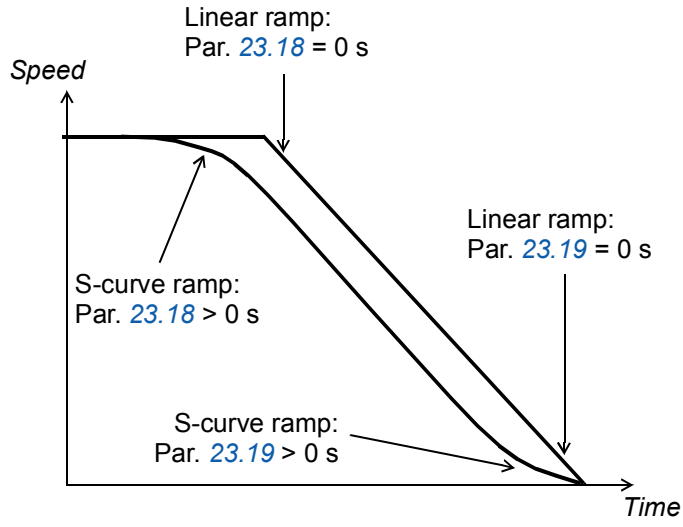
Bit	Name	Information
0	Enable	1 = Enable: Critical speeds enabled.
		0 = Disable: Critical speeds disabled.
1	Sign mode	1 = Signed: The signs of parameters 22.52…22.57 are taken into account.
		0 = Absolute: Parameters 22.52…22.57 are handled as absolute values. Each range is effective in both directions of rotation.
2…15	Reserved	

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.	1 = 1 rpm
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.	1 = 1 rpm
22.54	Critical speed 2 low	Defines the low limit for critical speed range 2. **Note:** This value must be less than or equal to the value of 22.55 Critical speed 2 high.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 2.	1 = 1 rpm
22.55	Critical speed 2 high	Defines the high limit for critical speed range 2. **Note:** This value must be greater than or equal to the value of 22.54 Critical speed 2 low.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 2.	1 = 1 rpm

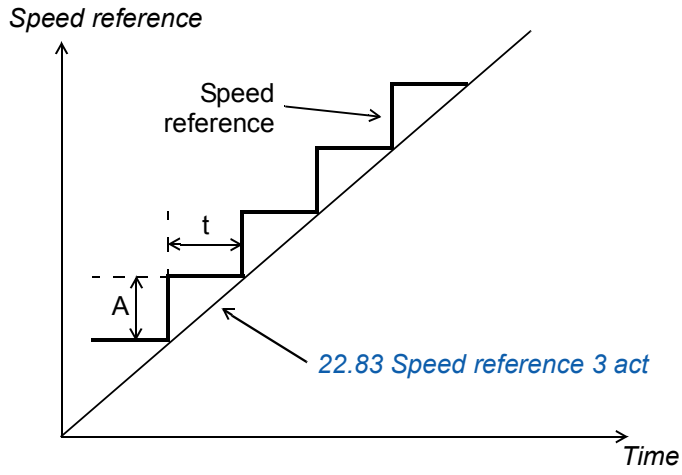
No.	Name/Value	Description	Def/FbEq
22.56	Critical speed 3 low	Defines the low limit for critical speed range 3. **Note:** This value must be less than or equal to the value of 22.57 Critical speed 3 high.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 3.	1 = 1 rpm
22.57	Critical speed 3 high	Defines the high limit for critical speed range 3. **Note:** This value must be greater than or equal to the value of 22.56 Critical speed 3 low.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 3.	1 = 1 rpm
22.81	Speed reference 1 act	Displays the value of speed reference source 1 (selected by parameter 22.11 Speed ref1 selection). This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of reference source 1.	100 = 1 rpm
22.82	Speed reference 2 act	Displays the value of speed reference source 2 (selected by parameter 22.12 Speed ref2 selection). This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of reference source 2.	100 = 1 rpm
22.83	Speed reference 3 act	Displays the value of speed reference after the mathematical function applied by parameter 22.13 Speed ref1 function and reference 1/2 selection (22.14 Speed ref1/2 selection). This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after source selection.	100 = 1 rpm
22.84	Speed reference 4 act	Displays the value of speed reference after application of 1st speed additive (22.15 Additive speed ref1). This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after additive 1.	100 = 1 rpm
22.85	Speed reference 5 act	Displays the value of speed reference after the application of the speed share scaling factor (22.16 Speed share). This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after speed share scaling.	100 = 1 rpm
22.86	Speed reference 6 act	Displays the value of speed reference after application of 2nd speed additive (22.17 Additive speed ref2). This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after additive 2.	100 = 1 rpm
22.87	Speed reference 7 act	Displays the value of speed reference before application of critical speeds. The value is received from 22.86 Speed reference 6 act unless overridden by • a constant speed • jogging reference • fieldbus reference (activated by the control word) • control panel reference • safe speed reference. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference before application of critical speeds.	100 = 1 rpm

No.	Name/Value	Description	Def/FbEq
23 Speed reference ramp		Speed reference ramp settings. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*).	
23.01	*Speed ref ramp in*	Displays the used speed reference before ramping and shaping in rpm. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference before ramping and shaping.	100 = 1 rpm
23.02	*Speed ref ramp out*	Displays the ramped and shaped speed reference in rpm. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after ramping and shaping.	100 = 1 rpm
23.11	*Ramp set selection*	Selects the source that switches between the two sets of acceleration/deceleration times defined by parameters *23.12*…*23.15*. 0 = Acceleration time 1 and deceleration time 1 are in force 1 = Acceleration time 2 and deceleration time 2 are in force	*DI4*
	Acc/Dec time 1	0.	1
	Acc/Dec time 2	1.	2
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
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 *46.10 Speed scaling*. 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.	1000 = 1 s

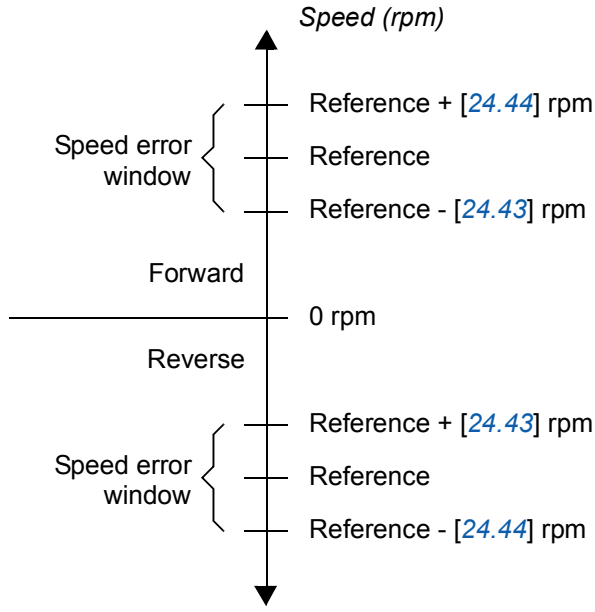
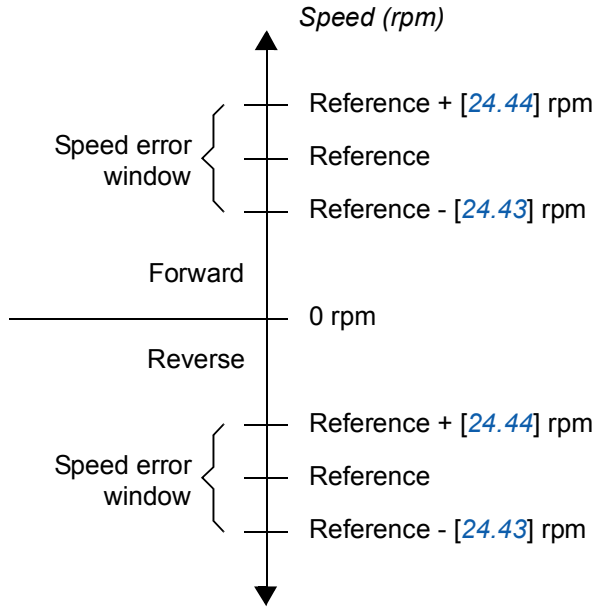
No.	Name/Value	Description	Def/FbEq
23.13	Deceleration time 1	Defines deceleration time 1 as the time required for the speed to change from the speed defined by parameter 46.10 Speed scaling to zero. If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the 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. 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.	1000 = 1 s
23.14	Acceleration time 2	Defines acceleration time 2. See parameter 23.12 Acceleration time 1.	20.000 s
	0.000 …1800.000 s	Acceleration time 2.	1000 = 1 s
23.15	Deceleration time 2	Defines deceleration time 2. See parameter 23.13 Deceleration time 1.	20.000 s
	0.000 …1800.000 s	Deceleration time 2.	1000 = 1 s

No.	Name/Value	Description	Def/FbEq
23.16	Shape time acc 1	Defines the shape of the acceleration ramp at the beginning of the acceleration. 0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.001…1000.000 s: S-curve ramp. S-curve ramps are ideal for lifting applications. The S-curve consists of symmetrical curves at both ends of the ramp and a linear part in between. **Acceleration:**  **Deceleration:**  	0.000 s
	0.000 …1800.000 s	Ramp shape at start of acceleration.	1000 = 1 s
23.17	Shape time acc 2	Defines the shape of the acceleration ramp at the end of the acceleration. See parameter 23.16 Shape time acc 1.	0.000 s
	0.000 …1800.000 s	Ramp shape at end of acceleration.	1000 = 1 s
23.18	Shape time dec 1	Defines the shape of the deceleration ramp at the beginning of the deceleration. See parameter 23.16 Shape time acc 1.	0.000 s
	0.000 …1800.000 s	Ramp shape at start of deceleration.	1000 = 1 s

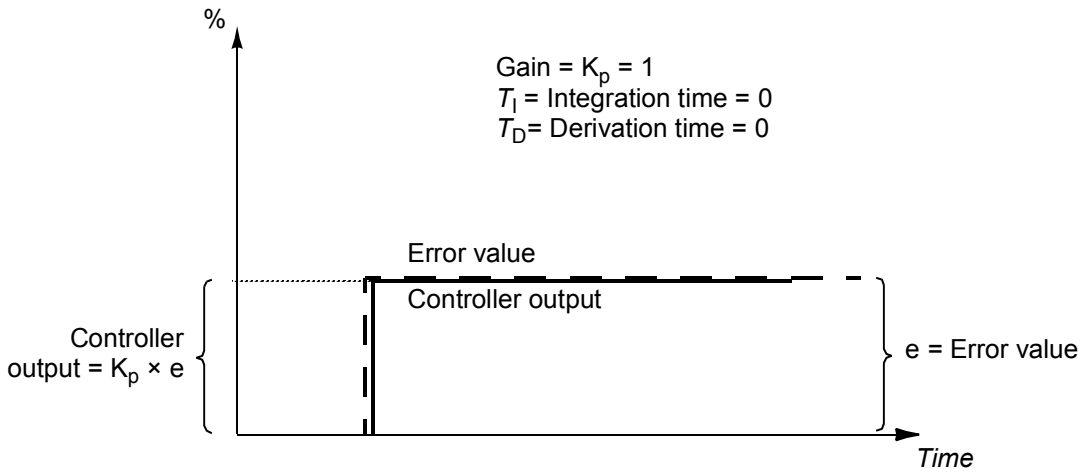
No.	Name/Value	Description	Def/FbEq
23.19	Shape time dec 2	Defines the shape of the deceleration ramp at the end of the deceleration. See parameter 23.16 Shape time acc 1.	0.000 s
	0.000 …1800.000 s	Ramp shape at end of deceleration.	1000 = 1 s
23.20	Acc time jogging	Defines the acceleration time for the jogging function i.e. the time required for the speed to change from zero to the speed value defined by parameter 46.10 Speed scaling. See section Jogging (page 28).	60.000 s
	0.000 …1800.000 s	Acceleration time for jogging.	1000 = 1 s
23.21	Dec time jogging	Defines the deceleration time for the jogging function i.e. the time required for the speed to change from the speed value defined by parameter 46.10 Speed scaling to zero. See section Jogging (page 28).	60.000 s
	0.000 …1800.000 s	Deceleration time for jogging.	1000 = 1 s
23.23	Emergency stop time	Defines the time inside which the drive is stopped if an emergency stop Off3 is activated (i.e. the time required for the speed to change from the speed value defined by parameter 46.10 Speed 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 active ramp time.	3.000 s
	0.000 …1800.000 s	Emergency stop Off3 deceleration time.	1000 = 1 s
23.24	Ramp in zero	Selects a source that forces the speed reference to zero. 0 = Force speed reference to zero 1 = Normal operation	Inactivated
	Activated	0.	0
	Inactivated	1.	1
	DI1	Digital input DI1 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	4
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	5
	DI5	Digital input DI5 (as indicated by 10.01 DI status, bit 4).	6
	DI6	Digital input DI6 (as indicated by 10.01 DI status, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by 11.01 DIO status, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by 11.01 DIO status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
23.26	Ramp out balance enable	Selects the source for enabling/disabling speed reference ramp balancing. See parameter 23.27 Ramp output balance ref. 0 = Disabled 1 = Enabled	Off
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3

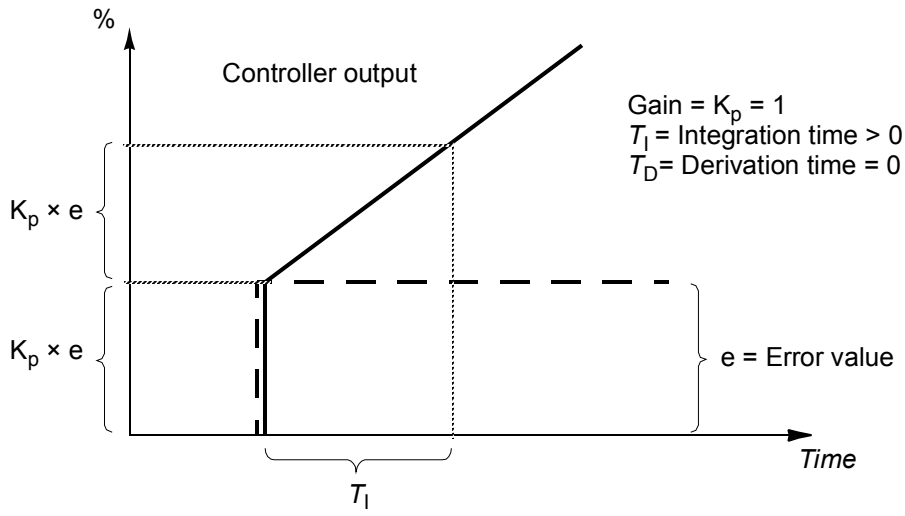
No.	Name/Value	Description	Def/FbEq
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
23.27	*Ramp output balance ref*	Defines the reference for speed ramp balancing. The output of the ramp generator is forced to this value when balancing is enabled by parameter *23.26 Ramp out balance enable*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Speed ramp balancing reference.	100 = 1 rpm
23.28	*Variable slope enable*	Activates the variable slope function, which controls the slope of the speed ramp during a speed reference change. 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 3 (*22.83 Speed reference 3 act*) 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.	0 ms
	1…30000 ms	Variable slope rate.	1 = 1 ms

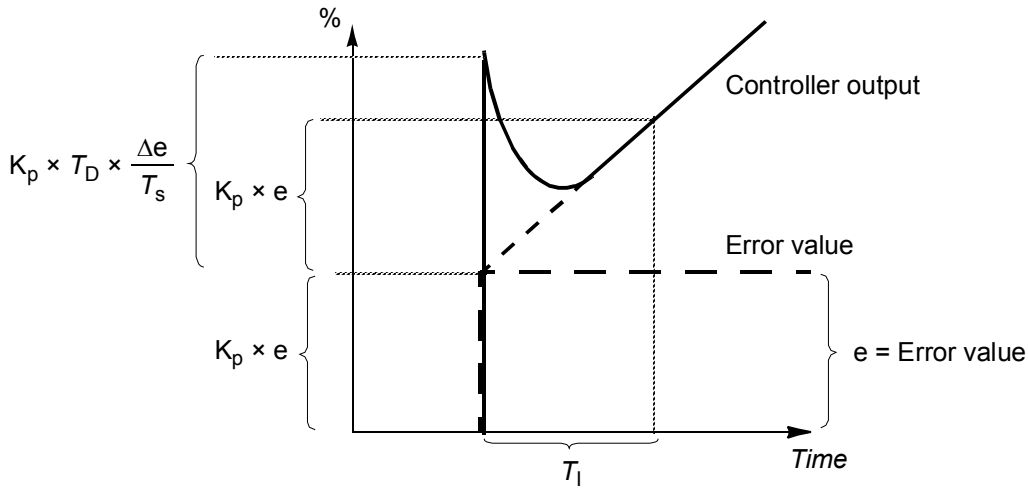
No.	Name/Value	Description	Def/FbEq
24 Speed reference conditioning		Speed error calculation; speed error window control configuration; speed error step.	
24.01	*Used speed reference*	Displays the ramped and corrected speed reference (before speed error calculation). This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference used for speed error calculation.	100 = 1 rpm
24.02	*Used actual speed*	Displays the speed feedback used for speed error calculation. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed feedback used for speed error calculation.	100 = 1 rpm
24.03	*Speed error filtered*	Displays the filtered speed error. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Filtered speed error.	100 = 1 rpm
24.04	*Speed error negative*	Displays the inverted (unfiltered) speed error. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Inverted speed error.	100 = 1 rpm
24.11	*Speed correction*	Defines a speed reference correction. This value is added to the existing reference between ramping and limitation. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*).	0
	-10000…10000	Speed reference correction.	1 = 1
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 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
24.41	*Speed error window control enable*	Enables or disables speed error window control. Speed error window control forms a speed supervision function for a torque-controlled drive. It supervises the speed error value (speed reference – actual speed). In the normal operating range, window control keeps the speed controller input at zero. The speed controller is evoked only if the speed error exits the speed error window. When the speed error moves outside the window, the exceeding part of the error value is connected to the speed controller. The speed controller produces a reference term relative to the input and gain of the speed controller (parameter *25.02 Proportional gain*) which the torque selector adds to the torque reference. The result is used as the internal torque reference for the drive. **Example:** In a load loss condition, the internal torque reference of the drive is decreased to prevent an excessive rise of the motor speed. If window control were inactive, the motor speed would rise until a speed limit of the drive were reached.	*Disable*
	Disable	Speed error window control inactive.	0

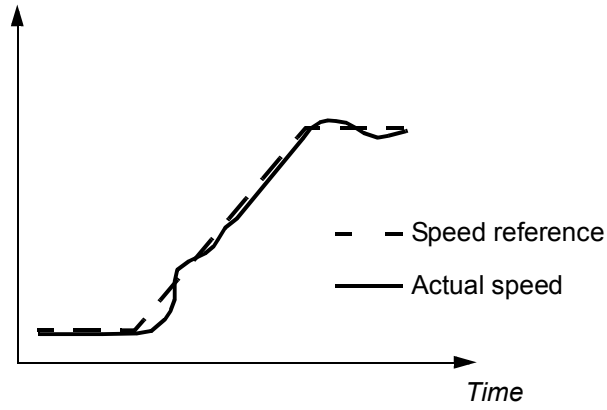
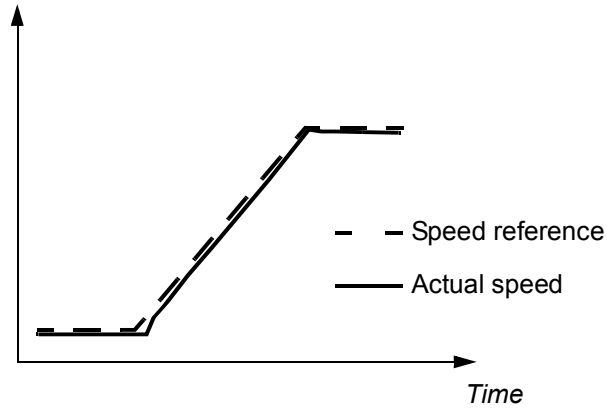
No.	Name/Value	Description	Def/FbEq
	Enable	Speed error window control active.	1
24.42	*Speed error window control mode*	Selects how the speed error window boundaries are defined on the basis of parameters *24.43 Speed error window high* and *24.44 Speed error window low*.	*Symmetric limits*
	Symmetric limits	The speed error window boundaries are defined symmetrically in both directions of rotation.  Note that it is parameter *24.44 Speed error window low* (rather than *24.43 Speed error window high*) that defines the overspeed limit in both directions of rotation. This is because the speed error window function monitors speed error (which is negative in case of overspeed, positive in case of underspeed).	0
	Signed limits	The speed error window is defined as shown below.  	1

No.	Name/Value	Description	Def/FbEq
24.43	Speed error window high	Defines the upper boundary of the speed error window. See also parameter 24.42 Speed error window control mode.	0 rpm
	0 … 3000 rpm	Upper boundary of speed error window.	1 = 1 rpm
24.44	Speed error window low	Defines the lower boundary of the speed error window. See also parameter 24.42 Speed error window control mode.	0 rpm
	0 … 3000 rpm	Lower boundary of speed error window.	1 = 1 rpm
24.46	Speed error step	Defines an additional speed step given to the input of the speed controller (and added to the speed error value).	0.0 rpm
	-3000.0 … 3000.0 rpm	Speed error step.	10 = 1 rpm

25 Speed control		Speed controller settings. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241).	
25.01	Torque reference speed control	Displays the speed controller output that is transferred to the torque controller. This parameter is read-only.	-
	-1600.0 … 1600.0 %	Limited speed controller output torque.	10 = 1%
25.02	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%.	
	0.00 …250.00	Proportional gain for speed controller.	100 = 1

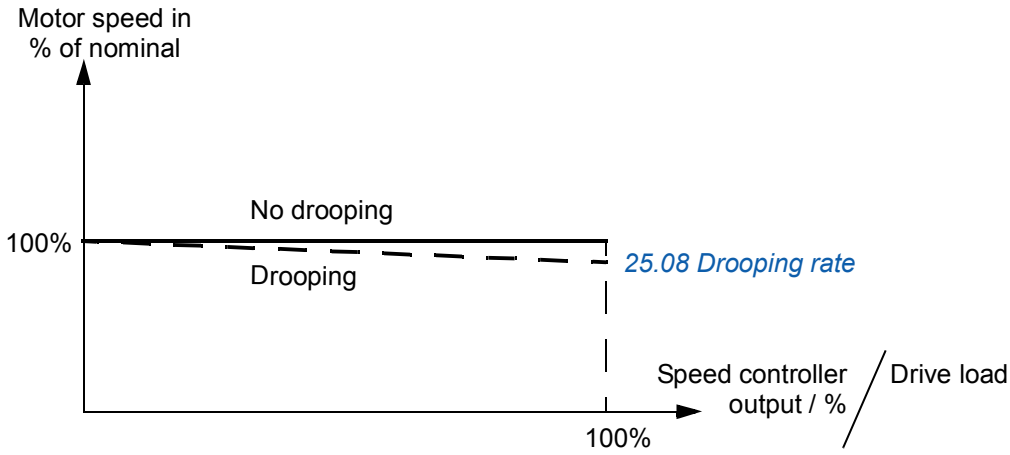
No.	Name/Value	Description	Def/FbEq
25.03	*Integration time*	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. Too short an integration time makes the control unstable. If parameter value is set to zero, the I-part of the controller is disabled. Anti-windup 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.  **Note:** This parameter is automatically set by the speed controller autotune function. See parameter *23.20 PI tune mode*.	0.50 s
	0.00 … 1000.00 s	Integration time for speed controller.	100 = 1 s

No.	Name/Value	Description	Def/FbEq
25.04	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. 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 **Note:** Changing this parameter value is recommended only if a pulse encoder is used.	0.000 s
	0.000 … 10000.000 s	Derivation time for speed controller.	1000 = 1 s
25.05	Derivation filt time	Defines the derivation filter time constant. See parameter 25.04 Derivation time.	8.0 ms
	0.0 … 1000.0 ms	Derivation filter time constant.	10 = 1 ms

No.	Name/Value	Description	Def/FbEq
25.06	Acc comp derivation time	Defines the derivation time for acceleration(/deceleration) compensation. In order to compensate inertia 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 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.	100 = 1 s
25.07	Acc comp filt time	Defines the derivation filter time constant for the acceleration (or deceleration) compensation. See parameters 25.04 Derivation time and 25.06 Acc comp derivation time.	8.0 ms
	0.0 … 1000.0 ms	Acceleration compensation derivation time.	10 = 1 ms

No.	Name/Value	Description	Def/FbEq
25.08	*Drooping rate*	Defines the droop rate in percent of the nominal motor speed. Drooping decreases the drive speed slightly as the drive load increases. The actual speed decrease at a certain operating point depends on the droop rate setting and the drive load (= torque reference / speed controller output). At 100% speed controller output, drooping is at its nominal level, i.e. equal to the value of this parameter. The drooping effect decreases linearly to zero along with the decreasing load. The droop rate can be used e.g. to adjust the load sharing in a Master/Follower application run by several drives. In a Master/Follower application the motor shafts are coupled to each other. The correct droop rate for a process must be found out case by case in practice.	0.00%
	0.00 … 100.00%	Droop rate.	100 = 1%
25.09	*Speed ctrl balance enable*	Selects the source for enabling/disabling speed controller output balancing. See parameter *25.10 Speed ctrl balance reference*. 0 = Disabled 1 = Enabled	*Off*
	Off	0.	1
	On	1.	2
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11

Speed decrease = Speed controller output × Drooping × Max. speed
Example: Speed controller output is 50%, droop rate is 1%, maximum speed of the drive is 1500 rpm.
Speed decrease = 0.50 × 0.01 × 1500 rpm = 7.5 rpm.



No.	Name/Value	Description	Def/FbEq
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
25.10	*Speed ctrl balance reference*	Defines the reference used in speed controller output balancing. The output of the speed controller is forced to this value when balancing is enabled by parameter *25.09 Speed ctrl balance enable*. In order to guarantee smooth operation during output balancing, the D-part of the speed controller is disabled and the acceleration compensation term is set to zero.	0
	-300 … 300	Speed control output balancing reference.	1 = 1
25.11	*Min torque speed control*	Defines the minimum speed controller output torque.	-300.0%
	-1600.0 … 0.0%	Minimum speed controller output torque.	10 = 1%
25.12	*Max torque speed control*	Defines the maximum speed controller output torque.	300.0%
	0.0 … 1600.0%	Maximum speed controller output torque.	10 = 1%
25.15	*Proportional gain em stop*	Defines the proportional gain for the speed controller when an emergency stop is active. See parameter *25.02 Proportional gain*.	10
	0 … 250	Proportional gain upon an emergency stop.	1 = 1
25.53	*Torque prop reference*	Displays the output of the proportional (P) part of the speed controller. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*). This parameter is read-only.	-
	-16000.0 … 16000.0%	P-part output of speed controller.	10 = 1%
25.54	*Torque integ reference*	Displays the output of the integral (I) part of the speed controller. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*). This parameter is read-only.	-
	-16000.0 … 16000.0%	I-part output of speed controller.	10 = 1%
25.55	*Torque der reference*	Displays the output of the derivative (D) part of the speed controller. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*). This parameter is read-only.	-
	-16000.0 … 16000.0%	D-part output of speed controller.	10 = 1%
25.56	*Torque acc compensation*	Displays the output of the acceleration compensation function. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*). This parameter is read-only.	-
	-16000.0 … 16000.0%	Output of acceleration compensation function.	10 = 1%
25.57	*Torque reference unbalanced*	Displays the acceleration-compensated output of the speed controller. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*). This parameter is read-only.	-
	-16000.0 … 16000.0%	Acceleration-compensated output of speed controller.	10 = 1%

No.	Name/Value	Description	Def/FbEq
26 Torque reference chain		Settings of the torque reference chain. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*).	
26.01	*Torque ref to TC*	Displays the torque reference given to the torque controller in percent. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*). This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference for torque control.	10 = 1%
26.02	*Torque ref used*	Displays the torque reference after frequency, voltage and torque limitation in percent of motor nominal torque. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*). This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference for torque control.	10 = 1%
26.08	*Minimum torque ref*	Defines the minimum torque reference.	-300.0%
	-1000.0 … 0.0%	Minimum torque reference.	10 = 1%
26.09	*Maximum torque ref*	Defines the maximum torque reference.	300.0%
	0.0 … 1000.0%	Maximum torque reference.	10 = 1%
26.11	*Torque ref1 selection*	Selects torque reference source 1. See also parameter *26.13 Torque ref1 function*.	*Zero*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *66*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *67*).	2
	Control panel	*03.01 Panel reference* (see page *50*).	3
	FB A ref1	*03.05 FB A reference 1* (see page *50*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *50*).	5
	Application program	*03.15 Application reference 1* (see page *51*).	13
	PID	*40.01 Process PID actual value* (output of the process PID controller).	15
	Other	The value is taken from another parameter.	-
26.12	*Torque ref2 selection*	Selects torque reference source 2. See also parameter *26.13 Torque ref1 function*. For the available selections, see parameter *26.11 Torque ref1 selection*.	*Zero*
26.13	*Torque ref1 function*	Selects a mathematical function between the reference sources selected by parameters *26.11 Torque ref1 selection* and *26.12 Torque ref2 selection*. The result of the function is then selectable as torque reference 1 in parameter *26.14 Torque ref1/2 selection*.	*Ref 1*
	Ref 1	Signal selected by *26.11 Torque ref1 selection* is used as torque reference 1 as such.	0
	Add	The sum of the reference sources is used as torque reference 1.	1
	Sub	The subtraction ([*26.11 Torque ref1 selection*] - [*26.12 Torque ref2 selection*]) of the reference sources is used as torque reference 1.	2
	Mul	The multiplication of the reference sources is used as torque reference 1.	3

No.	Name/Value	Description	Def/FbEq
	Min	The smaller of the reference sources is used as torque reference 1.	4
	Max	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. (The sources of the references are defined by parameters *26.11 Torque ref1 selection* and *26.12 Torque ref2 selection* respectively.) 0 = Torque reference 1 1 = Torque reference 2	*Torque reference 1*
	Torque reference 1	0.	0
	Torque reference 2	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
26.15	*Load share*	Defines the scaling factor for the torque reference (the torque reference is multiplied by the value).	1.000
	-8.000 … 8.000	Torque reference scaling factor.	1000 = 1
26.16	*Additive torque ref 1*	Selects the source for torque reference additive 1. **Note:** For safety reasons, the additive is not applied when an emergency stop is active. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*).	*Zero*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *66*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *67*).	2
	Control panel	*03.01 Panel reference* (see page *50*).	3
	FB A ref1	*03.05 FB A reference 1* (see page *50*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *50*).	5
	Application program	*03.15 Application reference 1* (see page *51*).	13
	PID	*40.01 Process PID actual value* (output of the process PID controller).	15
	Other	The value is taken from another parameter.	-
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.	1000 = 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.	1000 = 1 s
26.25	*Additive torque ref 2*	Selects the source of torque reference additive 2. The value received from the selected source is added to the torque reference after operating mode selection. Because of this, the additive can be used in speed and torque modes. **Note:** For safety reasons, the additive is not applied when an emergency stop is active. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*).	*Zero*

No.	Name/Value	Description	Def/FbEq
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *66*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *67*).	2
	Control panel	*03.01 Panel reference* (see page *50*).	3
	FB A ref1	*03.05 FB A reference 1* (see page *50*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *50*).	5
	Application program	*03.15 Application reference 1* (see page *51*).	13
	PID	*40.01 Process PID actual value* (output of the process PID controller).	15
	Other	The value is taken from another parameter.	-
26.26	*Force torque ref add 2 zero*	Selects a source that forces torque reference additive 2 (see parameter *26.25 Additive torque ref 2*) to zero. 0 = Normal operation 1 = Force torque reference additive 2 to zero.	*Off*
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
26.41	*Torque step*	When enabled by parameter *26.42 Torque step enable*, adds an additional step to the torque reference.	0.00%
	-300.00 … 300.00%	Torque step.	
26.42	*Torque step enable*	Enables a torque step (defined by parameter *26.41 Torque step*).	*Disable*
	Disable	Torque step disabled.	0
	Enable	Torque step enabled.	1
26.70	*Torque ref1 actual*	Displays the value of torque reference source 1 (selected by parameter *26.11 Torque ref1 selection*). This parameter is read-only.	-
	-1600.0 … 1600.0%	Value of torque reference source 1.	10 = 1%
26.71	*Torque ref2 actual*	Displays the value of torque reference source 2 (selected by parameter *26.12 Torque ref2 selection*). This parameter is read-only.	-
	-1600.0 … 1600.0%	Value of torque reference source 2.	10 = 1%

No.	Name/Value	Description	Def/FbEq
26.72	Torque ref3 actual	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 diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after selection.	10 = 1%
26.73	Torque ref4 actual	Displays the torque reference after application of reference additive A. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after application of reference additive A.	10 = 1%
26.74	Torque ref ramped	Displays the torque reference after limiting and ramping. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after limiting and ramping.	10 = 1%
26.75	Torque ref5 actual	Displays the torque reference after control mode selection. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after control mode selection.	10 = 1%
26.76	Torque ref6 actual	Displays the torque reference after application of reference additive 2. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after application of reference additive 2.	10 = 1%
26.77	Torque ref add A actual	Displays the value of the source of torque reference additive 2. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference additive 2.	10 = 1%
26.78	Torque ref add B actual	Displays the value of torque reference additive 2 before it is added to torque reference. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference additive 2.	10 = 1%
26.81	Rush control gain	Rush controller gain term.	10.0
	1.0 …10000.0	Rush controller gain.	10 = 1
26.82	Rush control integration time	Rush controller integration time term.	2.0 s
	0.1 …10.0 s	Rush controller integration time.	10 = 1 s
28 Frequency reference chain		Settings of the frequency reference chain. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241).	
28.01	Frequency ref ramp in	Displays the used frequency reference before ramping. This parameter is read-only.	-
	-3000.0 … 3000.0 Hz	Frequency reference before ramping.	1 = 1 Hz

No.	Name/Value	Description	Def/FbEq
28.02	Frequency ref ramped	Displays the final frequency reference (after selection, limitation and ramping). This parameter is read-only.	-
	-3000.0 … 3000.0 Hz	Final frequency reference.	1 = 1 Hz
28.11	Frequency ref1 selection	Selects frequency reference source 1. See also parameter 28.13 Frequency ref1 function.	AI1 scaled
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (see page 66).	1
	AI2 scaled	12.22 AI2 scaled value (see page 67).	2
	Control panel	03.01 Panel reference (see page 50).	3
	FB A ref1	03.05 FB A reference 1 (see page 50).	4
	FB A ref2	03.06 FB A reference 2 (see page 50).	5
	Application program	03.15 Application reference 1 (see page 51).	13
	PID	40.01 Process PID actual value (output of the process PID controller).	15
	Other	The value is taken from another parameter.	-
28.12	Frequency ref2 selection	Selects frequency reference source 2. See also parameter 28.13 Frequency ref1 function. For the selections, see parameter 28.11 Frequency ref1 selection.	Zero
28.13	Frequency ref1 function	Selects a mathematical function between the reference sources selected by parameters 28.11 Frequency ref1 selection and 28.12 Frequency ref2 selection. The result of the function is then selectable as frequency reference 1 in parameter 28.14 Frequency ref1/2 selection.	Ref1
	Ref1	Signal selected by 28.11 Frequency ref1 selection is used as frequency reference 1 as such.	0
	Add	The sum of the reference sources is used as frequency reference 1.	1
	Sub	The subtraction ([28.11 Frequency ref1 selection] - [28.12 Frequency ref2 selection]) of the reference sources is used as frequency reference 1.	2
	Mul	The multiplication of the reference sources is used as frequency reference 1.	3
	Min	The smaller of the reference sources is used as frequency reference 1.	4
	Max	The greater of the reference sources is used as frequency reference 1.	5
28.14	Frequency ref1/2 selection	Configures the selection between frequency references 1 and 2. (The sources of the references are defined by parameters 28.11 Frequency ref1 selection and 28.12 Frequency ref2 selection respectively.) 0 = Frequency reference 1 1 = Frequency reference 2	Frequency reference 1
	Frequency reference 1	0.	0
	Frequency reference 2	1.	1

No.	Name/Value	Description	Def/FbEq
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
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.
1	Dir ena	1 = Start dir: To determine running direction for a constant frequency, the sign of the constant frequency setting (parameters *28.26…28.32*) is multiplied by the direction signal (forward: +1, reverse: -1). For example, if the direction signal is reverse and the active constant frequency is negative, the drive will run in the forward direction.
		0 = According to par: The running direction for the constant frequency is determined by the sign of the constant speed setting (parameters *28.26…28.32*).

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:	*Off*

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

Off	0.	0
On	1.	1
DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7

No.	Name/Value	Description	Def/FbEq
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
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*.	*Off*
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*.	*Off*
28.26	*Constant frequency 1*	Defines constant frequency 1.	5 Hz
	-3000…3000 Hz	Constant frequency 1.	1 = 1 Hz
28.27	*Constant frequency 2*	Defines constant frequency 2.	10 Hz
	-3000…3000 Hz	Constant frequency 2.	1 = 1 Hz
28.28	*Constant frequency 3*	Defines constant frequency 3.	15 Hz
	-3000…3000 Hz	Constant frequency 3.	1 = 1 Hz
28.29	*Constant frequency 4*	Defines constant frequency 4.	20 Hz
	-3000…3000 Hz	Constant frequency 4.	1 = 1 Hz
28.30	*Constant frequency 5*	Defines constant frequency 5.	25 Hz
	-3000…3000 Hz	Constant frequency 5.	1 = 1 Hz
28.31	*Constant frequency 6*	Defines constant frequency 6.	40 Hz
	-3000…3000 Hz	Constant frequency 6.	1 = 1 Hz
28.32	*Constant frequency 7*	Defines constant frequency 7.	50 Hz
	-3000…3000 Hz	Constant frequency 7.	1 = 1 Hz
28.41	*Frequency ref safe*	Defines a safe frequency reference that is used with supervision parameters such as • *49.05 Communication loss action* • *50.02 FBA A comm loss func*.	0 Hz
	-3000…3000 Hz	Safe frequency reference.	1 = 1 Hz

No.	Name/Value	Description	Def/FbEq
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 27).	00b

Bit	Name	Information
0	Enable	1 = Enable: Critical frequencies enabled.
		0 = Disable: Critical frequencies disabled.
1	Sign mode	1 = Signed: 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.

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 Hz
	-3000…3000 Hz	Low limit for critical frequency 1.	1 = 1 Hz
28.53	Critical frequency 1 high	Defines the high limit for critical frequency 1. **Note:** This value must be greater than or equal to the value of 28.52 Critical frequency 1 low.	0 Hz
	-3000…3000 Hz	High limit for critical frequency 1.	1 = 1 Hz
28.54	Critical frequency 2 low	Defines the low limit for critical frequency 2. **Note:** This value must be less than or equal to the value of 28.55 Critical frequency 2 high.	0 Hz
	-3000…3000 Hz	Low limit for critical frequency 2.	1 = 1 Hz
28.55	Critical frequency 2 high	Defines the high limit for critical frequency 2. **Note:** This value must be greater than or equal to the value of 28.54 Critical frequency 2 low.	0 Hz
	-3000…3000 Hz	High limit for critical frequency 2.	1 = 1 Hz
28.56	Critical frequency 3 low	Defines the low limit for critical frequency 3. **Note:** This value must be less than or equal to the value of 28.57 Critical frequency 3 high.	0 Hz
	-3000…3000 Hz	Low limit for critical frequency 3.	1 = 1 Hz
28.57	Critical frequency 3 high	Defines the high limit for critical frequency 3. **Note:** This value must be greater than or equal to the value of 28.56 Critical frequency 3 low.	0 Hz
	-3000…3000 Hz	High limit for critical frequency 3.	1 = 1 Hz
28.71	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	Off
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	4
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	5

No.	Name/Value	Description	Def/FbEq
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
28.72	*Acceleration time 1*	Defines acceleration time 1 as the time required for the frequency to change from zero to the frequency defined by parameter *46.11 Frequency scaling*. 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 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.	1000 = 1 s
28.73	*Deceleration time 1*	Defines deceleration time 1 as the time required for the frequency to change from the frequency defined by parameter *46.11 Frequency scaling* 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.	1000 = 1 s
28.74	*Acceleration time 2*	Defines acceleration time 2. See parameter *28.72 Acceleration time 1*.	20.000 s
	0.000 … 1800.000 s	Acceleration time 2.	1000 = 1 s
28.75	*Deceleration time 2*	Defines deceleration time 2. See parameter *28.73 Deceleration time 1*.	20.000 s
	0.000 … 1800.000 s	Deceleration time 2.	1000 = 1 s
28.76	*Ramp in zero*	Selects a source that forces the frequency reference to zero. 0 = Force frequency reference to zero 1 = Normal operation	*On*
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7

No.	Name/Value	Description	Def/FbEq
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
28.77	*Ramp hold*	Selects a source that forces the output of the frequency ramp generator to actual frequency value. 0 = Force ramp output to actual frequency 1 = Normal operation	*On*
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
28.78	*Ramp output balance*	Defines a reference for frequency ramp balancing. The output of the ramp generator is forced to this value when balancing is enabled by parameter *28.79 Ramp output balance ena*.	0.0 Hz
	-3000.0 … 3000.0 Hz	Frequency ramp balancing reference.	10 = 1 Hz
28.79	*Ramp output balance ena*	Selects the source for enabling/disabling speed ramp balancing. See parameter *28.78 Ramp output balance*. 0 = Disabled 1 = Enabled	*Off*
	Off	0.	
	On	1.	
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
28.80	*Frequency ref ramp in sel*	Selects the signal source for the frequency ramp generator input.	*Freq ref unlimited*
	NULL	None.	0
	Freq ref unlimited	*28.97 Frequency ref unlimited*.	1
	Other (value)	The value is taken from another parameter.	-

No.	Name/Value	Description	Def/FbEq
28.81	Frequency ref in scalar control	Selects the signal that is used as a frequency reference in scalar control.	Frequency ref ramped
	NULL	None.	0
	Frequency ref ramped	28.02 Frequency ref ramped, i.e. the frequency control chain.	1
	Other (value)	The value is taken from another parameter.	-
28.90	Frequency ref1 act	Displays the value of frequency reference source 1 (selected by parameter 28.11 Frequency ref1 selection). This parameter is read-only.	-
	-3000.0 … 3000.0 Hz	Value of frequency reference source 1.	1 = 1 Hz
28.91	Frequency ref2 act	Displays the value of frequency reference source 2 (selected by parameter 28.12 Frequency ref2 selection). This parameter is read-only.	-
	-3000.0 … 3000.0 Hz	Value of frequency reference source 2.	1 = 1 Hz
28.92	Frequency ref3 act	Displays the frequency reference after the function applied by parameter 28.13 Frequency ref1 function (if any), and after selection (28.14 Frequency ref1/2 selection). This parameter is read-only.	-
	-3000.0 … 3000.0 Hz	Frequency reference after selection.	1 = 1 Hz
28.96	Frequency ref7 act	Displays the frequency reference after application of constant frequencies, control panel reference, etc. This parameter is read-only.	-
	-3000.0 … 3000.0 Hz	Frequency reference 7.	1 = 1 Hz
28.97	Frequency ref unlimited	Displays the frequency reference after application of critical frequencies, but before ramping and limiting. This parameter is read-only.	-
	-3000.0 … 3000.0 Hz	Frequency reference before ramping and limiting.	1 = 1 Hz

No.	Name/Value	Description	Def/FbEq
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	Spd ctl tlim min	1 = Speed controller output is being limited by *25.11 Min torque speed control*
2	Spd ctl tlim max	1 = Speed controller output is being limited by *25.12 Max torque speed control*
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	

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 reference is being limited by *26.08 Minimum torque ref*
3	Maximum torque	*1 = Torque reference is being limited by *26.09 Maximum torque ref*
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 anymore torque
7	Reserved	
8	Thermal	1 = Input current is being limited by the main circuit thermal limit
9	SOA 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/FbEq
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.	-1500.00 rpm
	-30000.00 … 30000.00 rpm	Minimum allowed speed.	100 = 1 rpm
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.	100 = 1 rpm
30.13	*Minimum frequency*	Defines the minimum allowed frequency. **WARNING!** This value must not be higher than *30.14 Maximum frequency*.	-50.0 Hz
	-3000.0 … 3000.0 Hz	Minimum frequency.	10 = 1 Hz
30.14	*Maximum frequency*	Defines the maximum allowed frequency. **WARNING!** This value must not be lower than *30.13 Minimum frequency*.	50 Hz
	-3000.0 … 3000.0 Hz	Maximum frequency.	10 = 1 Hz
30.17	*Maximum current*	Defines the maximum allowed motor current.	0.00 A
	0.00 … 30000.00 A	Maximum motor current.	100 = 1 A
30.19	*Minimum torque*	Defines the minimum torque limit for the drive (in percent of nominal motor torque).	-300.0%
	-1600.0 … 1600.0%	Minimum torque.	10 = 1%
30.20	*Maximum torque*	Defines the maximum torque limit for the drive (in percent of nominal motor torque).	300.0%
	-1600.0 … 1600.0%	Maximum torque.	10 = 1%
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.	100 = 1%
30.27	*Power generating limit*	Defines the maximum allowed power fed by the motor to the inverter in percent of nominal motor power.	-300.00%
	-600.00 … 0.00%	Maximum generating power.	10 = 1%
30.30	*Overvoltage control*	Enables the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque. **Note:** If the drive is equipped with a brake chopper and resistor, or a regenerative supply unit, the controller must be disabled.	*Enable*
	Disable	Overvoltage control disabled.	0

No.	Name/Value	Description	Def/FbEq
	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

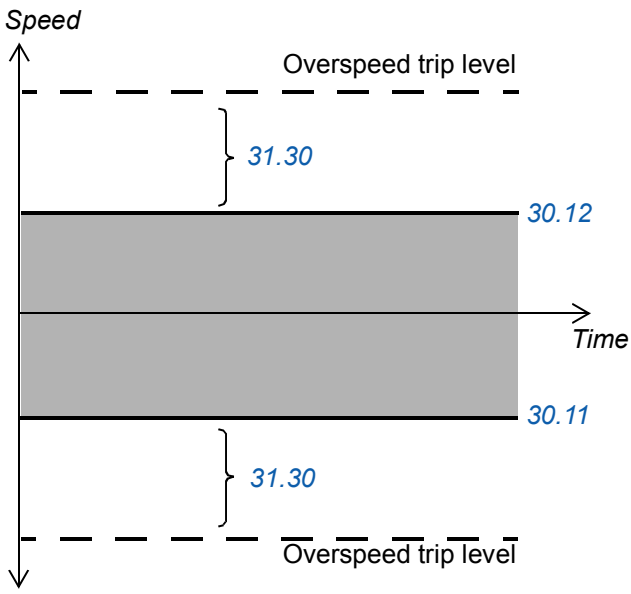
31 Fault functions		Settings that define the behavior of the drive upon fault situations.	
31.01	*External event 1 source*	Defines the source of external event 1. See also parameter *31.02 External event 1 type*. 0 = Trigger event 1 = Normal operation	*Inactive*
	Forced	0.	0
	Inactive	1.	1
	DIIL	DIIL input (as indicated by *10.01 DI status*, bit 15).	2
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	3
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	4
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	5
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	6
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	7
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	8
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	11
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
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
	Pure event	The event is only logged with a time stamp. No fault or warning is generated.	2
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.	*DI3*
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	3

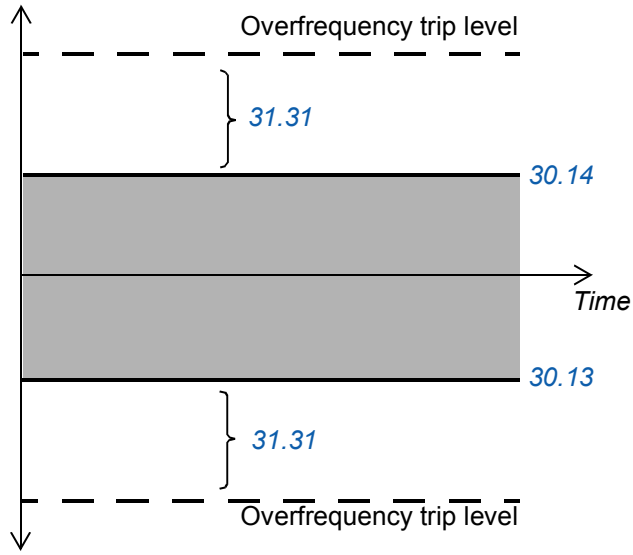
No.	Name/Value	Description	Def/FbEq
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	4
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	5
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	6
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	7
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	8
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	11
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
31.12	*Autoreset sel*	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. The bits of the binary number correspond to the following faults:	0000h

Bit	Fault
0	Overcurrent
1	Overvoltage
2	Undervoltage
3	AI < Min
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…15	Reserved

31.13	*Selectable fault*	Defines the fault that can be automatically reset using parameter *31.12 Autoreset sel*, bit 10. The faults are listed in chapter *Fault tracing* (page *209*).	0
	0…65535	Fault code.	1 = 1
31.14	*Number of trials*	Defines the number of automatic fault resets the drive performs within the time defined by parameter *31.15 Trial time*.	0
	0…5	Number of automatic resets.	1 = 1
31.15	*Trial time*	Defines the time for the automatic reset function. See parameter *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 sel*.	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	No action taken.	0
	Fault	The drive trips on fault *3381 Output phase loss*.	1

No.	Name/Value	Description	Def/FbEq
31.20	*Earth fault*	Selects how the drive reacts when an earth fault or current unbalance is detected in the motor or the motor cable.	*Fault*
	No	No action taken.	0
	Warning	The drive generates an *A2B3 Earth leakage* warning.	1
	Fault	The drive trips on fault *2330 Earth leakage*.	2
31.21	*Supply phase loss*	Selects how the drive reacts when a supply phase loss is detected.	*Fault*
	No	No action taken.	0
	Fault	The drive trips on fault *3130 Input phase loss*.	1
31.22	*STO diagnostics*	Selects how the drive reacts when it detects the absence of one or both Safe torque off (STO) signals. **Note:** This parameter is for supervision only. The Safe torque off function can activate even when this parameter is set to *No*. For more information on the Safe torque off function, see the *Hardware manual* of the drive.	*Fault*
	Fault	The drive trips on *FA81 Safe torque off 1* and/or *FA82 Safe torque off 2* (depending on which STO signal is lost); fault *5091 Safe torque off* is also generated.	0
	Warning	Drive running: The drive trips on *5091 Safe torque off* when one or both of the STO signals is lost. Drive stopped: The drive generates an *A5A0 Safe torque off* warning if both STO signals are absent. If only one of the signals is lost, the drive trips on *FA81 Safe torque off 1* or *FA82 Safe torque off 2*; fault *5091 Safe torque off* is also generated.	1
	No	Drive running: The drive trips on *5091 Safe torque off* when one or both of the STO signals is lost. Drive stopped: No action if both STO signals are absent. If only one of the signals is lost, the drive trips on *FA81 Safe torque off 1* or *FA82 Safe torque off 2*.	2
	Only warning	The drive generates an *A5A0 Safe torque off* warning if both STO signals are absent. If only one of the signals is lost, the drive trips on *FA81 Safe torque off 1* or *FA82 Safe torque off 2*.	3
31.23	*Cross connection*	Selects how the drive reacts to incorrect input power and motor cable connection (i.e. input power cable is connected to drive motor connection).	*Fault*
	No	No action taken.	0
	Fault	The drive trips on fault *3181 Cross connection*.	1

No.	Name/Value	Description	Def/FbEq
31.24	Stall function	Selects how the drive reacts to a motor stall condition. A stall condition is defined as follows: • The drive is at stall current limit (31.25 Stall current limit), and • the output frequency is below the level set by parameter 31.27 Stall frequency high or the motor speed is below the level set by parameter 31.26 Stall speed high, and • the conditions above have been valid longer than the time set by parameter 31.28 Stall time.	Fault
	No	None (stall supervision disabled).	0
	Warning	The drive generates an A780 Motor stall warning.	1
	Fault	The drive trips on fault 7121 Motor stall.	2
31.25	Stall current limit	Stall current limit in percent of the nominal current of the motor. See parameter 31.24 Stall function.	200.0%
	0.0 … 1600.0%	Stall current limit.	10 = 1%
31.26	Stall speed high	Stall speed limit in rpm. See parameter 31.24 Stall function.	150.0 rpm
	0.0 … 10000.0 rpm	Stall speed limit.	10 = 1 rpm
31.27	Stall frequency high	Stall frequency limit. See parameter 31.24 Stall function. **Note:** Setting the limit below 10 Hz is not recommended.	15.0 Hz
	0.0 … 1000.0 Hz	Stall frequency limit.	10 = 1 Hz
31.28	Stall time	Stall time. See parameter 31.24 Stall function.	20 s
	0 … 3600 s	Stall time.	1 = 1 s
31.30	Speed trip margin	Defines, together with 30.11 Minimum speed and 30.12 Maximum speed, the maximum allowed speed of the motor (overspeed protection). If actual speed (01.04 Encoder 1 speed filtered) 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. **Example:** If the maximum speed is 1420 rpm and speed trip margin is 300 rpm, the drive trips at 1720 rpm.  	500 rpm
	0…10000 rpm	Overspeed trip margin.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq
31.31	Frequency trip margin	Defines, together with 30.13 Minimum frequency and 30.14 Maximum frequency, the maximum allowed frequency of the motor (overfrequency protection). If the output frequency (01.06 Output frequency) exceeds the limits by more than the value of this parameter, the drive trips on the 7310 Overspeed fault. Frequency  	50 Hz
	0…10000 Hz	Overfrequency trip margin.	1 = 1 Hz

33 Maintenance timer & counter		Configuration of maintenance timers/counters. See also section Maintenance timers and counters (page 44).	
33.01	Counter status	Displays the maintenance timer/counter status word, indicating which maintenance timers/counters have exceeded their limits. This parameter is read-only.	-

Bit	Name	Description
0	Ontime1	1 = On-time timer 1 has reached its preset limit.
1	Ontime2	1 = On-time timer 2 has reached its preset limit.
2	Edge1	1 = Signal edge counter 1 has reached its preset limit.
3	Edge2	1 = Signal edge counter 2 has reached its preset limit.
4	Value1	1 = Value counter 1 has reached its preset limit.
5	Value2	1 = Value counter 2 has reached its preset limit.
6…15	Reserved	

33.10	On-time 1 actual	Reading of on-time timer 1. Can be reset on the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295 s	Reading of on-time timer 1.	1 = 1 s
33.11	On-time 1 limit	Sets the warning limit for on-time timer 1.	-
	0…4294967295 s	Warning limit for on-time counter 1.	1 = 1 s

No.	Name/Value	Description	Def/FbEq
33.12	On-time 1 function	Configures on-time timer 1. This timer runs whenever the signal selected by parameter 33.13 On-time 1 source is on. After the limit set by 33.11 On-time 1 limit is reached, the warning specified by 33.14 On-time 1 warning select is given (if enabled by this parameter), and the timer reset. The current value of the timer is readable from parameter 33.10 On-time 1 actual. Bit 0 of 33.01 Counter status indicates that the time has exceeded the limit.	00b

Bit	Function
0	Counter mode 0 = Loop: If warning is enabled by bit 1, it stays active only for 10 seconds 1 = Saturate: If warning is enabled by bit 1, it stays active until reset
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning is given when the limit is reached
2…15	Reserved

33.13	On-time 1 source	Selects the signal to be monitored by on-time timer 1.	FALSE
	FALSE	Constant 0.	0
	TRUE	Constant 1.	1
	RO1	Bit 0 of 10.21 RO status (page 58).	2
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
33.14	On-time 1 warning select	Selects the warning message for on-time timer 1.	On-time 1
	On-time 1	Pre-selectable warning message for on-time timer 1.	0
	Device clean	Pre-selectable warning message for on-time timer 1.	6
	Additional cooling fan	Pre-selectable warning message for on-time timer 1.	7
	Cabinet fan	Pre-selectable warning message for on-time timer 1.	8
	DC-capacitor	Pre-selectable warning message for on-time timer 1.	9
	Motor bearing	Pre-selectable warning message for on-time timer 1.	10
33.20	On-time 2 actual	Reading of on-time timer 2. Can be reset on the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295 s	Reading of on-time timer 2.	1 = 1 s
33.21	On-time 2 limit	Sets the warning limit for on-time timer 2.	0 s
	0…4294967295 s	Warning limit for on-time counter 2.	1 = 1 s

No.	Name/Value	Description	Def/FbEq
33.22	On-time 2 function	Configures on-time timer 2. This timer runs whenever the signal selected by parameter 33.23 On-time 2 source is on. After the limit set by 33.21 On-time 2 limit is reached, the warning specified by 33.24 On-time 2 warning select is given (if enabled by this parameter), and the timer reset. The current value of the timer is readable from parameter 33.20 On-time 2 actual. Bit 1 of 33.01 Counter status indicates that the time has exceeded the limit.	00b

Bit	Function
0	Counter mode 0 = Loop: If warning is enabled by bit 1, it stays active only for 10 seconds 1 = Saturate: If warning is enabled by bit 1, it stays active until reset
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning is given when the limit is reached
2…15	Reserved

33.23	On-time 2 source	Selects the signal to be monitored by on-time timer 2.	FALSE
	FALSE	Constant 0.	0
	TRUE	Constant 1.	1
	RO1	Bit 0 of 10.21 RO status (page 58).	2
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
33.24	On-time 2 warning select	Selects the warning message for on-time timer 2.	On-time 2
	On-time 2	Pre-selectable warning message for on-time timer 2.	1
	Device clean	Pre-selectable warning message for on-time timer 2.	6
	Additional cool fan	Pre-selectable warning message for on-time timer 2.	7
	Cabinet fan	Pre-selectable warning message for on-time timer 2.	8
	DC-capacitor	Pre-selectable warning message for on-time timer 2.	9
	Motor bearing	Pre-selectable warning message for on-time timer 2.	10
33.30	Edge counter 1 actual	Reading of signal edge counter 1. Can be reset on the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Reading of signal edge counter 1.	1 = 1
33.31	Edge counter 1 limit	Sets the warning limit for signal edge counter 1.	0
	0…4294967295	Warning limit for signal edge counter 1.	1 = 1

No.	Name/Value	Description	Def/FbEq
33.32	Edge counter 1 func	Configures signal edge counter 1. This counter is incremented every time the signal selected by parameter 33.33 Edge counter 1 source switches on or off (or either, depending on the setting of this parameter). A divisor may be applied to the count (see 33.34 Edge counter 1 divider). After the limit set by 33.31 Edge counter 1 limit is reached, the warning specified by 33.35 Edge counter 1 warning select is given (if enabled by this parameter), and the counter reset. The current value of the counter is readable from parameter 33.30 Edge counter 1 actual. Bit 2 of 33.01 Counter status indicates that the count has exceeded the limit.	0000b

Bit	Function
0	Counter mode 0 = Loop: If warning is enabled by bit 1, it stays active only for 10 seconds 1 = Saturate: If warning is enabled by bit 1, it stays active until reset
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning is given when the limit is reached
2	Count rising edge 0 = Disable: Rising edges are not counted 1 = Enable: Rising edges are counted
3	Count falling edge 0 = Disable: Falling edges are not counted 1 = Enable: Falling edges are counted
4…15	Reserved

33.33	Edge counter 1 source	Selects the signal to be monitored by signal edge counter 1.	FALSE
	FALSE	Constant 0.	0
	TRUE	Constant 1.	1
	RO1	Bit 0 of 10.21 RO status (page 58).	2
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
33.34	Edge counter 1 divider	Divisor for signal edge counter 1. Determines how many signal edges increment the counter by 1.	1
	0…4294967295	Divisor for signal edge counter 1.	1 = 1
33.35	Edge counter 1 warning select	Selects the warning message for signal edge counter 1.	Edge counter 1
	Edge counter 1	Pre-selectable warning message for signal edge counter 1.	2
	Main contactor	Pre-selectable warning message for signal edge counter 1.	11
	Output relay	Pre-selectable warning message for signal edge counter 1.	12
	Motor starts	Pre-selectable warning message for signal edge counter 1.	13
	Power ups	Pre-selectable warning message for signal edge counter 1.	14
	DC-charge	Pre-selectable warning message for signal edge counter 1.	15
33.40	Edge counter 2 actual	Reading of signal edge counter 2. Can be reset on the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Reading of signal edge counter 2.	1 = 1
33.41	Edge counter 2 limit	Sets the warning limit for signal edge counter 2.	0
	0…4294967295	Warning limit for signal edge counter 2.	1 = 1

No.	Name/Value	Description	Def/FbEq
33.42	Edge counter 2 function	Configures signal edge counter 2. This counter is incremented every time the signal selected by parameter 33.43 Edge counter 2 source switches on or off (or either, depending on the setting of this parameter). A divisor may be applied to the count (see 33.44 Edge counter 2 divider). After the limit set by 33.41 Edge counter 2 limit is reached, the warning specified by 33.45 Edge counter 2 warning select is given (if enabled by this parameter), and the counter reset. The current value of the counter is readable from parameter 33.40 Edge counter 2 actual. Bit 3 of 33.01 Counter status indicates that the count has exceeded the limit.	0000b

Bit	Function
0	Counter mode 0 = Loop: If warning is enabled by bit 1, it stays active only for 10 seconds 1 = Saturate: If warning is enabled by bit 1, it stays active until reset
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning is given when the limit is reached
2	Count rising edge 0 = Disable: Rising edges are not counted 1 = Enable: Rising edges are counted
3	Count falling edge 0 = Disable: Falling edges are not counted 1 = Enable: Falling edges are counted
4…15	Reserved

33.43	Edge counter 2 source	Selects the signal to be monitored by signal edge counter 2.	FALSE
	FALSE	0.	0
	TRUE	1.	1
	RO1	Bit 0 of 10.21 RO status (page 58).	2
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
33.44	Edge counter 2 divider	Divisor for signal edge counter 2. Determines how many signal edges increment the counter by 1.	1
	0…4294967295	Divisor for signal edge counter 2.	1 = 1
33.45	Edge counter 2 warning select	Selects the warning message for signal edge counter 2.	Edge counter 2
	Edge counter 2	Pre-selectable warning message for signal edge counter 2.	3
	Main contactor	Pre-selectable warning message for signal edge counter 2.	11
	Output relay	Pre-selectable warning message for signal edge counter 2.	12
	Motor starts	Pre-selectable warning message for signal edge counter 2.	13
	Power ups	Pre-selectable warning message for signal edge counter 2.	14
	DC-charge	Pre-selectable warning message for signal edge counter 2.	15
33.50	Value counter 1 actual	Reading of value counter 1. Can be reset on the control panel by keeping Reset depressed for over 3 seconds.	-
	-2147483648 … 2147483647	Reading of value counter 1.	1 = 1

No.	Name/Value	Description	Def/FbEq
33.51	Value counter 1 limit	Sets the warning limit for value counter 1.	0
	-2147483648 … 2147483647	Warning limit for value counter 1.	1 = 1
33.52	Value counter 1 function	Configures value counter 1. This counter measures, by integration, the area below the signal selected by parameter 33.53 Value counter 1 source. A divisor may be applied to the count (see 33.54 Value counter 1 divider). When the total area exceeds the limit set by parameter 33.51 Value counter 1 limit, the warning specified by 33.55 Value counter 1 warning select is given (if enabled by this parameter). The signal is sampled at 1-second intervals. Note that the scaled (see the “FbEq” column at the signal in question) value is used. The current value of the counter is readable from parameter 33.50 Value counter 1 actual. Bit 4 of 33.01 Counter status indicates that the count has exceeded the limit.	00b

Bit	Function
0	Counter mode 0 = Loop: If warning is enabled by bit 1, it stays active only for 10 seconds 1 = Saturate: If warning is enabled by bit 1, it stays active until reset
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning is given when the limit is reached
2…15	Reserved

33.53	Value counter 1 source	Selects the signal to be monitored by value counter 1.	NULL
	NULL	None.	0
	Speed rpm	01.01 Motor speed used (see page 50).	1
	Other	The value is taken from another parameter.	-
33.54	Value counter 1 divider	Divisor for value counter 1. The value of the monitored signal is divided by this value before integration.	1.000
	0.001 … 2147483.647	Divisor for value counter 1.	1000 = 1
33.55	Value counter 1 warning select	Selects the warning message for value counter 1.	Value 1
	Value 1	Pre-selectable warning message for value counter 1.	4
	Motor bearing	Pre-selectable warning message for value counter 1.	10
33.60	Value counter 2 actual	Reading of value counter 2. Can be reset on the control panel by keeping Reset depressed for over 3 seconds.	-
	-2147483648 … 2147483647	Reading of value counter 2.	1 = 1
33.61	Value counter 2 limit	Sets the warning limit for value counter 2.	0
	-2147483648 … 2147483647	Warning limit for value counter 2.	1 = 1

No.	Name/Value	Description	Def/FbEq
33.62	Value counter 2 function	Configures value counter 2. This counter measures, by integration, the area below the signal selected by parameter 33.63 Value counter 2 source. A divisor may be applied to the count (see 33.64 Value counter 2 divider). When the total area exceeds the limit set by parameter 33.61 Value counter 2 limit, the warning specified by 33.65 Value counter 2 warning select is given (if enabled by this parameter). The signal is sampled at 1-second intervals. Note that the scaled (see the "FbEq" column at the signal in question) value is used. The current value of the counter is readable from parameter 33.60 Value counter 2 actual. Bit 5 of 33.01 Counter status indicates that the count has exceeded the limit.	00b

Bit	Function
0	Counter mode 0 = Loop: If warning is enabled by bit 1, it stays active only for 10 seconds 1 = Saturate: If warning is enabled by bit 1, it stays active until reset
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning is given when the limit is reached
2…15	Reserved

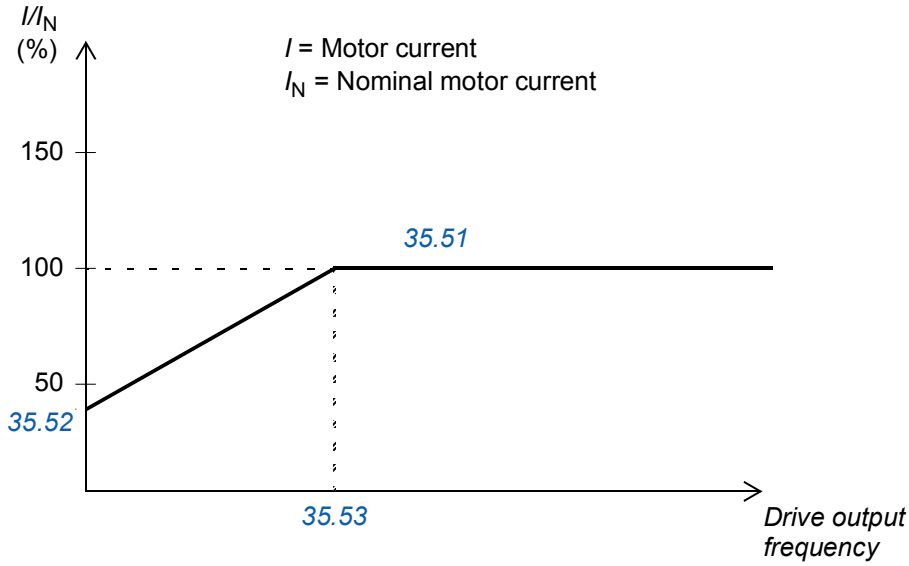
33.63	Value counter 2 source	Selects the signal to be monitored by value counter 2.	NULL
	NULL	None.	0
	Motor speed	01.01 Motor speed used (see page 50).	1
	Other	The value is taken from another parameter.	-
33.64	Value counter 2 divider	Divisor for value counter 2. The value of the monitored signal is divided by this value before integration.	1.000
	0.001 … 2147483.647	Divisor for value counter 1.	1000 = 1
33.65	Value counter 2 warning select	Selects the warning message for value counter 2.	Value 2
	Value 2	Pre-selectable warning message for value counter 2.	5
	Motor bearing	Pre-selectable warning message for value counter 2.	10

35 Motor thermal protection		Motor thermal protection settings. See also section Thermal motor protection (page 40).	
35.01	Motor estimated temperature	Displays the motor temperature in degrees Celsius as estimated by the thermal motor protection model (see parameters 35.50…35.55). This parameter is read-only.	-
	-60 … 1000 °C	Estimated motor temperature.	1 = 1 °C
35.02	Measured temperature 1	Displays the temperature received through the source defined by parameter 35.11 Supervision 1 source. This parameter is read-only.	-
	-10 … 1000 °C	Measured temperature 1.	

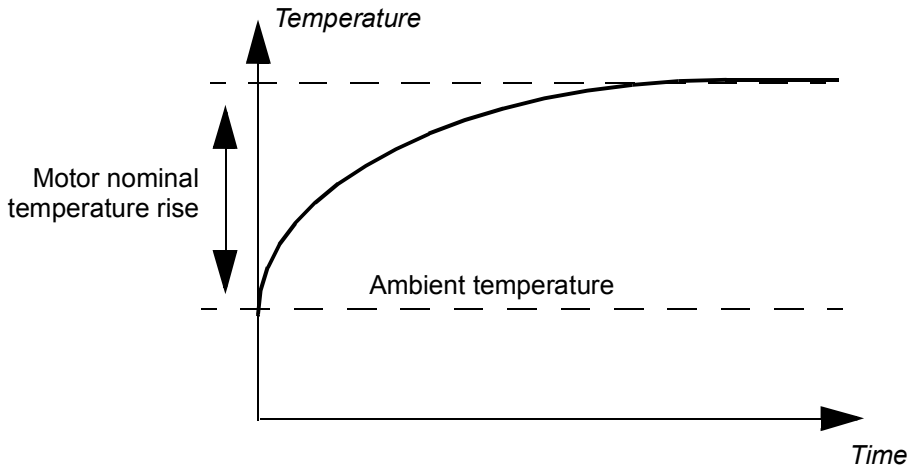
No.	Name/Value	Description	Def/FbEq
35.03	Measured temperature 2	Displays the temperature received through the source defined by parameter 35.21 Supervision 2 source. This parameter is read-only.	-
	-10 … 1000 °C	Measured temperature 2.	
35.10	Supervision 1 protection	Defines the action taken by the drive when measured temperature 1 (parameter 35.02) exceeds the appropriate limits set by parameters 35.12 Supervision 1 fault limit and 35.13 Supervision 1 warning limit.	No
	No	No action.	0
	Warning	Warning A491 External temperature is generated when measured temperature 1 exceeds the limit set by parameter 35.13 Supervision 1 warning limit.	1
	Fault	Warning A491 External temperature is generated when measured temperature 1 exceeds the limit set by parameter 35.13 Supervision 1 warning limit. The drive trips on fault 4981 External temperature when measured temperature 1 exceeds the limit set by parameter 35.12 Supervision 1 fault limit.	2
35.11	Supervision 1 source	Selects the source from which measured temperature 1 is read.	Estimated temperature
	Disabled	None. Temperature supervision 1 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter 35.01 Motor estimated temperature).	1
	KTY84 StdIO / Extension module	Reserved.	2
	KTY84 Adapter 1	Reserved.	3
	KTY84 Adapter 2	Reserved.	4
	PT100 x1 StdIO	Reserved.	5
	PT100 x2 StdIO	Reserved.	6
	PT100 x3 StdIO	Reserved.	7
	PTC DI6	A PTC sensor connected to digital input DI6.	8
	PTC Adapter 1	Reserved.	9
	PTC Adapter 2	Reserved.	10
35.12	Supervision 1 fault limit	Defines the fault limit for temperature supervision 1. See parameter 35.10 Supervision 1 protection.	110 °C
	-10 … 1000 °C	Fault limit for temperature supervision 1.	1 = 1 °C
35.13	Supervision 1 warning limit	Defines the warning limit for temperature supervision 1. See parameter 35.10 Supervision 1 protection.	90 °C
	-10 … 1000 °C	Warning limit for temperature supervision 1.	1 = 1 °C
35.14	Supervision 1 AI select	Selects the input for parameter 35.10 Supervision 1 protection, selections KTY84 StdIO / Extension module, PT100 x1 StdIO, PT100 x2 StdIO and PT100 x3 StdIO.	Estimated temperature
	NULL	None.	0
	AI1 actual value	Analog input AI1.	1
	AI2 actual value	Analog input AI2.	2
	Other (value)	The value is taken from another parameter.	-

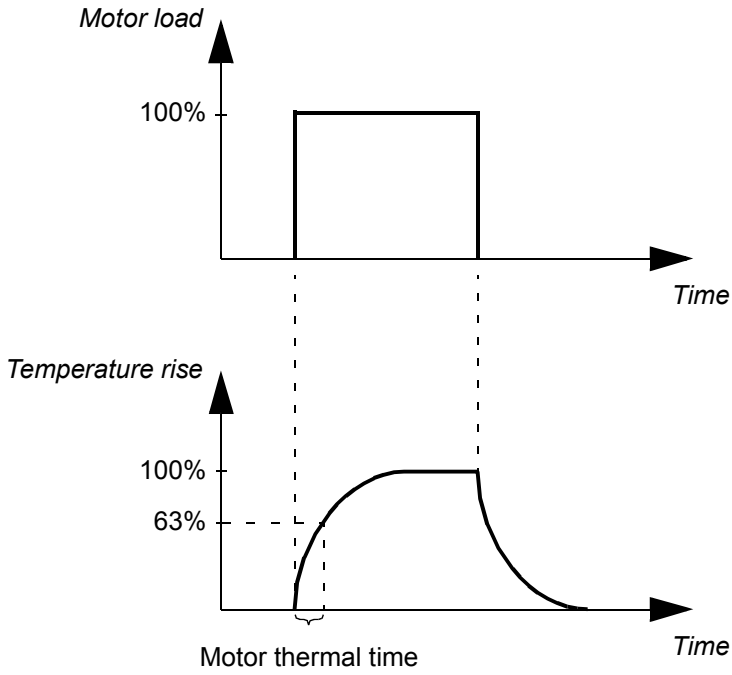
No.	Name/Value	Description	Def/FbEq
35.20	Supervision 2 protection	Defines the action taken by the drive when measured temperature 2 (parameter 35.03) exceeds the appropriate limits set by parameters 35.22 Supervision 2 fault limit and 35.23 Supervision 2 warning limit.	Estimated temperature
	No	No action.	0
	Warning	Warning A491 External temperature is generated when measured temperature 1 exceeds the limit set by parameter 35.23 Supervision 2 warning limit.	1
	Fault	Warning A491 External temperature is generated when measured temperature 1 exceeds the limit set by parameter 35.23 Supervision 2 warning limit. The drive trips on fault 4981 External temperature when measured temperature 1 exceeds the limit set by parameter 35.22 Supervision 2 fault limit.	2
35.21	Supervision 2 source	Selects the source from which measured temperature 2 is read.	
	Disabled	None. Temperature supervision 2 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter 35.01 Motor estimated temperature).	1
	KTY84 StdIO / Extension module	Reserved.	2
	KTY84 Adapter 1	Reserved.	3
	KTY84 Adapter 2	Reserved.	4
	PT100 x1 StdIO	Reserved.	5
	PT100 x2 StdIO	Reserved.	6
	PT100 x3 StdIO	Reserved.	7
	PTC DI6	A PTC sensor connected to digital input DI6.	8
	PTC Adapter 1	Reserved.	9
	PTC Adapter 2	Reserved.	10
35.22	Supervision 2 fault limit	Defines the fault limit for temperature supervision 2. See parameter 35.20 Supervision 2 protection.	110 °C
	-10 … 1000 °C	Fault limit for temperature supervision 2.	1 = 1 °C
35.23	Supervision 2 warning limit	Defines the warning limit for temperature supervision 2. See parameter 35.20 Supervision 2 protection.	90 °C
	-10 … 1000 °C	Warning limit for temperature supervision 2.	1 = 1 °C
35.24	Supervision 2 AI select	Selects the input for parameter 35.20 Supervision 2 protection, selections KTY84 StdIO / Extension module, PT100 x1 StdIO, PT100 x2 StdIO and PT100 x3 StdIO.	NULL
	NULL	None.	0
	AI1 actual value	Analog input AI1.	1
	AI2 actual value	Analog input AI2.	2
	Other (value)	The value is taken from another parameter.	-

No.	Name/Value	Description	Def/FbEq
35.50	Motor ambient temperature	Defines the ambient temperature of the motor (in °C) for the motor thermal protection model. The motor thermal protection model estimates the motor temperature on the basis of the parameters in this group. 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 (if the motor is overheated). **WARNING!** The model cannot protect the motor if it does not cool properly because of dust, dirt, etc.	20 °C
	-60 … 100 °C	Ambient temperature.	1 = 1 °C
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 equal to 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.	100%
	50 … 150%	Maximum load for the motor load curve.	1 = 1%
35.52	Zero speed load	Defines the motor load curve together with parameters 35.51 Motor load curve and 35.53 Break point. Defines the maximum motor load at zero speed of the load curve. A higher value can be used if the motor has an external motor fan to boost the cooling. See the motor manufacturer's recommendations. See parameter 35.51 Motor load curve.	
	50 … 150%	Zero speed load for the motor load curve.	1 = 1%



No.	Name/Value	Description	Def/FbEq
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 i.e. 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.	
	1.00 … 500.00 Hz	Break point for the motor load curve.	100 = 1 Hz
35.54	Motor nominal temp rise	Defines the temperature rise of the motor when the motor is loaded with nominal current. See the motor manufacturer's recommendations.	
	0 … 300 °C	Temperature rise.	1 = 1 °C



No.	Name/Value	Description	Def/FbEq
35.55	Motor thermal time const	Defines the thermal time constant for the motor thermal protection model (i.e. time inside which the temperature has reached 63% of the nominal temperature). See the motor manufacturer's recommendations. 	
	100 … 10000 s	Motor thermal time constant.	1 = 1 s

40 Process PID set1		Parameter values for process PID control. Two different sets of parameter values can be pre-defined. The first set is made up of parameters 40.07…40.56*, the second set is defined by the parameters in group 41 Process PID set2. The binary source that defines which set is used is selected by parameter 40.57 Sel between set1 set2. See also the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). *The remaining parameters in this group are common for both sets.	
40.01	Process PID actual value	Displays the output of the process PID controller. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only. The unit is selected by parameter 40.12 Unit selection.	-
	-32768 … 32767	Process PID controller output.	1 = 1 unit
40.02	Feedback actual value	Displays the value of process feedback after source selection, mathematical function (parameter 40.10 Feedback function), and filtering. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only. The unit is selected by parameter 40.12 Unit selection.	-
	-2147483648 … 2147483647	Process feedback.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq
40.03	Setpoint actual value	Displays the value of process PID setpoint after source selection, mathematical function (40.18 Setpoint function), limitation and ramping. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only. The unit is selected by parameter 40.12 Unit selection.	-
	-2147483648 … 2147483647	Setpoint for process PID controller.	1 = 1 unit
40.04	Deviation actual value	Displays the process PID deviation. By default, this value equals setpoint - feedback, but deviation can be inverted by parameter 40.31 Deviation inversion. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only. The unit is selected by parameter 40.12 Unit selection.	-
	-2147483648 … 2147483647	PID deviation.	1 = 1 unit
40.05	Trim output actual value	Displays the trimmed reference output. See section Trimming (page 38), and the control chain diagrams in chapter Control chain and drive logic diagrams (page 241). This parameter is read-only. The unit is selected by parameter 40.12 Unit selection.	-
	-2147483648 … 2147483647	Trimmed reference.	1 = 1 unit
40.06	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	Trim mode	1 = Trim function active.
6	Tracking mode	1 = Tracking function active.
7	Output limit high	1 = PID output is being limited by par. 40.37.
8	Output limit low	1 = PID output is being limited by par. 40.36.
9	Deadband active	1 = Deadband active (see par. 40.39)
10	PID set	0 = Parameter set 1 in use. 1 = Parameter set 2 in use.
11	PID preset requested	0 = Parameter set 1 requested. 1 = Parameter set 2 requested.
12…15	Reserved	

40.07	PID operation mode	Activates/deactivates process PID control.	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/FbEq
40.08	Feedback 1 source	Selects the first source of process feedback. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241).	AI1 scaled
	Zero	Zero feedback.	0
	AI1 scaled	12.12 AI1 scaled value (see page 66).	1
	AI2 scaled	12.22 AI2 scaled value (see page 67).	2
	Freq in scaled	11.39 Freq in 1 scaled (see page 63).	3
	Motor current	01.07 Motor current (see page 50).	5
	Power inu out	01.14 Output power (see page 50).	6
	Motor torque	01.10 Motor torque % (see page 50).	7
	Other (value)	The value is taken from another parameter.	-
40.09	Feedback 2 source	Selects the second source of process feedback. For the selections, see parameter 40.08 Feedback 1 source.	Zero
40.10	Feedback function	Defines how process feedback is calculated from the two sources selected by parameters 40.08 Feedback 1 source and 40.09 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	Feedback filter time	Defines the filter time constant for process feedback.	0.000 s
	0.000 … 30.000 s	Feedback filter time.	10 = 1 s
40.12	Unit selection	Defines the unit for parameters 40.01…40.05, 40.21…40.24 and 40.47.	RPM
	RPM	rpm.	0
	%	%.	1
	Hz	Hz.	2

No.	Name/Value	Description	Def/FbEq
40.14	Setpoint base	Defines, together with parameter 40.15 Output base, a general scaling factor for the process PID control chain. The scaling can be utilized when, for example, the process setpoint is input in Hz, and the output of the PID controller is used as an rpm value in speed control. In this case, this parameter might be set to 50, and parameter 40.15 to the nominal motor speed at 50 Hz. In effect, the output of the PID controller = [40.15] when deviation (setpoint - feedback) = [40.14] and [40.15] = 1. **Note:** The scaling is based on the ratio between 40.14 and 40.15. For example, the values 50 and 1500 would produce the same scaling as 1 and 30.	1500
	-2147483648 … 2147483647	Process setpoint base.	1 = 1
40.15	Output base	See parameter 40.14 Setpoint base.	1500
	-2147483648 … 2147483647	Process PID controller output base.	1 = 1
40.16	Setpoint 1 source	Selects the first source of process PID setpoint. This setpoint is available in parameter 40.25 Setpoint selection as setpoint 1. See the control chain diagrams in chapter Control chain and drive logic diagrams (page 241).	AI2 scaled
	Zero	Zero.	0
	Control panel	03.01 Panel reference (see page 50).	1
	Internal setpoint	Internal setpoint. See parameter 40.19 Internal setpoint selection 1.	2
	AI1 scaled	12.12 AI1 scaled value (see page 66).	3
	AI2 scaled	12.22 AI2 scaled value (see page 67).	4
	Freq in scaled	11.39 Freq in 1 scaled (see page 63).	10
	Other (value)	The value is taken from another parameter.	-
40.17	Setpoint 2 source	Selects the second source of process setpoint. This setpoint is available in parameter 40.25 Setpoint selection as setpoint 2. For the selections, see parameter 40.16 Setpoint 1 source.	Zero
40.18	Setpoint function	Selects a mathematical function between the setpoint sources selected by parameters 40.16 Setpoint 1 source and 40.17 Setpoint 2 source.	In1 or In2
	In1 or In2	No mathematical function applied. The source selected by parameter 40.25 Setpoint selection is used.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3
	In1/In2	Source 1 divided by source 2.	4
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6
	AVE(In1,In2)	Average of the two sources.	7
	sqrt(In1)	Square root of source 1.	8
	sqrt(In1-In2)	Square root of (source 1 - source 2).	9
	sqrt(In1+In2)	Square root of (source 1 + source 2).	10

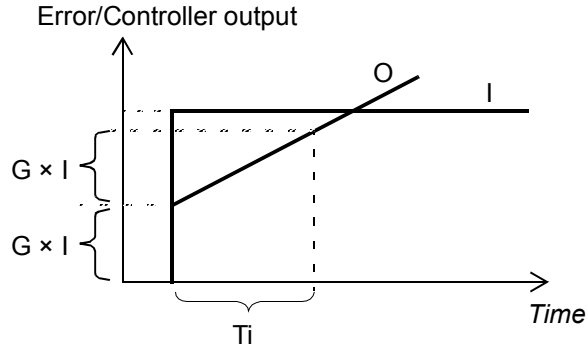
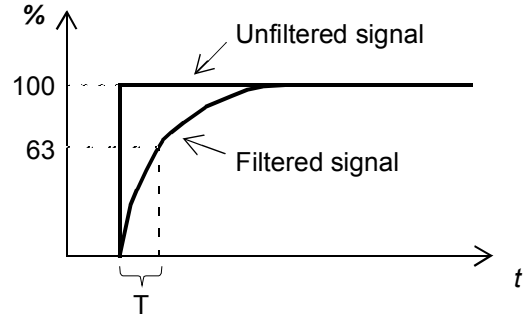
No.	Name/Value	Description	Def/FbEq
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
40.19	*Internal setpoint selection 1*	Selects, together with *40.20 Internal setpoint selection 2*, the internal setpoint out of the presets defined by parameters *40.19*…*40.24*.	*Not selected*

Source defined by par. ***40.19***	Source defined by par. ***40.20***	Setpoint preset active
0	0	1 (par. ***40.21***)
1	0	2 (par. ***40.22***)
0	1	3 (par. ***40.23***)
1	1	4 (par. ***40.24***)

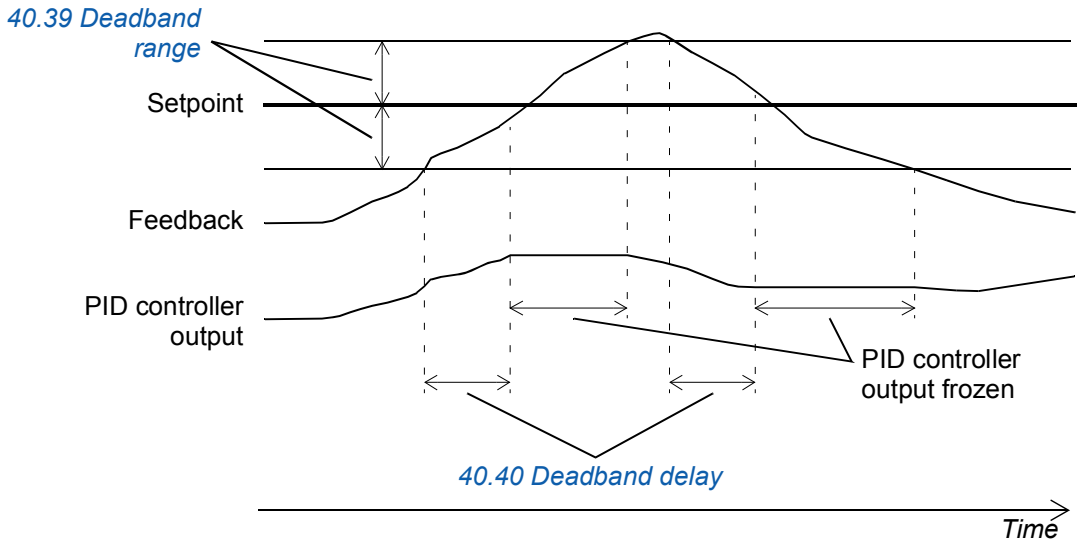
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
40.20	*Internal setpoint selection 2*	Selects, together with *40.19 Internal setpoint selection 1*, the internal setpoint out of the presets defined by parameters *40.19*…*40.24*. See table at *40.19 Internal setpoint selection 1*.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-

No.	Name/Value	Description	Def/FbEq
40.21	Internal setpoint 1	Process setpoint preset 1. See parameter 40.19 Internal setpoint selection 1. The unit is selected by parameter 40.12 Unit selection.	0
	-2147483648 … 2147483647	Process setpoint preset 1.	1 = 1 unit
40.22	Internal setpoint 2	Process setpoint preset 2. See parameter 40.19 Internal setpoint selection 1. The unit is selected by parameter 40.12 Unit selection.	0
	-2147483648 … 2147483647	Process setpoint preset 2.	1 = 1 unit
40.23	Internal setpoint 3	Process setpoint preset 3. See parameter 40.19 Internal setpoint selection 1. The unit is selected by parameter 40.12 Unit selection.	0
	-2147483648 … 2147483647	Process setpoint preset 3.	1 = 1 unit
40.24	Internal setpoint 4	Process setpoint preset 4. See parameter 40.19 Internal setpoint selection 1. The unit is selected by parameter 40.12 Unit selection.	0
	-2147483648 … 2147483647	Process setpoint preset 4.	1 = 1 unit
40.25	Setpoint selection	Configures the selection between setpoint sources 1 (40.16) and 2 (40.17). This parameter is only effective when parameter 40.18 Setpoint function is set to In1 or In2. 0 = Setpoint source 1 1 = Setpoint source 2	Off
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	4
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	5
	DI5	Digital input DI5 (as indicated by 10.01 DI status, bit 4).	6
	DI6	Digital input DI6 (as indicated by 10.01 DI status, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by 11.01 DIO status, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by 11.01 DIO status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
40.26	Setpoint min	Defines a minimum limit for the process PID controller setpoint.	0.0
	-32767.0 … 32767.0	Minimum limit for process PID controller setpoint.	10 = 1
40.27	Setpoint max	Defines a maximum limit for the process PID controller setpoint.	32767.0
	-32767.0 … 32767.0	Maximum limit for process PID controller setpoint.	1 = 1

No.	Name/Value	Description	Def/FbEq
40.28	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.	10 = 1
40.29	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.	10 = 1
40.30	Setpoint freeze enable	Freezes, or defines a source that can be used to freeze, the setpoint of the process PID controller. This ture 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 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 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	4
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	5
	DI5	Digital input DI5 (as indicated by 10.01 DI status, bit 4).	6
	DI6	Digital input DI6 (as indicated by 10.01 DI status, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by 11.01 DIO status, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by 11.01 DIO status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
40.31	Deviation inversion	Inverts the input of the process PID controller. 0 = Setpoint - Feedback 1 = Feedback - Setpoint	Ref - Fbk
	Ref - Fbk	0.	0
	Fbk - Ref	1.	1
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
40.32	Gain	Defines the gain for the process PID controller. See parameter 40.33 Integration time.	1.0
	0.1 … 100.0	Gain for PID controller.	10 = 1

No.	Name/Value	Description	Def/FbEq
40.33	*Integration time*	Defines the integration time for the process PID controller.  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 … 3600.0 s	Integration time.	10 = 1 s
40.34	*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.	0.0 s
	0.0 … 10.0 s	Derivation time.	10 = 1 s
40.35	*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/FbEq
40.36	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.	-32767.0
	-32767.0 … 32767.0	Minimum limit for process PID controller output.	1 = 1
40.37	Output max	Defines the maximum limit for the process PID controller output. See parameter 40.36 Output min.	32767.0
	-32767.0 … 32767.0	Maximum limit for process PID controller output.	1 = 1
40.38	Output freeze enable	Freezes, or defines a source that can be used to freeze, the output of the process PID controller. 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 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 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	4
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	5
	DI5	Digital input DI5 (as indicated by 10.01 DI status, bit 4).	6
	DI6	Digital input DI6 (as indicated by 10.01 DI status, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by 11.01 DIO status, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by 11.01 DIO status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-

No.	Name/Value	Description	Def/FbEq
40.39	Deadband range	Defines a deadband around the setpoint. Whenever process feedback enters the deadband, a delay timer starts. If the feedback remains within the deadband longer than the delay (40.40 Deadband delay), the PID controller output is frozen. Normal operation resumes after the feedback value leaves the deadband.	0.0
			
	0 … 32767.0	Deadband range.	10 = 1
40.40	Deadband delay	Delay for the deadband. See parameter 40.39 Deadband range.	0.0 s
	0.0 … 3600.0 s	Delay for deadband area.	10 = 1 s
40.41	Sleep mode	Selects the mode of the sleep function. See also section Sleep function for process PID control (page 34).	No
	No	Sleep function disabled.	0
	Internal	The motor speed is compared to the value of 40.43 Sleep level. If the motor speed remains below this value longer than the sleep delay (40.44 Sleep delay), the drive enters sleep mode. Parameters 40.44…40.48 are in force.	1
	External	The sleep function is activated by the source selected by parameter 40.42 Sleep enable. Parameters 40.44…40.48 are in force.	2
40.42	Sleep enable	Defines a source that is used to activate the sleep function when parameter 40.41 Sleep mode is set to External. 0 = Sleep function disabled 1 = Sleep function activated	Off
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	4
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	5
	DI5	Digital input DI5 (as indicated by 10.01 DI status, bit 4).	6

No.	Name/Value	Description	Def/FbEq
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
40.43	*Sleep level*	Defines the start limit for the sleep function when parameter *40.41 Sleep mode* is set to *Internal*.	0.0
	0.0 … 32767.0	Sleep start level.	10 = 1
40.44	*Sleep delay*	Defines a delay for the sleep function. The delay timer starts when the sleep condition selected by parameter *40.41 Sleep mode* becomes true, and resets if the condition becomes false.	60.0 s
	0.0 … 3600.0 s	Sleep start delay.	10 = 1 s
40.45	*Sleep boost time*	Defines a boost time for the sleep boost step. See parameter *40.46 Sleep boost step*.	0.0 s
	0.0 … 3600.0 s	Sleep boost time.	10 = 1 s
40.46	*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 Sleep boost time*. If active, sleep boost is aborted when the drive wakes up.	0.0
	0.0 … 32767.0	Sleep boost step.	10 = 1
40.47	*Wake-up deviation*	Defines the wake-up level as deviation between process setpoint and feedback. The unit is selected by parameter *40.12 Unit selection*. When the deviation exceeds the value of this parameter, and remains there for the duration of the wake-up delay (*40.48 Wake up delay*), the drive wakes up. See also parameter *40.31 Deviation inversion*.	0
	-2147483648 … 2147483647	Wake-up level (as deviation between process setpoint and feedback).	1 = 1 unit
40.48	*Wake up delay*	Defines a wake-up delay for the sleep function. See parameter *40.47 Wake-up deviation*. The delay timer starts when the deviation exceeds the wake-up level (*40.47 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.	100 = 1 s
40.49	*Tracking mode*	Activates (or selects a source that activates) tracking mode. In tracking mode, the value selected by parameter *40.50 Tracking ref selection* is substituted for the PID controller output. 1 = Tracking mode enabled	*Off*
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6

No.	Name/Value	Description	Def/FbEq
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
40.50	*Tracking ref selection*	Selects the value source for tracking mode. See parameter *40.49 Tracking mode*.	*Zero*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *66*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *67*).	2
	FB A ref1	Fieldbus adapter A reference 1.	3
	FB A ref2	Fieldbus adapter A reference 2.	4
	Other	The value is taken from another parameter.	-
40.51	*Trim mode*	Activates the trim function and selects between direct and proportional trimming (or a combination of both). With trimming, it is possible to apply a corrective factor to the drive reference (setpoint). The output after trimming is available as parameter *40.05 Trim output actual value*. See the control chain diagrams in chapter *Control chain and drive logic diagrams* (page *241*).	*Off*
	Off	The trim function is inactive.	0
	Direct	The trim function is active. The trimming factor is relative to the maximum speed, torque or frequency; the selection between these is made by parameter *40.52 Trim selection*.	1
	Proportional	The trim function is active. The trimming factor is relative to the reference selected by parameter *40.53 Trimmed ref pointer*.	2
	Combined	The trim function is active. The trimming factor is a combination of both *Direct* and *Proportional* modes; the proportions of each are defined by parameter *40.54 Trim mix*.	3
40.52	*Trim selection*	Selects whether trimming is used for correcting the speed, torque or frequency reference.	*Torque*
	Torque	Torque reference trimming.	1
	Speed	Speed reference trimming.	2
	Frequency	Frequency reference trimming.	3
40.53	*Trimmed ref pointer*	Selects the signal source for the trim reference.	*Zero*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *66*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *67*).	2
	FB A ref1	Fieldbus adapter A reference 1.	3
	FB A ref2	Fieldbus adapter A reference 2.	4
	Other	The value is taken from another parameter.	-

No.	Name/Value	Description	Def/FbEq
40.54	Trim mix	When parameter 40.51 Trim mode is set to Combined, defines the effect of direct and proportional trim sources in the final trimming factor. 0.000 = 100% proportional 0.500 = 50% proportional, 50% direct 1.000 = 100% direct	0.000
	0.000 … 1.000	Trim mix.	100 = 1
40.55	Trim adjust	Defines a multiplier for the trimming factor. This value is multiplied by the result of parameter 40.51 Trim mode. Consequently, the result of the multiplication is used to multiply the result of parameter 40.56 Correction source.	1.000
	-100.000 … 100.000	Multiplier for trimming factor.	1000 = 1
40.56	Correction source	Selects the reference to be trimmed.	PID ref
	PID ref	PID setpoint.	1
	PID output	PID controller output.	2
40.57	Sel between set1 set2	Selects the source that determines whether process PID parameter set 1 (parameters 40.07…40.56) or set 2 (group 41 Process PID set2) 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 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	4
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	5
	DI5	Digital input DI5 (as indicated by 10.01 DI status, bit 4).	6
	DI6	Digital input DI6 (as indicated by 10.01 DI status, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by 11.01 DIO status, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by 11.01 DIO status, bit 1).	11
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-

41 Process PID set2	A second set of parameter values for process PID control. The selection between this set and first set (parameter group 40 Process PID set1) is made by parameter 40.57 Sel between set1 set2. See also parameters 40.01…40.06, and the control chain diagrams in chapter Control chain and drive logic diagrams (page 241).	
41.07	PID operation mode	See parameter 40.07 PID operation mode.	Off
41.08	Feedback 1 source	See parameter 40.08 Feedback 1 source.	AI1 scaled
41.09	Feedback 2 source	See parameter 40.09 Feedback 2 source.	Zero
41.10	Feedback function	See parameter 40.10 Feedback function.	In1
41.11	Feedback filter time	See parameter 40.11 Feedback filter time.	0.000 s

No.	Name/Value	Description	Def/FbEq
41.12	Unit selection	See parameter 40.12 Unit selection.	RPM
41.14	Setpoint base	See parameter 40.14 Setpoint base.	1500
41.15	Output base	See parameter 40.15 Output base.	1500
41.16	Setpoint 1 source	See parameter 40.16 Setpoint 1 source.	AI2 scaled
41.17	Setpoint 2 source	See parameter 40.17 Setpoint 2 source.	Zero
41.18	Setpoint function	See parameter 40.18 Setpoint function.	In1 or In2
41.19	Internal setpoint selection 1	See parameter 40.19 Internal setpoint selection 1.	Not selected
41.20	Internal setpoint selection 2	See parameter 40.20 Internal setpoint selection 2.	Not selected
41.21	Internal setpoint 1	See parameter 40.21 Internal setpoint 1.	0
41.22	Internal setpoint 2	See parameter 40.22 Internal setpoint 2.	0
41.23	Internal setpoint 3	See parameter 40.23 Internal setpoint 3.	0
41.24	Internal setpoint 4	See parameter 40.24 Internal setpoint 4.	0
41.25	Setpoint selection	See parameter 40.25 Setpoint selection.	Off
41.26	Setpoint min	See parameter 40.26 Setpoint min.	0.0
41.27	Setpoint max	See parameter 40.27 Setpoint max.	32767.0
41.28	Setpoint increase time	See parameter 40.28 Setpoint increase time.	0.0 s
41.29	Setpoint decrease time	See parameter 40.29 Setpoint decrease time.	0.0 s
41.30	Setpoint freeze enable	See parameter 40.30 Setpoint freeze enable.	Not selected
41.31	Deviation inversion	See parameter 40.31 Deviation inversion.	Ref - Fbk
41.32	Gain	See parameter 40.32 Gain.	1.0
41.33	Integration time	See parameter 40.33 Integration time.	60.0 s
41.34	Derivation time	See parameter 40.34 Derivation time.	0.0 s
41.35	Derivation filter time	See parameter 40.35 Derivation filter time.	0.0 s
41.36	Output min	See parameter 40.36 Output min.	-32767.0
41.37	Output max	See parameter 40.37 Output max.	32767.0
41.38	Output freeze enable	See parameter 40.38 Output freeze enable.	Not selected
41.39	Deadband range	See parameter 40.39 Deadband range.	0.0
41.40	Deadband delay	See parameter 40.40 Deadband delay.	0.0 s
41.41	Sleep mode	See parameter 40.41 Sleep mode.	No
41.42	Sleep enable	See parameter 40.42 Sleep enable.	Off
41.43	Sleep level	See parameter 40.43 Sleep level.	0.0
41.44	Sleep delay	See parameter 40.44 Sleep delay.	60.0 s
41.45	Sleep boost time	See parameter 40.45 Sleep boost time.	0.0 s
41.46	Sleep boost step	See parameter 40.46 Sleep boost step.	0.0
41.47	Wake-up deviation	See parameter 40.47 Wake-up deviation.	0
41.48	Wake up delay	See parameter 40.48 Wake up delay.	0.50 s
41.49	Tracking mode	See parameter 40.49 Tracking mode.	Off

No.	Name/Value	Description	Def/FbEq
41.50	Tracking ref selection	See parameter 40.50 Tracking ref selection.	Zero
41.51	Trim mode	See parameter 40.51 Trim mode.	Off
41.52	Trim selection	See parameter 40.52 Trim selection.	Torque
41.53	Trimmed ref pointer	See parameter 40.53 Trimmed ref pointer.	Zero
41.54	Trim mix	See parameter 40.54 Trim mix.	0.000
41.55	Trim adjust	See parameter 40.55 Trim adjust.	1.000
41.56	Correction source	See parameter 40.56 Correction source.	PID ref

43 Brake chopper		Settings of the internal brake chopper.	
43.01	Braking resistor temperature	Displays the estimated temperature of the braking resistor. 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. This parameter is read-only.	-
	0.0 … 120.0%	Estimated brake resistor temperature.	10 = 1%
43.06	Braking chopper enable	Enables brake chopper control. **Note:** Before enabling brake chopper control, ensure that a brake resistor is connected and overvoltage control is switched off (parameter 30.30 Overvoltage control).	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	Braking chopper runtime enable	Selects the source for quick run-time brake chopper 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 drive is operating in the generator mode.	Off
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
43.08	Brake resistor thermal tc	Defines the thermal time constant of the brake resistor for overload protection.	0 s
	0 … 100 s	Brake resistor thermal time constant.	1 = 1 s
43.09	Brake resistor Pmax cont	Defines the maximum continuous braking power which will raise the resistor temperature to the maximum allowed value. The value is used in the overload protection.	0.00 kW
	0.10 … 10000.00 kW	Maximum continuous braking power.	100 = 1 kW
43.10	Brake resistance	Defines the resistance value of the brake resistor. The value is used for brake chopper protection.	0 ohm
	0…1000 ohm	Brake resistor resistance value.	1 = 1 ohm

No.	Name/Value	Description	Def/FbEq
43.11	Brake resistor fault limit	Selects the fault limit for the brake resistor temperature supervision. 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 supervision. 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 35).	
44.01	Brake control status	Displays the mechanical brake 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	1 = Request for opening torque is active
2	Hold stopped request	1 = Hold requested while brake is opening
3	Ramp to stopped	xxxxx
4	Enabled	1 = Brake control is enabled
5	Closed	1 = Brake control logic in BrakeClosed state
6	Opening	1 = Brake control logic in BrakeOpening state
7	Open	1 = Brake control logic in BrakeOpen state
8	Closing	1 = Brake control logic in BrakeClosing state
9…15	Reserved	

44.02	Brake torque memory	Torque (in percent). Memorized when a brake close command is issued.	-
	0…100%	Torque at brake closure.	1 = 1%
44.03	Brake open torque reference	Displays the currently active brake open torque. See parameters 44.09 Brake open torque source and 44.10 Brake open torque. This parameter is read-only.	-
	-2147483648 … 2147483647%	Currently active brake open torque.	10 = 1%
44.06	Brake control enable	Activates/deactivates (or selects a source that activates/deactivates) the brake control function. 0 = Brake control inactive 1 = Brake control active	Off
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by 10.01 DI status, bit 0).	2

No.	Name/Value	Description	Def/FbEq
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
44.07	*Brake acknowledge selection*	Activates (and selects the source for) brake open/closed supervision. When a brake control error (unexpected state of the acknowledgement signal) is detected, the drive reacts as defined by parameter *44.17 Brake fault function*. 0 = Brake open 1 = Brake closed	*No acknowledge*
	Off	0.	0
	On	1.	1
	No acknowledge	Brake open/closed supervision disabled.	2
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	3
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	4
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	5
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	6
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	7
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	8
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	11
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
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 and increased the motor torque to the level required for brake release (parameter *44.09 Brake open torque source*). 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
44.09	*Brake open torque source*	Selects the source for the “brake open” torque value (motor starting torque at brake release). See also parameter *44.10 Brake open torque*.	*Brake open torque*
	Zero	Zero.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *66*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *67*).	2

No.	Name/Value	Description	Def/FbEq
	FBA ref1	Fieldbus adapter A reference 1.	3
	FBA ref2	Fieldbus adapter A reference 2.	4
	Brake torque memory	Parameter *44.02 Brake torque memory*.	7
	Brake open torque	Parameter *44.10 Brake open torque*.	8
	Other	The value is taken from another parameter.	-
44.10	*Brake open torque*	Defines the motor starting torque at brake release (in percent of motor nominal torque) when parameter parameter *44.09 Brake open torque source* is set to *Brake open torque*. **Note:** If different from 0, this value overrides the setting of parameter parameter *44.09 Brake open torque source*.	0%
	-1000 … 1000%	Motor starting torque at brake release.	1 = 1%
44.11	*Force brake closed*	Selects a source that holds the open command, in effect keeping the brake closed. 0 = Normal brake operation 1 = Hold “open brake” command **Note:** This parameter cannot be changed while the drive is running.	*Off*
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
44.12	*Brake close request*	Selects the source for brake close/open request. 0 = Request brake open 1 = Request brake close **Note:** This parameter cannot be changed while the drive is running.	*Off*
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (as indicated by *10.01 DI status*, bit 0).	2
	DI2	Digital input DI2 (as indicated by *10.01 DI status*, bit 1).	3
	DI3	Digital input DI3 (as indicated by *10.01 DI status*, bit 2).	4
	DI4	Digital input DI4 (as indicated by *10.01 DI status*, bit 3).	5
	DI5	Digital input DI5 (as indicated by *10.01 DI status*, bit 4).	6
	DI6	Digital input DI6 (as indicated by *10.01 DI status*, bit 5).	7
	DIO1	Digital input/output DIO1 (as indicated by *11.01 DIO status*, bit 0).	10

No.	Name/Value	Description	Def/FbEq
	DIO2	Digital input/output DIO2 (as indicated by *11.01 DIO status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *49*).	-
44.13	*Brake close delay*	Specifies a delay e 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 remains below this level for the duration of the brake close level delay (*44.13 Brake close delay*), a close command is given.	10.0 rpm
	0.0 … 1000.0 rpm	Brake close speed.	10 = 1 rpm
44.15	*Brake close level delay*	Brake close level delay. See parameter *44.14 Brake close level*.	0.00 s
	0.00 … 10.00 s	Brake close level delay.	100 = 1 s
44.16	*Brake reopen delay*	Defines a minimum time between brake closure and a subsequent open command.	0.00 s
	0.00 … 10.00 s	Brake reopen delay.	100 = 1 s
44.17	*Brake fault function*	Determines how the drive reacts upon a mechanical brake control error. If brake supervision has been disabled by parameter *44.07 Brake acknowledge selection*, this parameter is not effective.	*Fault*
	Fault	The drive trips on a *71A2 Mechanical brake closing failed* / *71A3 Mechanical brake opening failed* fault if the status of the brake open/close signal does not match the status presumed by the brake control logic. The drive trips on a *71A5 Mechanical brake opening not allowed* fault if the brake open conditions cannot be fulfilled (for example, the required motor starting torque is not achieved).	0
	Warning	The drive generates a *A7A1 Mechanical brake closing failed* / *A7A2 Mechanical brake opening failed* warning if the status of the brake open/close signal does not match the status presumed by the brake control logic. The drive generates a *A7A5 Mechanical brake opening not allowed* warning if the brake open conditions cannot be fulfilled (for example, the required motor starting torque is not achieved).	1
	Open fault	The drive generates a *A7A1 Mechanical brake closing failed* warning (when closing the brake) and trips on a *71A3 Mechanical brake opening failed* fault (when opening the brake) if the status of the brake open/close signal does not match the status presumed by the brake control logic. The drive trips on a *71A5 Mechanical brake opening not allowed* fault if the brake open conditions cannot be fulfilled (for example, the required motor starting torque is not achieved).	2
44.18	*Brake fault delay*	Defines a close fault delay, ie. time between brake closure and brake close fault trip.	0.00 s
	0.00 … 60.00 s	Brake close fault delay.	100 = 1 s

No.	Name/Value	Description	Def/FbEq
45 Energy savings		Settings of the energy savings calculator. See also section *Energy savings calculator* (page 44).	
45.01	*Saved energy in GWh*	Energy saved in GWh compared to direct-on-line motor connection. This parameter is incremented when *45.02 Saved energy in MWh* rolls over. This parameter is read-only (see parameter *45.21 Reset savings*).	-
	0…65535 GWh	Energy savings in GWh.	1 = 1 GWh
45.02	*Saved energy in MWh*	Energy saved in MWh compared to direct-on-line motor connection. This parameter is incremented when *45.03 Saved energy in kWh* rolls over. When this parameter rolls over, parameter *45.01 Saved energy in GWh* is incremented. This parameter is read-only (see parameter *45.21 Reset savings*).	-
	0…999 MWh	Energy savings in MWh.	1 = 1 MWh
45.03	*Saved energy in kWh*	Energy saved in kWh compared to direct-on-line motor connection. If the internal braking chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat. When this parameter rolls over, parameter *45.02 Saved energy in MWh* is incremented. This parameter is read-only (see parameter *45.21 Reset savings*).	-
	0.0 … 999.9 kWh	Energy savings in kWh.	10 = 1 kWh
45.05	*Monetary savings in thousands*	Monetary savings in thousands compared to direct-on-line motor connection. This parameter is incremented when *45.06 Monetary savings* rolls over. The currency is defined by parameter *45.17 E tariff unit*. This parameter is read-only (see parameter *45.21 Reset savings*).	-
	0…4294967295 thousands	Monetary savings in thousands of units.	1 = 1 thousand
45.06	*Monetary savings*	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 Select used tariff*). When this parameter rolls over, parameter *45.05 Monetary savings in thousands* is incremented. The currency is defined by parameter *45.17 E tariff unit*. This parameter is read-only (see parameter *45.21 Reset savings*).	-
	0.00 … 999.00 units	Monetary savings.	100 = 1 unit

No.	Name/Value	Description	Def/FbEq
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 Select used tariff). The currency is defined by parameter 45.17 E tariff unit. A scaling factor can be set by parameter 45.20 Units for savings. This parameter is read-only (see parameter 45.21 Reset savings).	-
	0.00 … 21474836.47 units	Monetary savings.	100 = 1 unit
45.08	Saved CO2 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 Saved CO2 rolls over. This parameter is read-only (see parameter 45.21 Reset savings).	-
	0…65535 metric kilotons	Reduction in CO_2 emissions in metric kilotons.	1 = 1 metric kiloton
45.09	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). When this parameter rolls over, parameter 45.08 Saved CO2 in kilotons is incremented. This parameter is read-only (see parameter 45.21 Reset savings).	-
	0.0 … 999.9 metric tons	Reduction in CO_2 emissions in metric tons.	10 = 1 metric ton
45.10	Total saved CO2	Reduction in CO_2 emissions in metric tons (or kilotons; see par. 45.20) 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 Reset savings).	-
	0.0 … 214748364.7 metric tons or kilotons	Reduction in CO_2 emissions in metric tons.	10 = 1 metric ton or kiloton
45.11	Energy optimization	Enables/disables the energy optimization function. The function optimizes the 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…10% 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

No.	Name/Value	Description	Def/FbEq
45.12	Energy tariff 1	Defines energy tariff 1 (price of energy per kWh). Depending on the setting of parameter 45.14 Select used tariff, 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 E tariff unit. **Note:** Tariffs are read only at the instant of selection, and are not applied retroactively.	1000.000 units
	0.000 … 4294967295.000 units	Energy tariff 1.	1000 = 1 unit
45.13	Energy tariff 2	Defines energy tariff 2 (price of energy per kWh). See parameter 45.12 Energy tariff 1.	2000.000 units
	0.000 … 4294967295.000 units	Energy tariff 2.	1000 = 1 unit
45.14	Select used tariff	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 (as indicated by 10.01 DI status, bit 0).	2
	DI2	Digital input DI2 (as indicated by 10.01 DI status, bit 1).	3
	DI3	Digital input DI3 (as indicated by 10.01 DI status, bit 2).	4
	DI4	Digital input DI4 (as indicated by 10.01 DI status, bit 3).	5
	DI5	Digital input DI5 (as indicated by 10.01 DI status, bit 4).	6
	DI6	Digital input DI6 (as indicated by 10.01 DI status, bit 5).	7
	Other [bit]	Source selection (see Terms and abbreviations on page 49).	-
45.17	E tariff unit	Specifies the currency used for the savings calculations.	EUR
	EUR	Euro.	101
	USD	US dollar.	102
	Local currency	The currency is determined by the language selection (see parameter 96.01 Language).	100
45.18	CO2 conversion factor	Defines a factor for conversion of saved energy into CO_2 emissions (kg/kWh or tn/MWh). For example, 45.10 Total saved CO2 = 45.02 Saved energy in MWh × 45.18 CO2 conversion factor (tn/MWh).	0.500 tn/MWh
	0.000 … 65.535 tn/MWh	Factor for conversion of saved energy into CO_2 emissions.	1000 = 1 tn/MWh
45.19	Reference power	Motor power when connected directly to the supply. 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.	-
	0.0 … 10000000.0 kW	Motor power.	10 = 1 kW

No.	Name/Value	Description	Def/FbEq
45.20	Units for savings	Specifies the scaling for parameters 45.07 Saved amount and 45.10 Total saved CO2.	Normal
	Normal	The unit of 45.07 Saved amount is the selected currency; the unit of 45.10 Total saved CO2 is metric tons.	1
	Normal x1000	The unit of 45.07 Saved amount is thousands of the selected currency; the unit of 45.10 Total saved CO2 is metric kilotons.	1000
45.21	Reset savings	Resets the savings counter parameters 45.01…45.10.	Done
	Done	Reset not requested (normal operation).	0
	Reset	Reset the savings counter parameters. The value reverts automatically to Done.	1
46 Monitoring/scaling settings		Speed supervision settings; actual signal filtering; general scaling settings.	
46.01	Above speed limit	Defines the supervision limit for actual speed. See also parameter 06.11 Main status word, bit 10.	0 rpm
	0 … 30000 rpm	Actual speed supervision limit.	1 = 1 rpm
46.03	At setpoint hysteresis	Defines the absolute value for the motor speed window supervision, ie. the absolute value for the difference between actual speed and unramped speed reference (01.01 Motor speed used - 23.01 Speed ref ramp in). When motor speed is within the limits defined by this parameter, bit 8 of 06.11 Main status word is 1. If motor speed is not within the limits, bit 8 is 0.	100 rpm
	0 … 30000 rpm	Absolute value for motor speed window supervision.	1 = 1 rpm
46.04	Filter time motor speed	Defines a filter time for signals 01.01 Motor speed used, 01.02 Motor speed estimated, 01.04 Encoder 1 speed filtered and 01.05 Encoder 2 speed filtered.	500 ms
	2…20000 ms	Motor speed signal filter time.	1 = 1 ms
46.05	Filter time output frequency	Defines a filter time for signal 01.07 Output frequency.	500 ms
	2…20000 ms	Output frequency signal filter time.	1 = 1 ms
46.06	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
46.07	Filter time power out	Defines a filter time for signal 01.14 Output power..	100 ms
	2…20000 ms	Output power signal filter time.	1 = 1 ms
46.10	Speed scaling	Defines the terminal speed value used in acceleration and the initial speed value used in deceleration (see parameter group 23 Speed reference ramp). Also defines the rpm value that corresponds to 20000 in fieldbus communication using the ABB Drives profile.	1500 rpm
	0…30000 rpm	Acceleration/deceleration terminal/initial speed.	1 = 1 rpm
46.11	Frequency scaling	Defines the terminal frequency value used in acceleration and the initial speed value used in deceleration (see parameter group 28 Frequency reference chain). Also defines the output frequency value that corresponds to 20000 in fieldbus communication.	50.0 Hz
	0.0 … 30000.0 Hz	Frequency corresponding to 20000 on fieldbus.	10 = 1 Hz

No.	Name/Value	Description	Def/FbEq
46.12	Torque scaling	Defines the output torque value (in percent of nominal motor torque) that corresponds to 1000 in fieldbus communication.	100.0%
	0.0 … 30000.0%	Torque corresponding to 1000 on fieldbus.	10 = 1%
46.13	Power scaling	Defines the output power value that corresponds to 10000 in fieldbus communication.	1000.0 kW
	0.0 … 30000.0 kW	Power corresponding to 10000 on fieldbus.	10 = 1 kW
47 Data storage		16-bit data storage parameters that can be written to and read from using other parameters' pointer settings. See also section Data storage parameters (page 45).	
47.01	Data storage1	Data storage parameter 1.	
	-32768…32767	16-bit data.	1 = 1
47.02	Data storage2	Data storage parameter 2.	
	-32768…32767	16-bit data.	1 = 1
47.03	Data storage3	Data storage parameter 3.	
	-32768…32767	16-bit data.	1 = 1
47.04	Data storage4	Data storage parameter 4.	
	-32768…32767	16-bit data.	1 = 1
47.05	Data storage5	Data storage parameter 5.	
	-32768…32767	16-bit data.	1 = 1
47.06	Data storage6	Data storage parameter 6.	
	-32768…32767	16-bit data.	1 = 1
47.07	Data storage7	Data storage parameter 7.	
	-32768…32767	16-bit data.	1 = 1
47.08	Data storage8	Data storage parameter 8.	
	-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.	230.4 kbps
	115.2 kbps	115.2 kbit/s.	4
	230.4 kbps	230.4 kbit/s.	5
	460.8 kbps	460.8 kbit/s.	6
49.05	Communication loss action	Selects how the drive reacts to a control panel (or PC tool) communication break.	No action
	No action	No action taken.	0
	Fault	Drive trips on 7081 Panel loss.	1

No.	Name/Value	Description	Def/FbEq
	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 by the average speed over the previous 10 seconds. **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 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*…. **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*…. The value reverts automatically to *Done*.	1

50 Fieldbus adapter (FBA)		Fieldbus communication configuration.	
50.01	*FBA A enable*	Enables/disables communication between the drive and fieldbus adapter A.	*Disable*
	Disable	Communication between drive and fieldbus adapter A disabled.	0
	Enable	Communication between drive and fieldbus adapter A enabled.	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*
	No	Communication break detection disabled.	0
	Fault	Communication break detection active. Upon a communication break, the drive trips on a *7510 FBA A communication* fault and coasts to a stop.	1
	Last speed	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C1 FB A communication*) and freezes the speed to the level the drive was operating at. The speed is determined by the average speed over the previous 10 seconds. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Constant speed	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C1 FB 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 used). **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
50.03	*FBA A comm loss t out*	Defines the time delay before the action defined by parameter *50.02 FBA A comm loss func* is taken. Time count starts when the communication link fails to update the message.	0.3 s
	0.3 … 6552.6 s	Time delay.	10 = 1 s

No.	Name/Value	Description	Def/FbEq
50.04	FBA A ref1 type	Selects the type and scaling of reference 1 received from fieldbus adapter A. The scaling of the reference is defined by parameters 46.10…46.13, depending on which reference type is selected by this parameter.	Auto
	Auto	Reference type and scaling is chosen automatically according to the currently active control mode.	0
	Transparent	No scaling is applied.	1
	General	TBA	2
	Torque	The scaling is defined by parameter 46.12 Torque scaling.	3
	Speed	The scaling is defined by parameter 46.10 Speed scaling.	4
	Frequency	The scaling is defined by parameter 46.11 Frequency scaling.	5
	Position	Reserved.	6
	Velocity	Reserved.	7
	DC voltage	Reserved.	8
	Active power	Reserved.	9
	Reactive power	Reserved.	10
50.05	FBA A ref2 type	Selects the type and scaling of reference 2 received from fieldbus adapter A. The scaling of the reference is defined by parameters 46.10…46.13, depending on which reference type is selected by this parameter. For the selections, see parameter 50.04 FBA A ref1 type.	Auto
50.06	FBA A SW sel	TBA	Auto
	Auto		0
	Transparent mode		1
50.07	FBA A actual 1 type	Selects the type and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter A. The scaling of the value is defined by parameters 46.10…46.13, depending on which actual value type is selected by this parameter. For the selections, see parameter 50.04 FBA A ref1 type.	Auto
50.08	FBA A actual 2 type	Selects the type and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter A. The scaling of the value is defined by parameters 46.10…46.13, depending on which actual value type is selected by this parameter. For the selections, see parameter 50.04 FBA A ref1 type.	Auto
50.09	FBA A SW transparent source	Selects the source of the fieldbus status word when parameter 50.06 FBA A SW sel is set to Transparent mode.	NULL
	NULL	No source selected.	-
	Other	The value is taken from another parameter.	-
50.10	FBA A act1 transparent source	When parameter 50.07 FBA A actual 1 type is set to Transparent, this parameter selects the type of actual value 1 transmitted to the fieldbus network through fieldbus adapter A.	NULL
	NULL	No source selected.	-
	Other	The value is taken from another parameter.	-

No.	Name/Value	Description	Def/FbEq
50.11	FBA A act2 transparent source	When parameter 50.08 FBA A actual 2 type is set to Transparent, this parameter selects the type of actual value 2 transmitted to the fieldbus network through fieldbus adapter A.	NULL
	NULL	No source selected.	-
	Other	The value is taken from another parameter.	-
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 ensabled.	1
50.13	FBA A control word	Displays the control word sent by the master (PLC) to fieldbus adapter A. For details of the contents, see page 233. This parameter is read-only.	-
		Control word sent by master to fieldbus adapter A.	
50.14	FBA A reference 1	Displays raw reference REF1 sent by the master (PLC) to fieldbus adapter A. This parameter is read-only.	-
		Raw REF1 sent by master to fieldbus adapter A.	
50.15	FBA A reference 2	Displays raw reference REF2 sent by the master (PLC) to fieldbus adapter A. This parameter is read-only.	-
		Raw REF2 sent by master to fieldbus adapter A.	
50.16	FBA A status word	Displays the status word sent by fieldbus adapter A to the master (PLC). For details of the contents, see page 234. This parameter is read-only.	-
		Status word sent by fieldbus adapter A to master.	
50.17	FBA A actual value 1	Displays raw actual value ACT1 sent by fieldbus adapter A to the master (PLC). This parameter is read-only.	-
		Raw ACT1 sent by fieldbus adapter A to master.	
50.18	FBA A actual value 2	Displays raw actual value ACT2 sent by fieldbus adapter A to the master (PLC). This parameter is read-only.	-
		Raw ACT2 sent by fieldbus adapter A to master.	

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td>50.21</td><td>FBA A timelevel sel</td><td>Selects the communication speed.
In general, lower speeds reduce CPU load. The table below shows the read/write intervals for cyclic and acyclic data with each parameter setting.

<table><tr><th>Selection</th><th>Cyclic*</th><th>Acyclic**</th></tr><tr><td>Slow</td><td>10 ms</td><td>10 ms</td></tr><tr><td>Normal</td><td>2 ms</td><td>10 ms</td></tr><tr><td>Fast</td><td>500 µs</td><td>2 ms</td></tr><tr><td>Very fast</td><td>250 µs</td><td>500 µs</td></tr></table>
*Cyclic data consists of fieldbus Control and Status words, Ref1, Ref2, Act1 and Act2.
**Acyclic data consists of the parameter data mapped to parameter groups 52 FBA A data In and 53 FBA A data out.</td><td>Normal</td></tr>
<tr><td></td><td>Slow</td><td>Slow speed.</td><td>3</td></tr>
<tr><td></td><td>Normal</td><td>Normal speed.</td><td>0</td></tr>
<tr><td></td><td>Fast</td><td>Fast speed.</td><td>1</td></tr>
<tr><td></td><td>Very fast</td><td>Very fast speed.</td><td>2</td></tr>
<tr><td>51 FBA A settings</td><td></td><td>Fieldbus adapter A configuration.</td><td></td></tr>
<tr><td>51.01</td><td>FBA type</td><td>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; 1 = FPBA; 32 = FCAN; 37 = FDNA; 128 = FENA-11; 135 = FECA; 136 = FEPL; 485 = FSCA; 62944 = FSEA.
This parameter is read-only.</td><td>-</td></tr>
<tr><td>51.02</td><td>FBA Par2</td><td>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.</td><td>-</td></tr>
<tr><td>…</td><td>…</td><td>…</td><td>…</td></tr>
<tr><td>51.26</td><td>FBA Par26</td><td>See parameter 51.02 FBA Par2.</td><td>-</td></tr>
<tr><td>51.27</td><td>FBA par refresh</td><td>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.</td><td>Done</td></tr>
<tr><td></td><td>Done</td><td>Refreshing done.</td><td>0</td></tr>
<tr><td></td><td>Configure</td><td>Refreshing.</td><td>1</td></tr>
<tr><td>51.28</td><td>Par table ver</td><td>Displays the parameter table revision of the fieldbus adapter module mapping file stored in the memory of the drive.
In format axyz, where a = major revision number; xy = minor revision number; z = correction number.
This parameter is read-only.</td><td>-</td></tr>
<tr><td></td><td>0…65535</td><td>Parameter table revision of adapter module.</td><td>1 = 1</td></tr>
<tr><td>51.29</td><td>Drive type code</td><td>Displays the drive type code of the fieldbus adapter module mapping file stored in the memory of the drive.
This parameter is read-only.</td><td>-</td></tr>
<tr><td></td><td>0…65535</td><td>Drive type code of fieldbus adapter module mapping file.</td><td>1 = 1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq
51.30	Mapping file ver	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. Example: 0x107 = revision 1.07. This parameter is read-only.	-
	0…65535	Mapping file revision.	1 = 1
51.31	D2FBA comm sta	Displays the status of the fieldbus adapter module communication.	-
	Idle	Adapter is not configured.	0
	Exec.init	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Conf.err	Adapter configuration error: the major or minor revision code of the common program revision in the fieldbus adapter module is not the revision required by the module (see parameter 51.32 FBA comm SW ver), or mapping file upload has failed more than three times.	3
	Off-line	Adapter is off-line.	4
	On-line	Adapter is on-line.	5
	Reset	Adapter is performing a hardware reset.	6
51.32	FBA 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. Example: 190A = revision 1.90A.	
	0…65535	Common program revision of adapter module.	1 = 1
51.33	FBA 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.	
	0…65535	Application program version of adapter module.	1 = 1

52 FBA A data In		Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A.	
52.01	FBA 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
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	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
	Other	The value is taken from another parameter.	-
…	…	…	…
52.12	FBA data in12	See parameter 52.01 FBA data in1.	None

No.	Name/Value	Description	Def/FbEq
53 FBA A data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A.	
53.01	FBA 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
	CW 32bit	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	The value is taken from another parameter.	-
…	…	…	…
53.12	FBA data out12	See parameter 53.01 FBA data out1.	None

90 Feedback selection		Motor speed feedback configuration.	
90.01	Motor speed for control	Displays the estimated or measured motor speed that is used for motor control, ie. final motor speed feedback selected by parameter 90.41 Motor feedback selection and filtered by parameter 90.42 Motor speed filter time. This parameter is read-only.	-
	-21474836.48 … 21474836.47 rpm	Motor speed used for control.	100 = 1 rpm
90.02	Motor position	Displays the motor position received from the source selected by parameter 90.41 Motor feedback selection. This parameter is read-only.	-
	-21474836.48 … 21474836.47 rev	Motor position.	100 = 1 rev
90.03	Load speed	Displays the estimated or measured load speed that is used for motor control, ie. final motor speed feedback selected by parameter 90.41 Motor feedback selection and filtered by parameter 90.42 Motor speed filter time. This parameter is read-only.	-
	-21474836.48 … 21474836.47 rpm	Load speed.	100 = 1 rpm
90.04	Load position	Displays the load position received from the source selected by parameter 90.51 Load feedback selection. This parameter is read-only.	-
	-2147483648 … 2147483647 rev	Load position.	1 = 1 rev
90.05	Load position scaled	Displays the load position scaled with feed constant (see parameters 90.63 Feed constant numerator and 90.64 Feed constant denominator). This parameter is read-only.	-
	-2147483648 … 2147483647	Scaled load position.	1 = 1

No.	Name/Value	Description	Def/FbEq
90.10	Encoder 1 speed	Displays encoder 1 speed in rpm. This parameter is read-only.	-
	-21474836.48 … 21474836.47 rpm	Encoder 1 speed.	100 = 1 rpm
90.11	Encoder 1 position	Displays the actual position of encoder 1 within one revolution. This parameter is read-only.	-
	-21474836.48 … 21474836.47 rev	Encoder 1 position within one revolution.	100 = 1 rev
90.12	Encoder 1 multiturn revolutions	Displays the actual position of encoder 1 in full revolutions. This parameter is read-only.	-
	0 … 4294967295	Encoder 1 position in revolutions.	1 = 1
90.13	Encoder 1 revol extension	Displays the revolution counter extension for encoder 1. The counter is incremented when encoder position wraps around in the positive direction, and decremented in the negative direction. This parameter is effective only if position is absolute; updated for both single-turn and multiturn encoders. This parameter is read-only.	-
	-2147483648 … 2147483647	Encoder 1 revolution counter extension.	1 = 1
90.14	Encoder 1 position raw	Displays encoder 1 position within one revolution as an 24-bit unsigned integer received from the encoder interface. This parameter is read-only.	-
		Raw encoder 1 position within one revolution.	1 = 1
90.15	Encoder 1 revolutions raw	Displays encoder 1 revolutions as a raw measurement. This parameter is read-only.	-
		Raw encoder 1 revolution count.	1 = 1
90.20	Encoder 2 speed	Displays encoder 2 speed in rpm. This parameter is read-only.	-
	-21474836.48 … 21474836.47 rpm	Encoder 2 speed.	100 = 1 rpm
90.21	Encoder 2 position	Displays the actual position of encoder 2 within one revolution. This parameter is read-only.	-
	-21474836.48 … 21474836.47 rev	Encoder 2 position within one revolution.	100000000 = 1 rev
90.22	Encoder 2 multiturn revolutions	Displays the actual position of encoder 2 in full revolutions. This parameter is read-only.	-
	0 … 4294967295	Encoder 2 position in revolutions.	1 = 1
90.23	Encoder 2 revol extension	Displays the revolution counter extension for encoder 2. The counter is incremented when encoder position wraps around in the positive direction, and decremented in the negative direction. This parameter is effective only if position is absolute; updated for both single-turn and multiturn encoders. This parameter is read-only.	-
	-2147483648 … 2147483647	Encoder 2 revolution counter extension.	1 = 1

No.	Name/Value	Description	Def/FbEq
90.24	Encoder 2 position raw	Displays encoder 2 position within one revolution as a raw (24-bit unsigned integer) measurement. This parameter is read-only.	-
		Raw encoder 2 position within one revolution.	1 = 1
90.25	Encoder 2 revolutions raw	Displays encoder 2 revolutions as a raw measurement. This parameter is read-only.	-
		Raw encoder 2 revolution count.	1 = 1
90.26	Motor revol extension	Displays the motor revolution counter extension. The counter is incremented when encoder position wraps around in the positive direction, and decremented in the negative direction. This parameter is effective only if position is absolute; updated for both single-turn and multiturn encoders. This parameter is read-only.	-
	-2147483648 … 2147483647	Motor revolution counter extension.	1 = 1
90.27	Load revol extension	Displays the load revolution counter extension. The counter is incremented when encoder position wraps around in the positive direction, and decremented in the negative direction. This parameter is effective only if position is absolute; updated for both single-turn and multiturn encoders. This parameter is read-only.	-
	-2147483648 … 2147483647	Load revolution counter extension.	1 = 1
90.41	Motor feedback selection	Selects the motor speed feedback value used in control.	Estimate
	Estimate	A calculated speed estimate is used.	0
	Encoder 1	Actual speed measured by encoder 1. The encoder is set up by the parameters in group 92 Encoder 1 configuration.	1
	Encoder 2	Actual speed measured by encoder 1. The encoder is set up by the parameters in group 93 Encoder 2 configuration.	2
90.42	Motor speed filter time	Defines a filter time for motor speed feedback used for control (90.01 Motor speed for control).	3 ms
	0 … 10000 ms	Motor speed filter time.	1 = 1 ms
90.43	Motor gear numerator	Parameters 90.43 and 90.44 define a gear function between the motor speed feedback and motor control. The gear is used to correct a difference between the motor and encoder speeds for example if the encoder is not mounted directly on the motor shaft. $\frac{\text{90.43 Motor gear numerator}}{\text{90.44 Motor gear denominator}} = \frac{\text{Motor speed}}{\text{Encoder speed}}$	1
	-2147483648 … 2147483647	Motor gear numerator.	1 = 1
90.44	Motor gear denominator	See parameter 90.43 Motor gear numerator.	1
	-2147483648 … 2147483647	Motor gear denominator.	1 = 1
90.45	Motor feedback fault	Selects how the drive reacts to loss of motor feedback.	Fault
	Fault	Drive trips on a 7301 Motor speed feedback fault.	0

No.	Name/Value	Description	Def/FbEq
	Warning	Drive generates a *A7B0 Motor speed feedback* warning.	1
	None	No action taken.	2
90.46	*Force open loop*	Forces the use of estimated speed feedback.	*No*
	No	The feedback selected by *90.41 Motor feedback selection* is used.	0
	Yes	Calculated speed estimate is used (regardless of setting of *90.41 Motor feedback selection*).	1
90.51	*Load feedback selection*	Selects the load speed feedback value used in control.	*None*
	None	No load feedback selected.	0
	Encoder 1	Actual speed measured by encoder 1. The encoder is set up by the parameters in group *92 Encoder 1 configuration*.	1
	Encoder 2	Actual speed measured by encoder 1. The encoder is set up by the parameters in group *93 Encoder 2 configuration*.	2
	Estimate	A calculated speed estimate is used.	3
	Motor feedback	The source selected by parameter *90.41 Motor feedback selection* for motor feedback is also used for load feedback. Any difference between the motor and load speeds can be compensated by using the load gear function; see parameter *90.53 Load gear numerator*.	4
90.52	*Load speed filter time*	Defines a filter time for load speed feedback (*90.03 Load speed*).	3 ms
	0 … 10000 ms	Load speed filter time.	1 = 1 ms
90.53	*Load gear numerator*	Parameters *90.53* and *90.54* define a gear function between the load (ie. driven equipment) speed feedback and motor control. The gear is used to correct a difference between the load and encoder speeds for example if the encoder is not mounted directly on the rotated machinery. $\frac{\textit{90.53 Load gear numerator}}{\textit{90.54 Load gear denominator}} = \frac{\text{Load speed}}{\text{Encoder speed}}$	1
	-2147483648 … 2147483647	Load gear numerator.	1 = 1
90.54	*Load gear denominator*	See parameter *90.53 Load gear numerator*.	1
	-2147483648 … 2147483647	Load gear denominator.	1 = 1
90.56	*Load position offset*	Load-side position offset. The resolution is determined by parameter *90.57 Load position resolution*.	0 rev
	-32768 … 32767 rev	Load-side position offset.	1 = 1 rev
90.57	*Load position resolution*	Defines how many bits are used for load position count within one revolution.	16
	0…32	Load position resolution.	1 = 1

No.	Name/Value	Description	Def/FbEq
90.61	Gear numerator	Parameters 90.61 and 90.62 define a gear function between the motor and load speeds. $\frac{\text{90.61 Gear numerator}}{\text{90.62 Gear denominator}} = \frac{\text{Motor speed}}{\text{Load speed}}$	1
	-2147483648 … 2147483647	Gear numerator (motor-side).	1 = 1
90.62	Gear denominator	See parameter 90.61 Gear numerator.	1
	-2147483648 … 2147483647	Gear denominator (load-side).	1 = 1
90.63	Feed constant numerator	Parameters 90.63 and 90.64 define the feed constant for the position calculation: $\frac{\text{90.63 Feed constant numerator}}{\text{90.64 Feed constant denominator}}$ The feed constant converts rotational motion into translatory motion. The feed constant is the distance the load moves during one turn of the motor shaft. The translatory load position is shown by parameter 90.05 Load position scaled.	1
	-2147483648 … 2147483647	Feed constant numerator.	1 = 1
90.64	Feed constant denominator	See parameter 90.63 Feed constant numerator.	1
	-2147483648 … 2147483647	Feed constant denominator.	1 = 1
91 Encoder module settings		Configuration of encoder interface modules.	
91.01	FEN DI status	Displays the status of the digital inputs of FEN-xx encoder interface modules. This parameter is read-only.	-

Bit	Name
0	DI1 of interface 1 (see parameters 91.11 and 91.12)
1	DI2 of interface 1 (see parameters 91.11 and 91.12)
2…3	Reserved
4	DI1 of interface 2 (see parameters 91.13 and 91.14)
5	DI2 of interface 2 (see parameters 91.13 and 91.14)
6…15	Reserved

91.02	Module 1 status	Displays the type of the interface module found in the location specified by parameter 91.12 Module 1 location. **0** = No module found; **1** = No communication; **2** = Unknown; **3** = FEN-01; **4** = FEN-11; **5** = FEN-21; **6** = FEN-31. This parameter is read-only.	-

No.	Name/Value	Description	Def/FbEq
91.03	Module 2 status	Displays the type of the interface module found in the location specified by parameter 91.14 Module 2 location. **0** = No module found; **1** = No communication; **2** = Unknown; **3** = FEN-01; **4** = FEN-11; **5** = FEN-21; **6** = FEN-31. This parameter is read-only.	-
91.04	Module 1 temperature	Displays the temperature measured through the sensor input of interface module 1. This parameter is read-only.	-
	0…1000 °C	Temperature measured through interface module 1.	1 = 1 °C
91.06	Module 2 temperature	Displays the temperature measured through the sensor input of interface module 2. This parameter is read-only.	-
	0…1000 °C	Temperature measured through interface module 2.	1 = 1 °C
91.10	Encoder parameter refresh	Forces a reconfiguration of the FEN-xx encoder interface modules, which is needed for any parameter changes in groups 90…93 to take effect. **Note:** The parameter cannot be changed while the drive is running.	Done
	Done	Reconfiguration done (normal operation).	0
	Configure	Reconfigure. The value reverts automatically to Done.	1
91.11	Module 1 type	Defines the type of the module used as interface module 1.	None
	None	None (communication disabled).	0
	FEN-01	FEN-01.	1
	FEN-11	FEN-11.	2
	FEN-21	FEN-21.	3
	FEN-31	FEN-31.	4
91.12	Module 1 location	Specifies the slot (1…3) on the control unit of the drive into which the interface module is installed.	1
	1…254	Slot number.	1 = 1
91.13	Module 2 type	Defines the type of the module used as interface module 2.	None
	None	None (communication disabled).	0
	FEN-01	FEN-01.	1
	FEN-11	FEN-11.	2
	FEN-21	FEN-21.	3
	FEN-31	FEN-31.	4
91.14	Module 2 location	Specifies the slot (1…3) on the control unit of the drive into which the interface module is installed.	1
	1…254	Slot number.	1 = 1
91.21	Temperature meas sel1	Specifies the type of temperature sensor connected to interface module 1.	None
	None	None.	0
	PTC	PTC.	1
	KTY-84	KTY84.	2
91.22	Temperature filtering time 1	Defines a filtering time for the temperature measurement through interface module 1.	1500 ms
	0…10000 ms	Filtering time for temperature measurement.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq
91.23	PTC filtering 1	Defines how many consecutive samples must be received by interface module 1 before the status of a PTC sensor is interpreted as true instead of false.	1
	0…65535	Number of samples.	1 = 1
91.24	Temperature meas sel2	Specifies the type of temperature sensor connected to interface module 2.	None
	None	None.	0
	PTC	PTC.	1
	KTY-84	KTY84.	2
91.25	Temperature filtering time 2	Defines a filtering time for the temperature measurement through interface 2.	1500 ms
	0…10000 ms	Filtering time for temperature measurement.	1 = 1 ms
91.26	PTC filtering 2	Defines how many consecutive samples must be received by interface module 2 before the status of a PTC sensor is interpreted as true instead of false.	1
	0…65535	Number of samples.	1 = 1

92 Encoder 1 configuration	Settings for encoder 1. **Notes:** • The contents of the parameter group vary according to the selected encoder type. • It is recommended that encoder connection 1 (this group) is used whenever possible since the data received through that interface is fresher than the data received through connection 2 (group 93 Encoder 2 configuration).	
92.01	Encoder 1 type	Activates the communication with optional encoder/resolver interface module 1.	None
	None	Inactive.	0
	Abs enc	Communication active. Module type: FEN-11 Absolute Encoder Interface. Input: Absolute encoder input (X42).	3
	Resolver	Communication active. Module type: FEN-21 Resolver Interface. Input: Resolver input (X52).	4
	HTL	Communication active. Module type: FEN-31 HTL Encoder Interface. Input: HTL encoder input (X82).	5
92.02	Encoder 1 source	Selects the interface module that the encoder is connected to. (The physical locations and types of encoder interface modules are defined in parameter group 91 Encoder module settings.)	Adapter 1
	Adapter 1	Interface module 1.	1
	Adapter 2	Interface module 2.	2
92.03	Encoder 1 type act	Displays the type of optional encoder/resolver interface 1. For the possible values, see parameter 92.01 Encoder 1 type. This parameter is read-only.	-
92.10	Sine/cosine number	*(Visible when 92.01 Encoder 1 type = Abs enc)* Defines the number of sine/cosine wave cycles within one revolution. **Note:** This parameter need not be set when an EnDat or SSI encoder is used in continuous mode. See parameter 92.30 Serial link mode.	0
	0…65535	Number of sine/cosine wave cycles within one revolution.	1 = 1

No.	Name/Value	Description	Def/FbEq
92.10	Excitation signal frequency	(Visible when 92.01 Encoder 1 type = Resolver) Defines the frequency of the excitation signal.	1 kHz
	1…20 kHz	Excitation signal frequency.	1 = 1 kHz
92.10	Pulses/revolution	(Visible when 92.01 Encoder 1 type = HTL) Defines the pulse number per revolution.	0
	0…65535	Number of pulses.	1 = 1
92.11	Absolute position source	(Visible when 92.01 Encoder 1 type = Abs enc) Selects the source of the absolute position information.	None
	None	Not selected.	0
	Commut sig	Commutation signals.	1
	EnDat	Serial interface: EnDat encoder.	2
	Hiperface	Serial interface: HIPERFACE encoder.	3
	SSI	Serial interface: SSI encoder.	4
	Tamagawa	Serial interface: Tamagawa 17/33-bit encoder.	5
92.11	Excitation signal amplitude	(Visible when 92.01 Encoder 1 type = Resolver) Defines the amplitude of the excitation signal.	4.0 V
	4.0 … 12.0 V	Excitation signal amplitude.	10 = 1 V
92.11	Pulse encoder type	(Visible when 92.01 Encoder 1 type = HTL) Selects the type of encoder.	Quadrature
	Quadrature	Quadrature encoder (has two channels, A and B)	0
	Single track	Single-track encoder (has one channel, A)	1
92.12	Zero pulse enable	(Visible when 92.01 Encoder 1 type = Abs enc) Enables the encoder zero pulse for the absolute encoder input (X42) of the FEN-11 interface module. **Note:** No zero pulse exists with serial interfaces, ie. when parameter 92.11 Absolute position source is set to EnDat, Hiperface, SSI or Tamagawa.	Disable
	Disable	Zero pulse disabled.	0
	Enable	Zero pulse enabled.	1
92.12	Resolver polepairs	(Visible when 92.01 Encoder 1 type = Resolver) Defines the number of pole pairs of the encoder.	1
	1…32	Number of encoder pole pairs.	1 = 1 kHz
92.12	Speed calc mode	(Visible when 92.01 Encoder 1 type = HTL) Selects the speed calculation mode. *With a single-track encoder (parameter 92.11 Pulse encoder type is set to Single track), the speed is always positive.	Auto rising
	A&B all	Channels A and B: Rising and falling edges are used for speed calculation. *Channel B: Defines the direction of rotation. **Note:** With a single-track encoder (parameter 92.11 Pulse encoder type), this setting acts like setting A all.	0
	A all	Channel A: Rising and falling edges are used for speed calculation. *Channel B: Defines the direction of rotation.	1
	A rising	Channel A: Rising edges are used for speed calculation. *Channel B: Defines the direction of rotation.	2

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq</th></tr>
<tr><td></td><td>A falling</td><td>Channel A: Falling edges are used for speed calculation.
*Channel B: Defines the direction of rotation.</td><td>3</td></tr>
<tr><td></td><td>Auto rising</td><td>One of the above modes is selected automatically depending on the pulse frequency as follows:<table><tr><th>Pulse frequency of the channel(s)</th><th>Used mode</th></tr><tr><td>< 2442 Hz</td><td>A&B all</td></tr><tr><td>2442…4884 Hz</td><td>A all</td></tr><tr><td>> 4884 Hz</td><td>A rising</td></tr></table></td><td>4</td></tr>
<tr><td></td><td>Auto falling</td><td>One of the above modes is selected automatically depending on the pulse frequency as follows:<table><tr><th>Pulse frequency of the channel(s)</th><th>Used mode</th></tr><tr><td>< 2442 Hz</td><td>A&B all</td></tr><tr><td>2442…4884 Hz</td><td>A all</td></tr><tr><td>> 4884 Hz</td><td>A falling</td></tr></table></td><td>5</td></tr>
<tr><td>92.14</td><td>Revolution data width</td><td>(Visible when 92.01 Encoder 1 type = Abs enc)
Defines the number of bits used in revolution counting with an multiturn encoder.
The value is used when parameter 92.11 Absolute position source is set to EnDat, Hiperface or SSI. When parameter 92.11 Absolute position source is set to Tamagawa, setting this parameter to a non-zero value activates multiturn data requesting.</td><td>0</td></tr>
<tr><td></td><td>0…32</td><td>Number of bits used in revolution count. For example, a setting of 12 bits would support counting up to 4096 revolutions.</td><td>1 = 1</td></tr>
<tr><td>92.14</td><td>Speed estimation enable</td><td>(Visible when 92.01 Encoder 1 type = HTL)
Selects whether calculated or estimated speed is used. Estimation increases the speed ripple in steady state operation, but improves the dynamics.</td><td>Disable</td></tr>
<tr><td></td><td>Disable</td><td>Last calculated speed used. (The calculation interval is 62.5 microseconds to 4 milliseconds.)</td><td>0</td></tr>
<tr><td></td><td>Enable</td><td>Estimated speed (estimated at the time of data request) is used.</td><td>1</td></tr>
<tr><td>92.15</td><td>Transient filter</td><td>(Visible when 92.01 Encoder 1 type = HTL)
Activates transient filtering for the encoder (changes in direction of rotation are ignored above the selected pulse frequency).</td><td>4880 Hz</td></tr>
<tr><td></td><td>4880 Hz</td><td>Change in rotation of direction allowed below 4880 Hz.</td><td>0</td></tr>
<tr><td></td><td>2440 Hz</td><td>Change in rotation of direction allowed below 2440 Hz.</td><td>1</td></tr>
<tr><td></td><td>1220 Hz</td><td>Change in rotation of direction allowed below 1220 Hz.</td><td>2</td></tr>
<tr><td></td><td>Disabled</td><td>Change in rotation of direction allowed at any pulse frequency.</td><td>3</td></tr>
<tr><td>92.30</td><td>Serial link mode</td><td>(Visible when 92.01 Encoder 1 type = Abs enc)
Selects the serial link mode with an EnDat or SSI encoder.</td><td>Initial pos.</td></tr>
<tr><td></td><td>Initial pos.</td><td>Single position transfer mode (initial position).</td><td>0</td></tr>
<tr><td></td><td>Continuous</td><td>Continuous position data transfer mode.</td><td>1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq
92.31	EnDat calc time	*(Visible when 92.01 Encoder 1 type = Abs enc)* Selects the maximum encoder calculation time for an EnDat encoder. **Note:** This parameter needs to be set only when an EnDat encoder is used in continuous mode, ie. without incremental sin/cos signals (supported only as encoder 1). See also parameter 92.30 Serial link mode.	50 ms
	10 us	10 microseconds.	0
	100 us	100 microseconds.	1
	1 ms	1 millisecond.	2
	50 ms	50 milliseconds.	3
92.32	SSI cycle time	*(Visible when 92.01 Encoder 1 type = Abs enc)* Selects the transmission cycle for an SSI encoder. **Note:** This parameter needs to be set only when an SSI encoder is used in continuous mode, ie. without incremental sin/cos signals (supported only as encoder 1). See also parameter 92.30 Serial link mode.	100 us
	50 us	50 microseconds.	0
	100 us	100 microseconds.	1
	200 us	200 microseconds.	2
	500 us	500 microseconds.	3
	1 ms	1 millisecond.	4
	2 ms	2 milliseconds.	5
92.33	SSI clock cycles	*(Visible when 92.01 Encoder 1 type = Abs enc)* Defines the length of an SSI message. The length is defined as the number of clock cycles. The number of cycles can be calculated by adding 1 to the number of bits in an SSI message frame.	2
	2…127	SSI message length.	1 = 1
92.34	SSI position msb	*(Visible when 92.01 Encoder 1 type = Abs enc)* With an SSI encoder, defines the location of the MSB (most significant bit) of the position data within an SSI message.	1
	1…126	Position data MSB location (bit number).	1 = 1
92.35	SSI revol msb	*(Visible when 92.01 Encoder 1 type = Abs enc)* With an SSI encoder, defines the location of the MSB (most significant bit) of the revolution count within an SSI message.	1
	1…126	Revolution count MSB location (bit number).	1 = 1
92.36	SSI data format	*(Visible when 92.01 Encoder 1 type = Abs enc)* Selects the data format for an SSI encoder.	binary
	binary	Binary code.	0
	gray	Gray code.	1
92.37	SSI baud rate	*(Visible when 92.01 Encoder 1 type = Abs enc)* Selects the baud rate for an SSI encoder.	100 kBit/s
	10 kBit/s	10 kbit/s.	0
	50 kBit/s	50 kbit/s.	1
	100 kBit/s	100 kbit/s.	2
	200 kBit/s	200 kbit/s.	3

No.	Name/Value	Description	Def/FbEq
	500 kBit/s	500 kbit/s.	4
	1000 kBit/s	1000 kbit/s.	5
92.40	SSI zero phase	*(Visible when 92.01 Encoder 1 type = Abs enc)* Defines the phase angle within one sine/cosine signal period that corresponds to the value of zero on the SSI serial link data. The parameter is used to adjust the synchronization of the SSI position data and the position based on sine/cosine incremental signals. Incorrect synchronization may cause an error of ±1 incremental period. **Note:** This parameter needs to be set only when an SSI encoder is used in initial position mode (see parameter 92.30 Serial link mode).	315-45 deg
	315-45 deg	315-45 degrees.	0
	45-135 deg	45-135 degrees.	1
	135-225 deg	135-225 degrees.	2
	225-315 deg	225-315 degrees.	3
92.45	Hiperface parity	*(Visible when 92.01 Encoder 1 type = Abs enc)* Defines the use of parity and stop bits with a HIPERFACE encoder. Typically this parameter need not be set.	Odd
	Odd	Odd parity indication bit, one stop bit.	0
	Even	Even parity indication bit, one stop bit.	1
92.46	Hiperface baud rate	*(Visible when 92.01 Encoder 1 type = Abs enc)* Defines the transfer rate of the link with a HIPERFACE encoder. Typically this parameter need not be set.	4800 bits/s
	4800 bits/s	4800 bit/s.	0
	9600 bits/s	9600 bit/s.	1
	19200 bits/s	19200 bit/s.	2
	38400 bits/s	38400 bit/s.	3
92.47	Hiperface node address	*(Visible when 92.01 Encoder 1 type = Abs enc)* Defines the node address for a HIPERFACE encoder. Typically this parameter need not be set.	64
	0…255	HIPERFACE encoder node address.	1 = 1

93 Encoder 2 configuration	Settings for encoder 2. **Notes:** • The contents of the parameter group vary according to the selected encoder type. • It is recommended that encoder connection 1 (group 92 Encoder 1 configuration) is used whenever possible since the data received through that interface is fresher than the data received through connection 2 (this group).	
93.01	Encoder 2 type	Activates the communication with optional encoder/resolver interface module 2.	None
	None	Inactive.	0
	Abs enc	Communication active. Module type: FEN-11 Absolute Encoder Interface. Input: Absolute encoder input (X42).	3
	Resolver	Communication active. Module type: FEN-21 Resolver Interface. Input: Resolver input (X52).	4

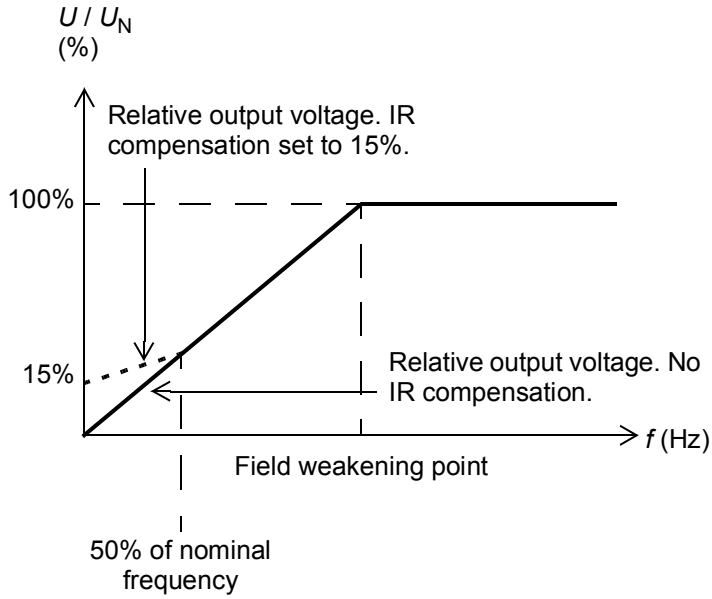
No.	Name/Value	Description	Def/FbEq
	HTL	Communication active. Module type: FEN-31 HTL Encoder Interface. Input: HTL encoder input (X82).	5
93.02	Encoder 2 source	Selects the interface module that the encoder is connected to. (The physical locations and types of encoder interface modules are defined in parameter group 91 Encoder module settings.)	Adapter 1
	Adapter 1	Interface module 1.	1
	Adapter 2	Interface module 2.	2
93.03	Encoder 2 type act	Displays the type of optional encoder/resolver interface module 1. For the possible values, see parameter 93.01 Encoder 2 type. This parameter is read-only.	-
93.10	Sine/cosine number	*(Visible when 93.01 Encoder 2 type = Abs enc)* See parameter 92.10 Sine/cosine number.	0
93.10	Excitation signal frequency	*(Visible when 93.01 Encoder 2 type = Resolver)* See parameter 92.10 Excitation signal frequency.	1 kHz
93.10	Pulses/revolution	*(Visible when 93.01 Encoder 2 type = HTL)* See parameter 92.10 Pulses/revolution.	0
93.11	Absolute position source	*(Visible when 93.01 Encoder 2 type = Abs enc)* See parameter 92.11 Absolute position source.	None
93.11	Excitation signal amplitude	*(Visible when 93.01 Encoder 2 type = Resolver)* See parameter 92.11 Excitation signal amplitude.	4.0 V
93.11	Pulse encoder type	*(Visible when 93.01 Encoder 2 type = HTL)* See parameter 92.11 Pulse encoder type.	Quadrature
93.12	Zero pulse enable	*(Visible when 93.01 Encoder 2 type = Abs enc)* See parameter 92.12 Zero pulse enable.	Disable
93.12	Resolver polepairs	*(Visible when 93.01 Encoder 2 type = Resolver)* See parameter 92.12 Resolver polepairs.	1
93.12	Speed calc mode	*(Visible when 93.01 Encoder 2 type = HTL)* See parameter 92.12 Speed calc mode.	Auto rising
93.14	Revolution data width	*(Visible when 93.01 Encoder 2 type = Abs enc)* See parameter 92.14 Revolution data width.	0
93.14	Speed estimation enable	*(Visible when 93.01 Encoder 2 type = HTL)* See parameter 92.14 Speed estimation enable.	Disable
93.15	Transient filter	*(Visible when 93.01 Encoder 2 type = HTL)* See parameter 92.15 Transient filter.	4880 Hz
93.30	Serial link mode	*(Visible when 93.01 Encoder 2 type = Abs enc)* See parameter 92.30 Serial link mode.	Initial pos.
93.31	EnDat calc time	*(Visible when 93.01 Encoder 2 type = Abs enc)* See parameter 92.31 EnDat calc time.	50 ms
93.32	SSI cycle time	*(Visible when 93.01 Encoder 2 type = Abs enc)* See parameter 92.32 SSI cycle time.	100 us
93.33	SSI clock cycles	*(Visible when 93.01 Encoder 2 type = Abs enc)* See parameter 92.33 SSI clock cycles.	2
93.34	SSI position msb	*(Visible when 93.01 Encoder 2 type = Abs enc)* See parameter 92.34 SSI position msb.	1
93.35	SSI revol msb	*(Visible when 93.01 Encoder 2 type = Abs enc)* See parameter 92.35 SSI revol msb.	1

No.	Name/Value	Description	Def/FbEq
93.36	SSI data format	(Visible when 93.01 Encoder 2 type = Abs enc) See parameter 92.36 SSI data format.	binary
93.37	SSI baud rate	(Visible when 93.01 Encoder 2 type = Abs enc) See parameter 92.37 SSI baud rate.	100 kBit/s
93.40	SSI zero phase	(Visible when 93.01 Encoder 2 type = Abs enc) See parameter 92.40 SSI zero phase.	315-45 deg
93.45	Hiperface parity	(Visible when 93.01 Encoder 2 type = Abs enc) See parameter 92.45 Hiperface parity.	Odd
93.46	Hiperface baud rate	(Visible when 93.01 Encoder 2 type = Abs enc) See parameter 92.46 Hiperface baud rate.	4800 bits/s
93.47	Hiperface node address	(Visible when 93.01 Encoder 2 type = Abs enc) See parameter 92.47 Hiperface node address.	64

95 HW configuration		Various hardware-related settings.	
95.01	Supply voltage	Selects the supply voltage range. This parameter is used by the ACS880 to determine the nominal voltage of the supply network. The value also affects the DC voltage control, trip and braking chopper limits of the drive. **Note:** The current rating of the drive is also affected by the selected supply voltage.	Not given
	Not given	No voltage defined. The drive will not start modulating before another value is selected.	0
	208…240 V	208…240 V	1
	380…415 V	380…415 V	2
	440…480 V	440…480 V	3
	500 V	500 V	4
	525…600 V	525…600 V	5
	660…690 V	660…690 V	6
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 fixed 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.	Disable
	Disable	Adaptive voltage limits disabled.	0
	Enable	Adaptive voltage limits enabled.	1
95.04	Control board supply	Specifies how the control unit of the drive is powered.	Internal 24V
	Internal 24V	The drive control unit is powered from the drive power unit it is connected to. This is the default setting.	0
	External 24V	The drive control unit is powered from an external power supply.	1

No.	Name/Value	Description	Def/FbEq
96 System		Language selection; parameter save and restore; control unit reboot.	
96.01	*Language*	Selects the language of the parameter interface and other displayed information. **Note:** Not all languages listed below are necessarily supported.	-
	Not selected	None.	0
	English US	US English.	1033
	Deutsch	German.	1031
	Italiano	Italian.	1040
	Español	Spanish.	3082
	Nederlands	Dutch.	1043
	Français	French.	1036
	Suomi	Finnish.	1035
	Svenska	Swedish.	1053
96.02	*Pass code*	Reserved.	0
	0…99999999	Pass code.	1 = 1
96.06	*Param 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 parameter values are restored to default values, except motor data, ID run results, and fieldbus adapter, drive-to-drive link and encoder configuration data.	8
	Clear all	All parameter values are restored to default values, including motor data, ID run results and fieldbus adapter and encoder configuration data. PC tool communication is interrupted during the restoring. The drive control unit is re-booted after the restoring is completed.	62
96.07	*Param save*	Saves the valid parameter values to permanent memory. **Note:** A new parameter value is saved automatically when changed from the PC tool or 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. The value reverts to 0 automatically.	0
	0…4294967295	1 = Reboot control unit.	1 = 1
97 Motor control		Switching frequency; slip gain; voltage reserve; flux braking; signal injection; IR compensation.	
97.01	*Switching frequency mode*	An optimization setting for balancing between control performance and motor noise level.	*Normal*
	Cyclic	Control performance optimized for cyclic load applications. **Note:** With this setting, the maximum motor cable length is smaller than with *Normal*.	0

No.	Name/Value	Description	Def/FbEq
	Low noise	Minimizes motor noise; control performance optimized for high (> 300 Hz) output frequencies. **Note:** Drive loadability is reduced with this setting and some derating must be applied if a certain constant output current is needed. This setting is not recommended for cyclic load applications. The maximum motor cable length is 50 m (164 ft) with drives up to 45 kW.	1
	Normal	Control performance optimized for long motor cables.	2
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 of the 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 of the 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. At the 105% gain value, no static speed error exists (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. 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.	0%
	-4 … 50%	Voltage reserve.	1 = 1%
97.05	*Flux braking*	Defines the level of braking power.	*Disabled*
	Disabled	Flux braking is disabled.	0
	Moderate	Flux level is limited during the braking. Deceleration time is longer compared to full braking.	1
	Full	Maximum braking power. Almost all available current is used to convert the mechanical braking energy to thermal energy in the motor.	2
97.10	*Signal injection*	Enables signal injection: a high-frequency alternating signal is injected to the motor in the low speed region to improve the stability of torque control. Signal injection can be enabled with different amplitude levels. **Notes:** • Use as low a level as possible that gives satisfactory performance. • Signal injection cannot be applied to asynchronous motors.	*Disabled*
	Disabled	Signal injection disabled.	0
	Enabled (5 %)	Signal injection enabled with amplitude level of 5%.	1
	Enabled (10 %)	Signal injection enabled with amplitude level of 10%.	2
	Enabled (15 %)	Signal injection enabled with amplitude level of 15%.	3

No.	Name/Value	Description	Def/FbEq
	Enabled (20 %)	Signal injection enabled with amplitude level of 20%.	4
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 direct torque control (DTC mode) cannot be applied.  See also section *IR compensation for scalar motor control* on page *30*.	0.00%
	0.00 … 50.00%	Voltage boost at zero speed in percent of nominal motor voltage.	100 = 1%

98 User motor parameters		Motor values supplied by the user that are used in the motor model.	
98.01	*User motor model*	Activates the motor model parameters *98.02*…*98.14* and the rotor angle offset parameter *98.15*. **Notes**: • Parameter value is automatically set to zero when ID run is selected by parameter *99.13 Identification run request*. The values of parameters *98.02*…*98.15* are updated according to the motor characteristics identified during the ID run. • This parameter cannot be changed while the drive is running.	*No*
	No	Parameters *98.02*…*98.15* inactive.	0
	Motor parameters	The values of parameters *98.02*…*98.14* are used in the motor model.	1
	Position offset	The value of parameter *98.15* is used as the rotor angle offset. Parameters *98.02*…*98.14* are inactive.	2
	Motor parameters & position offset	The values of parameters *98.02*…*98.14* are used in the motor model, and the value of parameter *98.15* is used as the rotor angle offset.	3
98.02	*Rs user*	Defines the stator resistance R_S of the motor model.	0.00000 p.u.
	0.00000 … 0.50000 p.u.	Stator resistance in per unit.	100000 = 1 p.u.

No.	Name/Value	Description	Def/FbEq
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.	100000 = 1 p.u.
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.	100000 = 1 p.u.
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.	100000 = 1 p.u.
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.	100000 = 1 p.u.
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.	100000 = 1 p.u.
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.	100000 = 1 p.u.
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.	100000 = 1 ohm
98.10	Rr user SI	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 ohm
	0.00000 … 100.00000 ohm	Rotor resistance.	100000 = 1 ohm
98.11	Lm user SI	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00 …100000.00 mH	Main inductance.	100 = 1 mH
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.	100 = 1 mH
98.13	Ld user SI	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00 …100000.00 mH	Direct axis inductance.	100 = 1 mH

No.	Name/Value	Description	Def/FbEq
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.	100 = 1 mH
98.15	Position offset user	Defines an angle offset between the zero position of the synchronous motor and the zero position of the position sensor. **Notes:** • The value is in electrical degrees. The electrical angle equals the mechanical angle multiplied by the number of motor pole pairs. • This parameter is valid only for permanent magnet motors.	0°
	0…360°	Angle offset.	1 = 1°

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	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 ctrl mode	Selects the motor control mode.	DTC
	DTC	Direct torque control. This mode is suitable for most applications. Note: Instead of direct torque control, use scalar control • 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).	0
	Scalar	Scalar control. The outstanding motor control accuracy of DTC cannot be achieved in scalar control. Some standard features are disabled in scalar control mode. **Note:** Correct motor run requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the inverter. See also section *Scalar motor control* on page *30*.	1
99.06	Motor nominal current	Defines the nominal motor current. Must be equal to the value on the motor rating plate. If multiple motors are connected to the drive, enter the total current of the motors. Notes: • Correct motor run 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_{Hd} of the drive (0…2 × I_{Hd} with scalar control mode).	10 = 1 A

No.	Name/Value	Description	Def/FbEq
99.07	*Motor nominal voltage*	Defines the nominal motor voltage as fundamental phase-to-phase rms voltage supplied to the motor at the nominal operating point. 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. **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.	1 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. **Note:** This parameter cannot be changed while the drive is running.	0.00 kW
	-10000.00 … 10000.00 kW	Nominal power of the motor.	100 = 1 kW
99.11	*Motor nominal cosfii*	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. **Note:** This parameter cannot be changed while the drive is running.	0.000 Nm
	0.00 … 4294672329.296 Nm	Nominal motor torque.	1000 = 1 N•m

No.	Name/Value	Description	Def/FbEq
99.13	*Identification run request*	Selects the type of the motor identification performed at the next start of the drive (for Direct Torque Control). During the identification, the drive will identify the characteristics of the motor for optimum motor control. After the ID run, the drive is stopped. **Note:** This parameter cannot be changed while the drive is running. Once the ID run is activated, it can be cancelled by stopping the drive: If ID run has already been performed once, parameter is automatically set to NO. If no ID run has been performed yet, parameter is automatically set to *Standstill*. In this case, the ID run must be performed. **Notes:** • ID run can only be performed in local control (i.e. when drive is controlled via PC tool or control panel). • ID run cannot be performed if parameter *99.04 Motor ctrl mode* is set to *Scalar*. • ID run must be performed every time any of the motor parameters (*99.04*, *99.06*…*99.12*) have been changed. Parameter is automatically set to *Standstill* after the motor parameters have been set. With a permanent magnet or synchronous reluctance motor, the motor shaft must NOT be locked and the load torque must be < 10% during the ID run (*Normal*/*Reduced*/*Standstill*). For the *Advanced* ID run, the machinery must always be de-coupled from the motor. • Ensure that possible Safe Torque Off and emergency stop circuits are closed during ID run. • Mechanical brake is not opened by the logic for the ID run.	*No*
	No	No motor ID run is requested. This mode can be selected only if the ID run (*Normal*/*Reduced*/*Standstill*/*Advanced*) has already been performed once.	0
	Normal	Normal ID run. Guarantees good control accuracy for all cases. The ID run takes about 90 seconds. This mode should be selected whenever it is possible. **Notes:** • The driven machinery must be de-coupled from the motor with Normal ID run, if the load torque is higher than 20%, or if the machinery is not able to withstand the nominal torque transient during the 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

No.	Name/Value	Description	Def/FbEq
	Reduced	Reduced ID Run. This mode should be selected instead of the *Normal* or *Advanced* ID Run if • mechanical losses are higher than 20% (i.e. the motor cannot be de-coupled from the driven equipment), or if • flux reduction is not allowed while the motor is running (i.e. in case of a motor with an integrated brake supplied from the motor terminals). With Reduced ID run, the control in the field weakening area or at high torques is not necessarily as accurate as with the 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 asynchronous motor, the motor shaft is not rotating (with permanent magnet motor the shaft can rotate < 0.5 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
	Autophasing	During autophasing, the start angle of the motor is determined. Note that other motor model values are not updated. See also parameter xxxxx. **Notes:** • Autophasing can only be selected after the *Normal*/*Reduced*/*Standstill*/*Advanced* ID run has been performed once. Autophasing is used with a permanent magnet motor when an absolute encoder, a resolver or an encoder with commutation signals has been added or replaced, and there is no need to perform the *Normal*/*Reduced*/*Standstill*/*Advanced* ID run again. • During Autophasing, the motor shaft must NOT be locked and the load torque must be < 5%.	4
	Current measurement calibration	Current offset and gain measurement calibration. The calibration will be performed at next start.	5

No.	Name/Value	Description	Def/FbEq
	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 in the whole operating area. **Notes:** • The driven machinery must be de-coupled from the motor because of high torque and speed transients that are applied. • During the run, the motor may rotate both in the forward and reverse direction. ⚠ **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	*Identification run performed*	Shows the selected ID run mode. For more information of the different modes, see the selections of parameter *99.13 Identification run request*.	*No*
	No	No ID run requested.	0
	Normal	*Normal* ID run.	1
	Reduced	*Reduced* ID run.	2
	Standstill	*Standstill* ID run.	3
	Autophasing	*Autophasing*.	4
	Current measurement calibration	*Current measurement calibration*.	5
	Advanced	*Advanced* ID run.	6
99.15	*Motor polepairs*	Calculated number of pole pairs in the motor.	0
	0…1000	Number of pole pairs.	1 = 1
99.16	*Phase order*	Switches the rotation direction of motor. This parameter can be used if the motor turns in the wrong direction (for example, because of the wrong phase order in the motor cable), and correcting the cabling is considered impractical. **Note:** After changing this parameter, the sign of encoder feedback (if any) must be checked. This can be done by setting parameter *90.41 Motor feedback selection* to *Estimate*, and comparing the sign of *90.41 Motor feedback selection* to *90.10 Encoder 1 speed* (or *90.20 Encoder 2 speed*). If the sign of the measurement is incorrect, the encoder wiring must be corrected or the sign of *90.43 Motor gear numerator* reversed.	*U V W*
	U V W	Normal.	0
	U W V	Reversed rotation direction.	1

100 Safety	FSO-xx settings.	
This group contains parameters related to the optional FSO-xx safety functions module. For details on the parameters in this group, refer to the documentation of the FSO-xx module.		

7

Additional parameter data

What this chapter contains

This chapter lists the parameters with some additional data. For parameter descriptions, see chapter *Parameters* (page *49*).

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	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	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.
List	Selection list.
No.	Parameter number.
PB	Packed Boolean (bit list).
Real	16-bit value 16-bit value (31 bits + sign) = integer value = fractional value

Term	Definition
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	Update time	Notes
01 Actual values						
01.01	Motor speed used	*Real*	-30000.00 … 30000.00	rpm		
01.02	Motor speed estimated	*Real*	-30000.00 … 30000.00	rpm		
01.04	Encoder 1 speed filtered	*Real*	-30000.00 … 30000.00	rpm		
01.05	Encoder 2 speed filtered	*Real*	-30000.00 … 30000.00	rpm		
01.06	Output frequency	*Real*	-3000.00 … 3000.00	Hz		
01.07	Motor current	*Real*	0.00 … 30000.00	A		
01.10	Motor torque %	*Real*	-1600.0 … 1600.0	%		
01.11	DC voltage	*Real*	0.00 … 2000.00	V		
01.14	Output power	*Real*	-32768.00 … 32767.00	kW		
01.18	Inverter GWh counter	*Real*	0…65535	GWh		
01.19	Inverter MWh counter	*Real*	0…999	MWh		
01.20	Inverter kWh counter	*Real*	0…999	kWh		
01.24	Flux actual %	*Real*	0…200	%		
01.30	Nominal torque scale	*Real*	0 … 4000000	N•m		
01.31	Ambient temperature	*Real*	-32768.0…32767.0	°C		
03 Input references						
03.01	Panel reference	*Real*	-100000.00 … 100000.00	-		
03.05	FB A reference 1	*Real*	-100000.00 … 100000.00	-		
03.06	FB A reference 2	*Real*	-100000.00 … 100000.00	-		
03.15	Application reference 1	*Real*	-30000.00 … 30000.00	-		
03.16	Application reference 2	*Real*	-30000.00 … 30000.00	-		
04 Warnings and faults						
04.01	Tripping fault	*Data*	0000h…FFFFh	-		
04.02	Active fault 2	*Data*	0000h…FFFFh	-		
04.03	Active fault 3	*Data*	0000h…FFFFh	-		
04.04	Active fault 4	*Data*	0000h…FFFFh	-		
04.05	Active fault 5	*Data*	0000h…FFFFh	-		
04.06	Active warning 1	*Data*	0000h…FFFFh	-		

No.	Name	Type	Range	Unit	Update time	Notes
04.07	Active warning 2	*Data*	0000h…FFFFh	-		
04.08	Active warning 3	*Data*	0000h…FFFFh	-		
04.09	Active warning 4	*Data*	0000h…FFFFh	-		
04.10	Active warning 5	*Data*	0000h…FFFFh	-		
04.11	Latest fault	*Data*	0000h…FFFFh	-		
04.12	2nd latest fault	*Data*	0000h…FFFFh	-		
04.13	3rd latest fault	*Data*	0000h…FFFFh	-		
04.14	4th latest fault	*Data*	0000h…FFFFh	-		
04.15	5th latest fault	*Data*	0000h…FFFFh	-		
04.16	Latest warning	*Data*	0000h…FFFFh	-		
04.17	2nd latest warning	*Data*	0000h…FFFFh	-		
04.18	3rd latest warning	*Data*	0000h…FFFFh	-		
04.19	4th latest warning	*Data*	0000h…FFFFh	-		
04.20	5th latest warning	*Data*	0000h…FFFFh	-		
05 Diagnostics						
05.01	On-time counter	*Real*	0…4294967295	d		
05.02	Run-time counter	*Real*	0…4294967295	d		
05.04	Fan on-time counter	*Real*	0…4294967295	d		
05.11	Inverter temperature %	*Real*	-40.0 … 160.0	%		
06 Control and status words						
06.01	Main control word	*PB*	0000h…FFFFh	-		
06.02	Application control word	*PB*	0000h…FFFFh	-		
06.11	Main status word	*PB*	0000h…FFFFh	-		
06.12	Status word 1	*PB*	0000h…FFFFh	-		
06.20	Control status word 1	*PB*	0000h…FFFFh	-		
06.21	Control status word 2	*PB*	0000h…FFFFh	-		
06.22	Speed control status word	*PB*	0000h…FFFFh	-		
06.30	User bit 0 selection	*Binary src*	-	-		
06.31	User bit 1 selection	*Binary src*	-	-		
06.32	User bit 2 selection	*Binary src*	-	-		
06.33	User bit 3 selection	*Binary src*	-	-		
07 System info						
07.03	Drive rating id	*List*	0…999	-		
07.04	Firmware name	*List*	-	-		

No.	Name	Type	Range	Unit	Update time	Notes
07.05	Firmware version	*Data*	-			
07.11	Cpu usage	*Real*	0…100	%		

Parameter groups 10…99

No.	Name	Type	Data len.	Range	Unit
10 Standard DI, RO					
10.01	DI status	*PB*		0000h…FFFFh	-
10.02	DI delayed status	*PB*		0000h…FFFFh	-
10.03	DI force selection	*PB*		0000h…FFFFh	-
10.04	DI force data	*PB*		0000h…FFFFh	-
10.05	DI1 ON delay	*Real*		0.0 … 3000.0	s
10.06	DI1 OFF delay	*Real*		0.0 … 3000.0	s
10.07	DI2 ON delay	*Real*		0.0 … 3000.0	s
10.08	DI2 OFF delay	*Real*		0.0 … 3000.0	s
10.09	DI3 ON delay	*Real*		0.0 … 3000.0	s
10.10	DI3 OFF delay	*Real*		0.0 … 3000.0	s
10.11	DI4 ON delay	*Real*		0.0 … 3000.0	s
10.12	DI4 OFF delay	*Real*		0.0 … 3000.0	s
10.13	DI5 ON delay	*Real*		0.0 … 3000.0	s
10.14	DI5 OFF delay	*Real*		0.0 … 3000.0	s
10.15	DI6 ON delay	*Real*		0.0 … 3000.0	s
10.16	DI6 OFF delay	*Real*		0.0 … 3000.0	s
10.21	RO status	*PB*		0000h…FFFFh	-
10.24	RO1 source	*Binary src*		-	-
10.25	RO1 ON delay	*Real*		0.0 … 3000.0	s
10.26	RO1 OFF delay	*Real*		0.0 … 3000.0	s
10.27	RO2 source	*Binary src*		-	-
10.28	RO2 ON delay	*Real*		0.0 … 3000.0	s
10.29	RO2 OFF delay	*Real*		0.0 … 3000.0	s
10.30	RO3 source	*Binary src*		-	-
10.31	RO3 ON delay	*Real*		0.0 … 3000.0	s
10.32	RO3 OFF delay	*Real*		0.0 … 3000.0	s
11 Standard DIO, FI, FO					
11.01	DIO status	*PB*		00000000b…11111111b	-
11.02	DIO delayed status	*PB*		00000000b…11111111b	-
11.05	DIO1 configuration	*List*		0…2	-
11.06	DIO1 output source	*Binary src*		-	
11.07	DIO1 ON delay	*Real*		0.0 … 3000.0	s
11.08	DIO1 OFF delay	*Real*		0.0 … 3000.0	s
11.09	DIO2 configuration	*List*		0…2	-
11.10	DIO2 output source	*Binary src*		-	
11.11	DIO2 ON delay	*Real*		0.0 … 3000.0	s
11.12	DIO2 OFF delay	*Real*		0.0 … 3000.0	s
11.38	Freq in 1 actual value	*Real*		0…30000	Hz

No.	Name	Type	Data len.	Range	Unit
11.39	Freq in 1 scaled	*Real*		0 … 30000	-
11.42	Freq in 1 min	*Real*		0…16000	Hz
11.43	Freq in 1 max	*Real*		0…16000	Hz
11.44	Freq in 1 scaled at min	*Real*		-32768.000 … 32767.000	-
11.45	Freq in 1 scaled at max	*Real*		-32768.000 … 32767.000	-
11.54	Freq out 1 actual value	*Real*		0…30000	Hz
11.55	Freq out 1 source	*Analog src*		-	-
11.58	Freq out 1 src min	*Real*		-32768.000 … 32767.000	-
11.59	Freq out 1 src max	*Real*		-32768.000 … 32767.000	-
11.60	Freq out 1 at src min	*Real*		0…16000	Hz
11.61	Freq out 1 at src max	*Real*		0…16000	Hz
12 Standard AI					
12.11	AI1 actual value	*Real*		-22.0 … 22.0	mA or V
12.12	AI1 scaled value	*Real*		-32768.0 … 32767.0	-
12.15	AI1 unit selection	*List*		-	-
12.16	AI1 filter time	*Real*		0.0 … 30.0	s
12.17	AI1 min	*Real*		-22.0 … 22.0	mA or V
12.18	AI1 max	*Real*		-22.0 … 22.0	mA or V
12.19	AI1 scaled at AI1 min	*Real*		-32768.0 … 32767.0	-
12.20	AI1 scaled at AI1 max	*Real*		-32768.0 … 32767.0	-
12.21	AI2 actual value	*Real*		-22.0 … 22.0	mA or V
12.22	AI2 scaled value	*Real*		-32768.000 … 32767.000	-
12.25	AI2 unit selection	*List*		-	-
12.26	AI2 filter time	*Real*		0.0 … 30.0	s
12.27	AI2 min	*Real*		-22.0 … 22.0	mA or V
12.28	AI2 max	*Real*		-22.0 … 22.0	mA or V
12.29	AI2 scaled at AI2 min	*Real*		-32768.0 … 32767.0	-
12.30	AI2 scaled at AI2 max	*Real*		-32768.0 … 32767.0	-
13 Standard AO					
13.11	AO1 actual value	*Real*		0.0 … 22.0	mA
13.12	AO1 source	*Analog src*		-	-
13.16	AO1 filter time	*Real*		0.0 … 30.0	s
13.17	AO1 source min	*Real*		-32768.0 … 32767.0	-
13.18	AO1 source max	*Real*		-32768.0 … 32767.0	-
13.19	AO1 out at AO1 src min	*Real*		0.0 … 22.0	mA
13.20	AO1 out at AO1 src max	*Real*		0.0 … 22.0	mA
13.21	AO2 actual value	*Real*		0.0 … 22.0	mA
13.22	AO2 source	*Analog src*		-	-
13.26	AO2 filter time	*Real*		0.0 … 30.0	s
13.27	AO2 source min	*Real*		-32768.0 … 32767.0	-

No.	Name	Type	Data len.	Range	Unit
13.28	AO2 source max	*Real*		-32768.0 … 32767.0	-
13.29	AO2 out at AO2 src min	*Real*		0.0 … 22.0	mA
13.30	AO2 out at AO2 src max	*Real*		0.0 … 22.0	mA
19 Operation mode					
19.01	Actual operation mode	*List*		-	-
19.11	Ext1/Ext2 selection	*Binary src*		-	-
19.12	Ext1 control mode 1	*List*		1…6	-
19.14	Ext2 control mode 1	*List*		1…6	-
19.16	Local control mode	*List*		0…1	-
19.17	Local control disable	*List*		0…1	-
19.20	Scalar control reference unit	*List*		0…1	-
20 Start/stop/direction					
20.01	Ext1 commands	*List*		-	-
20.02	Ext1 start trigger	*List*		0…1	-
20.03	Ext1 in1	*Binary src*		-	-
20.04	Ext1 in2	*Binary src*		-	-
20.05	Ext1 in3	*Binary src*		-	-
20.06	Ext2 commands	*List*		-	-
20.07	Ext2 start trigger	*List*		0…1	-
20.08	Ext2 in1	*Binary src*		-	-
20.09	Ext2 in2	*Binary src*		-	-
20.10	Ext2 in3	*Binary src*		-	-
20.12	Run enable 1	*Binary src*		-	-
20.19	Enable start command	*Binary src*		-	-
20.23	Positive speed reference enable	*Binary src*		-	-
20.24	Negative speed reference enable	*Binary src*		-	-
20.25	Jogging enable	*Binary src*		-	-
20.26	Jogging 1 start	*Binary src*		-	-
20.27	Jogging 2 start	*Binary src*		-	-
21 Start/stop mode					
21.01	Start mode	*List*		0…2	-
21.02	Magnetization time	*Real*		0…10000	ms
21.03	Stop mode	*List*		0…2	-
21.04	Emergency stop mode	*List*		0…2	-
21.05	Emergency stop source	*Binary src*		-	-
21.06	Zero speed limit	*Real*		0.00 … 30000.00	rpm
21.07	Zero speed delay	*Real*		0…30000	ms
21.08	DC current control	*PB*		00b…11b	-
21.09	DC hold speed	*Real*		0.0 … 1000.0	rpm

No.	Name	Type	Data len.	Range	Unit
21.10	DC current reference	*Real*		0.0 … 100.0	%
21.11	Post magnetization time	*Real*		0…3000	ms
21.13	Autophasing mode	*List*		0…2	-
22 Speed reference selection					
22.01	Speed ref unlimited	*Real*		-30000.00 … 30000.00	rpm
22.11	Speed ref1 selection	*Analog src*		-	-
22.12	Speed ref2 selection	*Analog src*		-	-
22.13	Speed ref1 function	*List*		0…5	-
22.14	Speed ref1/2 selection	*Binary src*		-	-
22.15	Additive speed ref1	*Analog src*		-	-
22.16	Speed share	*Real*		-8.000 … 8.000	-
22.17	Additive speed ref2	*Analog src*		-	-
22.21	Constant speed function	*PB*		00b…11b	-
22.22	Constant speed sel1	*Binary src*		-	-
22.23	Constant speed sel2	*Binary src*		-	-
22.24	Constant speed sel3	*Binary src*		-	-
22.26	Constant speed 1	*Real*		-30000.00 … 30000.00	rpm
22.27	Constant speed 2	*Real*		-30000.00 … 30000.00	rpm
22.28	Constant speed 3	*Real*		-30000.00 … 30000.00	rpm
22.29	Constant speed 4	*Real*		-30000.00 … 30000.00	rpm
22.30	Constant speed 5	*Real*		-30000.00 … 30000.00	rpm
22.31	Constant speed 6	*Real*		-30000.00 … 30000.00	rpm
22.32	Constant speed 7	*Real*		-30000.00 … 30000.00	rpm
22.41	Speed ref safe	*Real*		-30000.00 … 30000.00	rpm
22.42	Jogging 1 ref	*Real*		-30000.00 … 30000.00	rpm
22.43	Jogging 2 ref	*Real*		-30000.00 … 30000.00	rpm
22.51	Critical speed function	*PB*		00b…11b	-
22.52	Critical speed 1 low	*Real*		-30000.00 … 30000.00	rpm
22.53	Critical speed 1 high	*Real*		-30000.00 … 30000.00	rpm
22.54	Critical speed 2 low	*Real*		-30000.00 … 30000.00	rpm
22.55	Critical speed 2 high	*Real*		-30000.00 … 30000.00	rpm
22.56	Critical speed 3 low	*Real*		-30000.00 … 30000.00	rpm
22.57	Critical speed 3 high	*Real*		-30000.00 … 30000.00	rpm
22.81	Speed reference 1 act	*Real*		-30000.00 … 30000.00	rpm
22.82	Speed reference 2 act	*Real*		-30000.00 … 30000.00	rpm
22.83	Speed reference 3 act	*Real*		-30000.00 … 30000.00	rpm
22.84	Speed reference 4 act	*Real*		-30000.00 … 30000.00	rpm
22.85	Speed reference 5 act	*Real*		-30000.00 … 30000.00	rpm
22.86	Speed reference 6 act	*Real*		-30000.00 … 30000.00	rpm
22.87	Speed reference 7 act	*Real*		-30000.00 … 30000.00	rpm

No.	Name	Type	Data len.	Range	Unit
23 Speed reference ramp					
23.01	Speed ref ramp in	*Real*		-30000.00 … 30000.00	rpm
23.02	Speed ref ramp out	*Real*		-30000.00 … 30000.00	rpm
23.11	Ramp set selection	*Binary src*		-	-
23.12	Acceleration time 1	*Real*		0.000 …1800.000	s
23.13	Deceleration time 1	*Real*		0.000 …1800.000	s
23.14	Acceleration time 2	*Real*		0.000 …1800.000	s
23.15	Deceleration time 2	*Real*		0.000 …1800.000	s
23.16	Shape time acc 1	*Real*		0.000 …1800.000	s
23.17	Shape time acc 2	*Real*		0.000 …1800.000	s
23.18	Shape time dec 1	*Real*		0.000 …1800.000	s
23.19	Shape time dec 2	*Real*		0.000 …1800.000	s
23.20	Acc time jogging	*Real*		0.000 …1800.000	s
23.21	Dec time jogging	*Real*		0.000 …1800.000	s
23.23	Emergency stop time	*Real*		0.000 …1800.000	s
23.24	Ramp in zero	*Binary src*		-	-
23.26	Ramp out balance enable	*Binary src*		-	-
23.27	Ramp output balance ref	*Real*		-30000.00 … 30000.00	rpm
23.28	Variable slope enable	*List*		0…1	-
23.29	Variable slope rate	*Real*		1…30000	ms
24 Speed reference conditioning					
24.01	Used speed reference	*Real*		-30000.00 … 30000.00	rpm
24.02	Used actual speed	*Real*		-30000.00 … 30000.00	rpm
24.03	Speed error filtered	*Real*		-30000.00 … 30000.00	rpm
24.04	Speed error negative	*Real*		-30000.00 … 30000.00	rpm
24.11	Speed correction	*Real*		-10000…10000	-
24.12	Speed error filter time	*Real*		0…10000	ms
24.41	Speed error window control enable	*List*		0…1	-
24.42	Speed error window control mode	*List*		0…1	-
24.43	Speed error window high	*Real*		0…3000	rpm
24.44	Speed error window low	*Real*		0…3000	rpm
24.46	Speed error step	*Real*		-3000.0 … 3000.0	rpm
25 Speed control					
25.01	Torque reference speed control	*Real*		-1600.0 … 1600.0	%
25.02	Proportional gain	*Real*		0.00 … 250.00	-
25.03	Integration time	*Real*		0.00 … 1000.00	s
25.04	Derivation time	*Real*		0.000 … 10000.000	s
25.05	Derivation filt time	*Real*		0.0 … 1000.0	ms

No.	Name	Type	Data len.	Range	Unit
25.06	Acc comp derivation time	*Real*		0.00 … 1000.00	s
25.07	Acc comp filt time	*Real*		0.0 … 1000.0	ms
25.08	Drooping rate	*Real*		0.00 … 100.00	%
25.09	Speed ctrl balance enable	*Binary src*		-	-
25.10	Speed ctrl balance reference	*Real*		-300 … 300	-
25.11	Min torque speed control	*Real*		-1600.0 … 0.0	%
25.12	Max torque speed control	*Real*		0.0 … 1600.0	%
25.15	Proportional gain em stop	*Real*		0…250	-
25.53	Torque prop reference	*Real*		-16000.0 … 16000.0	%
25.54	Torque integ reference	*Real*		-16000.0 … 16000.0	%
25.55	Torque der reference	*Real*		-16000.0 … 16000.0	%
25.56	Torque acc compensation	*Real*		-16000.0 … 16000.0	%
25.57	Torque reference unbalanced	*Real*		-16000.0 … 16000.0	%
26 Torque reference chain					
26.01	Torque ref to TC	*Real*		-1600.0 … 1600.0	%
26.02	Torque ref used	*Real*		-1600.0 … 1600.0	%
26.08	Minimum torque ref	*Real*		-1000.0 … 0.0	%
26.09	Maximum torque ref	*Real*		0.0 … 1000.0	%
26.11	Torque ref1 selection	*Analog src*		-	-
26.12	Torque ref2 selection	*Analog src*		-	-
26.13	Torque ref1 function	*List*		0…5	-
26.14	Torque ref1/2 selection	*Binary src*		-	-
26.15	Load share	*Real*		-8.000 … 8.000	-
26.16	Additive torque ref 1	*Analog src*		-	-
26.17	Torque ref filter time	*Real*		0.000 … 30.000	s
26.18	Torque ramp up time	*Real*		0.000 … 60.000	s
26.19	Torque ramp down time	*Real*		0.000 … 60.000	s
26.25	Additive torque ref 2	*Analog src*		-	-
26.26	Force torque ref add 2 zero	*Binary src*		-	-
26.41	Torque step	*Real*		-300.00 … 300.00	%
26.42	Torque step enable	*List*		0…1	-
26.70	Torque ref1 actual	*Real*		-1600.0 … 1600.0	%
26.71	Torque ref2 actual	*Real*		-1600.0 … 1600.0	%
26.72	Torque ref3 actual	*Real*		-1600.0 … 1600.0	%
26.73	Torque ref4 actual	*Real*		-1600.0 … 1600.0	%
26.74	Torque ref ramped	*Real*		-1600.0 … 1600.0	%
26.75	Torque ref5 actual	*Real*		-1600.0 … 1600.0	%
26.76	Torque ref6 actual	*Real*		-1600.0 … 1600.0	%
26.77	Torque ref add A actual	*Real*		-1600.0 … 1600.0	%
26.78	Torque ref add B actual	*Real*		-1600.0 … 1600.0	%

No.	Name	Type	Data len.	Range	Unit
26.81	Rush control gain	*Real*		1.0 … 10000.0	-
26.82	Rush control integration time	*Real*		0.1 … 10.0	s
28 Frequency reference chain					
28.01	Frequency ref ramp in	*Real*		-3000.0 … 3000.0	Hz
28.02	Frequency ref ramped	*Real*		-3000.0 … 3000.0	Hz
28.11	Frequency ref1 selection	*Analog src*		-	-
28.12	Frequency ref2 selection	*Analog src*		-	-
28.13	Frequency ref1 function	*List*		0…5	-
28.14	Frequency ref1/2 selection	*Binary src*		-	-
28.21	Constant frequency function	*PB*		00b…11b	-
28.22	Constant frequency sel1	*Binary src*		-	-
28.23	Constant frequency sel2	*Binary src*		-	-
28.24	Constant frequency sel3	*Binary src*		-	-
28.26	Constant frequency 1	*Real*		-3000…3000	Hz
28.27	Constant frequency 2	*Real*		-3000…3000	Hz
28.28	Constant frequency 3	*Real*		-3000…3000	Hz
28.29	Constant frequency 4	*Real*		-3000…3000	Hz
28.30	Constant frequency 5	*Real*		-3000…3000	Hz
28.31	Constant frequency 6	*Real*		-3000…3000	Hz
28.32	Constant frequency 7	*Real*		-3000…3000	Hz
28.41	Frequency ref safe	*Real*		-3000…3000	Hz
28.51	Critical frequency function	*PB*		00b…11b	-
28.52	Critical frequency 1 low	*Real*		-3000…3000	
28.53	Critical frequency 1 high	*Real*		-3000…3000	
28.54	Critical frequency 2 low	*Real*		-3000…3000	
28.55	Critical frequency 2 high	*Real*		-3000…3000	
28.56	Critical frequency 3 low	*Real*		-3000…3000	
28.57	Critical frequency 3 high	*Real*		-3000…3000	
28.71	Ramp set selection	*Binary src*		-	-
28.72	Acceleration time 1	*Real*		0.000 …1800.000	s
28.73	Deceleration time 1	*Real*		0.000 …1800.000	s
28.74	Acceleration time 2	*Real*		0.000 …1800.000	s
28.75	Deceleration time 2	*Real*		0.000 …1800.000	s
28.76	Ramp in zero	*Binary src*		-	-
28.77	Ramp hold	*Binary src*		-	-
28.78	Ramp output balance	*Real*		-3000.0 … 3000.0	Hz
28.79	Ramp output balance ena	*Binary src*		-	-
28.80	Frequency ref ramp in sel	*Analog src*		-	-
28.81	Frequency ref in scalar control	*Analog src*		-	-
28.90	Frequency ref1 act	*Real*		-3000.0 … 3000.0	Hz

No.	Name	Type	Data len.	Range	Unit
28.91	Frequency ref2 act	*Real*		-3000.0 … 3000.0	Hz
28.92	Frequency ref3 act	*Real*		-3000.0 … 3000.0	Hz
28.96	Frequency ref7 act	*Real*		-3000.0 … 3000.0	Hz
28.97	Frequency ref unlimited	*Real*		-3000.0 … 3000.0	Hz
30 Limits					
30.01	Limit word 1	*PB*		0000h…FFFFh	-
30.02	Torque limit status	*PB*		0000h…FFFFh	-
30.11	Minimum speed	*Real*		-30000.00 … 30000.00	rpm
30.12	Maximum speed	*Real*		-30000.00 … 30000.00	rpm
30.13	Minimum frequency	*Real*		-3000.0 … 3000.0	Hz
30.14	Maximum frequency	*Real*		-3000.0 … 3000.0	Hz
30.17	Maximum current	*Real*		0.00 … 30000.00	A
30.19	Minimum torque	*Real*		-1600.0 … 1600.0	%
30.20	Maximum torque	*Real*		-1600.0 … 1600.0	%
30.26	Power motoring limit	*Real*		0.00 … 600.00	%
30.27	Power generating limit	*Real*		-600.00 … 0.00	kW
30.30	Overvoltage control	*List*		0…1	-
30.31	Undervoltage control	*List*		0…1	-
31 Fault functions					
31.01	External event 1 source	*Binary src*		-	-
31.02	External event 1 type	*List*		0…2	-
31.11	Fault reset selection	*Binary src*		-	-
31.12	Autoreset sel	*PB*		0000h…FFFFh	-
31.13	Selectable fault	*Real*		0…65535	-
31.14	Number of trials	*Real*		0…5	-
31.15	Trial time	*Real*		1.0 … 600.0	s
31.16	Delay time	*Real*		0.0 … 120.0	s
31.19	Motor phase loss	*List*		0…1	-
31.20	Earth fault	*List*		0…2	-
31.21	Supply phase loss	*List*		0…1	-
31.22	STO diagnostics	*List*		0…3	-
31.23	Cross connection	*List*		0…1	-
31.24	Stall function	*List*		0…2	-
31.25	Stall current limit	*Real*		0.0 … 1600.0	%
31.26	Stall speed high	*Real*		0.0 … 10000.0	rpm
31.27	Stall frequency high	*Real*		0.0 … 1000.0	Hz
31.28	Stall time	*Real*		0…3600	s
31.30	Speed trip margin	*Real*		0…10000	rpm
31.31	Frequency trip margin	*Real*		0…10000	Hz

No.	Name	Type	Data len.	Range	Unit
33 Maintenance timer & counter					
33.01	Counter status	*PB*		000000b…111111b	-
33.10	On-time 1 actual	*Real*		0…4294967295	s
33.11	On-time 1 limit	*Real*		0…4294967295	s
33.12	On-time 1 function	*PB*		00b…11b	-
33.13	On-time 1 source	*Binary src*		-	-
33.14	On-time 1 warning select	*List*		-	-
33.20	On-time 2 actual	*Real*		0…4294967295	s
33.21	On-time 2 limit	*Real*		0…4294967295	s
33.22	On-time 2 function	*PB*		00b…11b	-
33.23	On-time 2 source	*Binary src*		-	-
33.24	On-time 2 warning select	*List*		-	-
33.30	Edge counter 1 actual	*Real*		0…4294967295	-
33.31	Edge counter 1 limit	*Real*		0…4294967295	-
33.32	Edge counter 1 func	*PB*		0000b…1111b	-
33.33	Edge counter 1 source	*Binary src*		-	-
33.34	Edge counter 1 divider	*Real*		0…4294967295	-
33.35	Edge counter 1 warning select	*List*		-	-
33.40	Edge counter 2 actual	*Real*		0…4294967295	-
33.41	Edge counter 2 limit	*Real*		0…4294967295	-
33.42	Edge counter 2 function	*PB*		0000b…1111b	-
33.43	Edge counter 2 source	*Binary src*		-	-
33.44	Edge counter 2 divider	*Real*		0…4294967295	-
33.45	Edge counter 2 warning select	*List*		-	-
33.50	Value counter 1 actual	*Real*		-2147483648 … 2147483647	-
33.51	Value counter 1 limit	*Real*		-2147483648 … 2147483647	-
33.52	Value counter 1 function	*PB*		00b…11b	-
33.53	Value counter 1 source	*Analog src*		-	-
33.54	Value counter 1 divider	*Real*		0.001 … 2147483.647	-
33.55	Value counter 1 warning select	*List*		-	-
33.60	Value counter 2 actual	*Real*		-2147483648 … 2147483647	-
33.61	Value counter 2 limit	*Real*		-2147483648 … 2147483647	-
33.62	Value counter 2 function	*PB*		00b…11b	-
33.63	Value counter 2 source	*Analog src*		-	-
33.64	Value counter 2 divider	*Real*		0.001 … 2147483.647	-
33.65	Value counter 2 warning select	*List*		-	-
35 Motor thermal protection					
35.01	Motor estimated temperature	*Real*		-60 … 1000	°C
35.02	Measured temperature 1	*Real*		-10 … 1000	°C
35.03	Measured temperature 2	*Real*		-10 … 1000	°C

No.	Name	Type	Data len.	Range	Unit
35.10	Supervision 1 protection	*List*		0…2	-
35.11	Supervision 1 source	*List*		0…10	-
35.12	Supervision 1 fault limit	*Real*		-10 … 1000	°C
35.13	Supervision 1 warning limit	*Real*		-10 … 1000	°C
35.14	Supervision 1 AI select	*Analog src*		-	-
35.20	Supervision 2 protection	*List*		0…2	-
35.21	Supervision 2 source	*List*		0…10	-
35.22	Supervision 2 fault limit	*Real*		-10 … 1000	°C
35.23	Supervision 2 warning limit	*Real*		-10 … 1000	°C
35.24	Supervision 2 AI select	*Analog src*		-	-
35.50	Motor ambient temperature	*Real*		-60…100	°C
35.51	Motor load curve	*Real*		50…150	%
35.52	Zero speed load	*Real*		50…150	%
35.53	Break point	*Real*		1.00 … 500.00	Hz
35.54	Motor nominal temp rise	*Real*		0…300	°C
35.55	Motor thermal time const	*Real*		100…10000	s
40 Process PID set1					
40.01	Process PID actual value	*Real*		-32768 … 32767	rpm, % or Hz
40.02	Feedback actual value	*Real*		-2147483648 … 2147483647	rpm, % or Hz
40.03	Setpoint actual value	*Real*		-2147483648 … 2147483647	rpm, % or Hz
40.04	Deviation actual value	*Real*		-2147483648 … 2147483647	rpm, % or Hz
40.05	Trim output actual value	*Real*		-2147483648 … 2147483647	rpm, % or Hz
40.06	PID status word	*PB*		0000h…FFFFh	-
40.07	PID operation mode	*List*		0…2	-
40.08	Feedback 1 source	*Analog src*		-	-
40.09	Feedback 2 source	*Analog src*		-	-
40.10	Feedback function	*List*		0…11	-
40.11	Feedback filter time	*Real*		0.000 … 30.000	s
40.12	Unit selection	*List*		0…2	-
40.14	Setpoint base	*Real*		-2147483648 … 2147483647	-
40.15	Output base	*Real*		-2147483648 … 2147483647	-
40.16	Setpoint 1 source	*Analog src*		-	-
40.17	Setpoint 2 source	*Analog src*		-	-
40.18	Setpoint function	*List*		0…11	-
40.19	Internal setpoint selection 1	*Binary src*		-	-
40.20	Internal setpoint selection 2	*Binary src*		-	-

No.	Name	Type	Data len.	Range	Unit
40.21	Internal setpoint 1	*Real*		-2147483648 … 2147483647	rpm, % or Hz
40.22	Internal setpoint 2	*Real*		-2147483648 … 2147483647	rpm, % or Hz
40.23	Internal setpoint 3	*Real*		-2147483648 … 2147483647	rpm, % or Hz
40.24	Internal setpoint 4	*Real*		-2147483648 … 2147483647	rpm, % or Hz
40.25	Setpoint selection	*Binary src*		-	-
40.26	Setpoint min	*Real*		-32767.0 … 32767.0	-
40.27	Setpoint max	*Real*		-32767.0 … 32767.0	-
40.28	Setpoint increase time	*Real*		0.0 … 1800.0	s
40.29	Setpoint decrease time	*Real*		0.0 … 1800.0	s
40.30	Setpoint freeze enable	*Binary src*		-	-
40.31	Deviation inversion	*Binary src*		-	-
40.32	Gain	*Real*		0.1 … 100.0	-
40.33	Integration time	*Real*		0.0 … 3600.0	s
40.34	Derivation time	*Real*		0.0 … 10.0	s
40.35	Derivation filter time	*Real*		0.0 … 10.0	s
40.36	Output min	*Real*		-32767.0 … 32767.0	-
40.37	Output max	*Real*		-32767.0 … 32767.0	-
40.38	Output freeze enable	*Binary src*		-	-
40.39	Deadband range	*Real*		0.0 … 32767.0	-
40.40	Deadband delay	*Real*		0.0 … 3600.0	s
40.41	Sleep mode	*List*		0…2	-
40.42	Sleep enable	*Binary src*		-	-
40.43	Sleep level	*Real*		0.0 … 32767.0	-
40.44	Sleep delay	*Real*		0.0 … 3600.0	s
40.45	Sleep boost time	*Real*		0.0 … 3600.0	s
40.46	Sleep boost step	*Real*		0.0 … 32767.0	-
40.47	Wake-up deviation	*Real*		-2147483648 … 2147483647	rpm, % or Hz
40.48	Wake up delay	*Real*		0.00 … 60.00	s
40.49	Tracking mode	*Binary src*		-	-
40.50	Tracking ref selection	*Analog src*		-	-
40.51	Trim mode	*List*		0…3	-
40.52	Trim selection	*List*		1…3	-
40.53	Trimmed ref pointer	*Analog src*		-	-
40.54	Trim mix	*Real*		0.000 … 1.000	-
40.55	Trim adjust	*Real*		-100.000 … 100.000	-
40.56	Correction source	*List*		1…2	-
40.57	Sel between set1 set2	*Binary src*		-	-

No.	Name	Type	Data len.	Range	Unit
41 Process PID set2					
41.07	PID operation mode	*List*		0…2	-
41.08	Feedback 1 source	*Analog src*		-	-
41.09	Feedback 2 source	*Analog src*		-	-
41.10	Feedback function	*List*		0…11	-
41.11	Feedback filter time	*Real*		0.000 … 30.000	s
41.12	Unit selection	*List*		0…2	-
41.14	Setpoint base	*Real*		-2147483648 … 2147483647	-
41.15	Output base	*Real*		-2147483648 … 2147483647	-
41.16	Setpoint 1 source	*Analog src*		-	-
41.17	Setpoint 2 source	*Analog src*		-	-
41.18	Setpoint function	*List*		0…11	-
41.19	Internal setpoint selection 1	*Binary src*		-	-
41.20	Internal setpoint selection 2	*Binary src*		-	-
41.21	Internal setpoint 1	*Real*		-2147483648 … 2147483647	rpm, % or Hz
41.22	Internal setpoint 2	*Real*		-2147483648 … 2147483647	rpm, % or Hz
41.23	Internal setpoint 3	*Real*		-2147483648 … 2147483647	rpm, % or Hz
41.24	Internal setpoint 4	*Real*		-2147483648 … 2147483647	rpm, % or Hz
41.25	Setpoint selection	*Binary src*		-	-
41.26	Setpoint min	*Real*		-32767.0 … 32767.0	-
41.27	Setpoint max	*Real*		-32767.0 … 32767.0	-
41.28	Setpoint increase time	*Real*		0.0 … 1800.0	s
41.29	Setpoint decrease time	*Real*		0.0 … 1800.0	s
41.30	Setpoint freeze enable	*Binary src*		-	-
41.31	Deviation inversion	*Binary src*		-	-
41.32	Gain	*Real*		0.1 … 100.0	-
41.33	Integration time	*Real*		0.0 … 3600.0	s
41.34	Derivation time	*Real*		0.0 … 10.0	s
41.35	Derivation filter time	*Real*		0.0 … 10.0	s
41.36	Output min	*Real*		-32767.0 … 32767.0	-
41.37	Output max	*Real*		-32767.0 … 32767.0	-
41.38	Output freeze enable	*Binary src*		-	-
41.39	Deadband range	*Real*		0.0 … 32767.0	-
41.40	Deadband delay	*Real*		0.0 … 3600.0	s
41.41	Sleep mode	*List*		0…2	-
41.42	Sleep enable	*Binary src*		-	-
41.43	Sleep level	*Real*		0.0 … 32767.0	-
41.44	Sleep delay	*Real*		0.0 … 3600.0	s

No.	Name	Type	Data len.	Range	Unit
41.45	Sleep boost time	*Real*		0.0 … 3600.0	s
41.46	Sleep boost step	*Real*		0.0 … 32767.0	-
41.47	Wake-up deviation	*Real*		-2147483648 … 2147483647	rpm, % or Hz
41.48	Wake-up delay	*Real*		0.00 … 60.00	s
41.49	Tracking mode	*Binary src*		-	-
41.50	Tracking ref selection	*Analog src*		-	-
41.51	Trim mode	*List*		0…3	-
41.52	Trim selection	*List*		1…3	-
41.53	Trimmed ref pointer	*Analog src*		-	-
41.54	Trim mix	*Real*		0.000 … 1.000	-
41.55	Trim adjust	*Real*		-100.000 … 100.000	-
41.56	Correction source	*List*		1…2	-
43 Brake chopper					
43.01	Braking resistor temperature	*Real*		0.0 … 120.0	%
43.06	Braking chopper enable	*List*		0…2	-
43.07	Braking chopper runtime enable	*Binary src*		-	-
43.08	Brake resistor thermal tc	*Real*		0…100	s
43.09	Brake resistor Pmax cont	*Real*		0.10 … 10000.00	kW
43.10	Brake resistance	*Real*		0…1000	ohm
43.11	Brake resistor fault limit	*Real*		0…150	%
43.12	Brake resistor warning limit	*Real*		0…150	%
44 Mechanical brake control					
44.01	Brake control status	*PB*		00000000b…11111111b	-
44.02	Brake torque memory	*Real*		0…100	%
44.03	Brake open torque reference	*Real*		-2147483648 … 2147483647	%
44.06	Brake control enable	*Binary src*		-	-
44.07	Brake acknowledge selection	*Binary src*		-	-
44.08	Brake open delay	*Real*		0.00 … 5.00	s
44.09	Brake open torque source	*Analog src*		-	-
44.10	Brake open torque	*Real*		-1000…1000	%
44.11	Force brake closed	*Binary src*		-	-
44.12	Brake close request	*Binary src*		-	-
44.13	Brake close delay	*Real*		0.00 … 60.00	s
44.14	Brake close level	*Real*		0.0 … 1000.0	rpm
44.15	Brake close level delay	*Real*		0.00 … 10.00	s
44.16	Brake reopen delay	*Real*		0.00 … 10.00	s
44.17	Brake fault function	*List*		0…2	-
44.18	Brake fault delay	*Real*		0.00 … 60.00	s

No.	Name	Type	Data len.	Range	Unit
45 Energy savings					
45.01	Saved energy in GWh	*Real*		0…65535	GWh
45.02	Saved energy in MWh	*Real*		0…999	MWh
45.03	Saved energy in kWh	*Real*		0.0 … 999.0	kWh
45.05	Monetary savings in thousands	*Real*		0…4294967295	thousand
45.06	Monetary savings	*Real*		0.00 … 999.00	(selectable)
45.07	Saved amount	*Real*		0.00 … 21474836.47	(selectable)
45.08	Saved CO2 in kilotons	*Real*		0…65535	metric kiloton
45.09	Saved CO2	*Real*		0.0 … 999.9	metric ton
45.10	Total saved CO2	*Real*		0.0 … 214748364.7	metric ton or kiloton
45.11	Energy optimization	*List*		0…1	-
45.12	Energy tariff 1	*Real*		0.000 … 4294967295.000	(selectable)
45.13	Energy tariff 2	*Real*		0.000 … 4294967295.000	(selectable)
45.14	Select used tariff	*Binary src*		-	-
45.17	E tariff unit	*List*		100…102	-
45.18	CO2 conversion factor	*Real*		0.000 … 65.535	metric ton/ MWh
45.19	Reference power	*Real*		0.0 … 10000000.0	kW
45.20	Units for savings	*List*		1, 1000	-
45.21	Reset savings	*List*		0…1	-
46 Monitoring/scaling settings					
46.01	Above speed limit	*Real*		0…30000	rpm
46.03	At setpoint hysteresis	*Real*		0…30000	rpm
46.04	Filter time motor speed	*Real*		2…20000	ms
46.05	Filter time output frequency	*Real*		2…20000	ms
46.06	Filter time motor torque	*Real*		2…20000	ms
46.07	Filter time power out	*Real*		2…20000	ms
46.10	Speed scaling	*Real*		0…30000	rpm
46.11	Frequency scaling	*Real*		0.0 … 30000.0	Hz
46.12	Torque scaling	*Real*		0.0 … 30000.0	%
46.13	Power scaling	*Real*		0.0 … 30000.0	kW
47 Data storage					
47.01	Data storage1	*Real*		-32768…32767	-
47.02	Data storage2	*Real*		-32768…32767	-
47.03	Data storage3	*Real*		-32768…32767	-
47.04	Data storage4	*Real*		-32768…32767	-
47.05	Data storage5	*Real*		-32768…32767	-
47.06	Data storage6	*Real*		-32768…32767	-

No.	Name	Type	Data len.	Range	Unit
47.07	Data storage7	*Real*		-32768…32767	-
47.08	Data storage8	*Real*		-32768…32767	-
49 Panel port communication					
49.01	Node ID number	*Real*		1…32	-
49.03	Baud rate	*List*		4…6	-
49.05	Communication loss action	*List*		0…3	-
49.06	Refresh settings	*List*		0…1	-
50 Fieldbus adapter (FBA)					
50.01	FBA A enable	*List*		0…1	-
50.02	FBA A comm loss func	*List*		0…3	-
50.03	FBA A comm loss t out	*Real*		0.3 … 6552.6	s
50.04	FBA A ref1 type	*List*		0…10	-
50.05	FBA A ref2 type	*List*		0…10	-
50.06	FBA A SW sel	*List*		0…1	-
50.07	FBA A actual 1 type	*List*		0…10	-
50.08	FBA A actual 2 type	*List*		0…10	-
50.09	FBA A SW transparent source	*Analog src*		-	-
50.10	FBA A act1 transparent source	*Analog src*		-	-
50.11	FBA A act2 transparent source	*Analog src*		-	-
50.12	FBA A debug enable	*List*		0…1	-
50.13	FBA A control word	*Data*		0000h…FFFFh	-
50.14	FBA A reference 1	*Real*		0…4294967295	-
50.15	FBA A reference 2	*Real*		0…4294967295	-
50.16	FBA A status word	*Data*		0000h…FFFFh	-
50.17	FBA A actual value 1	*Real*		0…4294967295	-
50.18	FBA A actual value 2	*Real*		0…4294967295	-
50.21	FBA A timelevel sel	*List*		0…3	-
51 FBA A settings					
51.01	FBA type	*List*		-	-
51.02	FBA Par2	*Real*		0…65535	-
…	…	…		…	…
51.26	FBA Par26	*Real*		0…65535	-
51.27	FBA par refresh	*List*		0…1	-
51.28	Par table ver	*Data*		0…65535	-
51.29	Drive type code	*Real*		0…65535	-
51.30	Mapping file ver	*Real*		0…65535	-
51.31	D2FBA comm sta	*List*		0…6	-
51.32	FBA comm SW ver	*Data*		0…65535	-
51.33	FBA appl SW ver	*Data*		0…65535	-

No.	Name	Type	Data len.	Range	Unit
52 FBA A data In					
52.01	FBA data in1	*List*		-	-
…	…	…		…	…
52.12	FBA data in12	*List*		-	-
53 FBA A data out					
53.01	FBA data out1	*List*		-	-
…	…	…		…	…
53.12	FBA data out12	*List*		-	-
90 Feedback selection					
90.01	Motor speed for control	*Real*		-21474836.48 … 21474836.47	rpm
90.02	Motor position	*Real*		-21474836.48 … 21474836.47	rev
90.03	Load speed	*Real*		-21474836.48 … 21474836.47	rpm
90.04	Load position	*Real*		-2147483648 … 2147483647	rev
90.05	Load position scaled	*Real*		-2147483648 … 2147483647	-
90.10	Encoder 1 speed	*Real*		-21474836.48 … 21474836.47	rpm
90.11	Encoder 1 position	*Real*		-21474836.48 … 21474836.47	rev
90.12	Encoder 1 multiturn revolutions	*Real*		0…4294967295	-
90.13	Encoder 1 revol extension	*Real*		-2147483648 … 2147483647	-
90.14	Encoder 1 position raw	*Real*		TBA	-
90.15	Encoder 1 revolutions raw	*Real*		TBA	-
90.20	Encoder 2 speed	*Real*		-21474836.48 … 21474836.47	rpm
90.21	Encoder 2 position	*Real*		-21474836.48 … 21474836.47	rev
90.22	Encoder 2 multiturn revolutions	*Real*		0…4294967295	-
90.23	Encoder 2 revol extension	*Real*		-2147483648 … 2147483647	-
90.24	Encoder 2 position raw	*Real*		TBA	-
90.25	Encoder 2 revolutions raw	*Real*		TBA	-
90.26	Motor revol extension	*Real*		-2147483648 … 2147483647	-
90.27	Load revol extension	*Real*		-2147483648 … 2147483647	-
90.41	Motor feedback selection	*List*		0…2	-
90.42	Motor speed filter time	*Real*		0…10000	ms
90.43	Motor gear numerator	*Real*		-32768…32767	-
90.44	Motor gear denominator	*Real*		-32768…32767	-
90.45	Motor feedback fault	*List*		0…2	-
90.46	Force open loop	*List*		0…1	-
90.51	Load feedback selection	*List*		0…4	-
90.52	Load speed filter time	*Real*		0…10000	ms
90.53	Load gear numerator	*Real*		-2147483648 … 2147483647	-
90.54	Load gear denominator	*Real*		-2147483648 … 2147483647	-
90.56	Load position offset	*Real*		-32768 … 32767	rev

No.	Name	Type	Data len.	Range	Unit
90.57	Load position resolution	*Real*		0…32	-
90.61	Gear numerator	*Real*		-2147483648 … 2147483647	-
90.62	Gear denominator	*Real*		-2147483648 … 2147483647	-
90.63	Feed constant numerator	*Real*		-2147483648 … 2147483647	-
90.64	Feed constant denominator	*Real*		-2147483648 … 2147483647	-
91 Encoder module settings					
91.01	FEN DI status	*PB*		000000b…111111b	-
91.02	Module 1 status	*List*		-	-
91.03	Module 2 status	*List*		-	-
91.04	Module 1 temperature	*Real*		0…1000	°C
91.06	Module 2 temperature	*Real*		0…1000	°C
91.10	Encoder parameter refresh	*List*		0…1	-
91.11	Module 1 type	*List*		0…4	-
91.12	Module 1 location	*Real*		1…254	-
91.13	Module 2 type	*List*		0…4	-
91.14	Module 2 location	*Real*		1…254	-
91.21	Temperature meas sel1	*List*		0…2	-
91.22	Temperature filtering time 1	*Real*		0…10000	ms
91.23	PTC filtering 1	*Real*		0…65535	-
91.24	Temperature meas sel2	*List*		0…2	-
91.25	Temperature filtering time 2	*Real*		0…10000	ms
91.26	PTC filtering 2	*Real*		0…65535	-
92 Encoder 1 configuration					
92.01	Encoder 1 type	*List*		-	-
92.02	Encoder 1 source	*List*		1…2	-
92.03	Encoder 1 type act	*List*		-	-
Other parameters in this group when parameter 92.01 Encoder 1 type = Abs enc					
92.10	Sine/cosine number	*Real*		0…65535	-
92.11	Absolute position source	*List*		0…5	-
92.12	Zero pulse enable	*List*		0…1	-
92.14	Revolution data width	*Real*		0…32	-
92.30	Serial link mode	*List*		0…1	-
92.31	EnDat calc time	*List*		0…3	-
92.32	SSI cycle time	*List*		0…5	-
92.33	SSI clock cycles	*Real*		2…127	-
92.34	SSI position msb	*Real*		1…126	-
92.35	SSI revol msb	*Real*		1…126	-
92.36	SSI data format	*List*		0…1	-
92.37	SSI baud rate	*List*		0…5	-
92.40	SSI zero phase	*List*		0…3	-

No.	Name	Type	Data len.	Range	Unit
92.45	Hiperface parity	*List*		0…1	-
92.46	Hiperface baud rate	*List*		0…3	-
92.47	Hiperface node address	*Real*		0…255	-
Other parameters in this group when parameter 92.01 Encoder 1 type = Resolver					
92.10	Excitation signal frequency	*Real*		1…20	kHz
92.11	Excitation signal amplitude	*Real*		4.0 … 12.0	V
92.12	Resolver polepairs	*List*		1…32	-
Other parameters in this group when parameter 92.01 Encoder 1 type = HTL					
92.10	Pulses/revolution	*Real*		0…65535	-
92.11	Pulse encoder type	*List*		0…1	-
92.12	Speed calc mode	*List*		0…5	-
92.14	Speed estimation enable	*List*		0…1	-
92.15	Transient filter	*List*		0…3	-
93 Encoder 2 configuration					
93.01	Encoder 2 type	*List*		-	-
93.02	Encoder 2 source	*List*		1…2	-
93.03	Encoder 2 type act	*List*		-	-
Other parameters in this group when parameter 93.01 Encoder 2 type = Abs enc					
93.10	Sine/cosine number	*Real*		0…65535	-
93.11	Absolute position source	*List*		0…5	-
93.12	Zero pulse enable	*List*		0…1	-
93.14	Revolution data width	*Real*		0…32	-
93.30	Serial link mode	*List*		0…1	-
93.31	EnDat calc time	*List*		0…3	-
93.32	SSI cycle time	*List*		0…5	-
93.33	SSI clock cycles	*Real*		2…127	-
93.34	SSI position msb	*Real*		1…126	-
93.35	SSI revol msb	*Real*		1…126	-
93.36	SSI data format	*List*		0…1	-
93.37	SSI baud rate	*List*		0…5	-
93.40	SSI zero phase	*List*		0…3	-
93.45	Hiperface parity	*List*		0…1	-
93.46	Hiperface baud rate	*List*		0…3	-
93.47	Hiperface node address	*Real*		0…255	-
Other parameters in this group when parameter 93.01 Encoder 2 type = Resolver					
93.10	Excitation signal frequency	*Real*		1…20	kHz
93.11	Excitation signal amplitude	*Real*		4.0 … 12.0	V
93.12	Resolver polepairs	*List*		1…32	-
Other parameters in this group when parameter 93.01 Encoder 2 type = HTL					
93.10	Pulses/revolution	*Real*		0…65535	-

No.	Name	Type	Data len.	Range	Unit
93.11	Pulse encoder type	*List*		0…1	-
93.12	Speed calc mode	*List*		0…5	-
93.14	Speed estimation enable	*List*		0…1	-
93.15	Transient filter	*List*		0…3	-
95 HW configuration					
95.01	Supply voltage	*List*		0…6	-
95.02	Adaptive voltage limits	*List*		0…1	-
95.04	Control board supply	*List*		0…1	-
96 System					
96.01	Language	*List*		-	-
96.02	Pass code	*Data*		0…99999999	-
96.06	Param restore	*List*		-	-
96.07	Param save	*List*		0…1	-
96.08	Control board boot	*Real*		0…4294967295	-
97 Motor control					
97.01	Switching frequency mode	*List*		0…2	-
97.03	Slip gain	*Real*		0…200	%
97.04	Voltage reserve	*Real*		-4…50	%
97.05	Flux braking	*List*		0…2	-
97.10	Signal injection	*List*		0…4	-
97.13	IR compensation	*Real*		0.00 … 50.00	%
98 User motor parameters					
98.01	User motor model	*List*		0…3	-
98.02	Rs user	*Real*		0.0000 … 0.50000	p.u.
98.03	Rr user	*Real*		0.0000 … 0.50000	p.u.
98.04	Lm user	*Real*		0.00000 … 10.00000	p.u.
98.05	SigmaL user	*Real*		0.00000 … 1.00000	p.u.
98.06	Ld user	*Real*		0.00000 … 10.00000	p.u.
98.07	Lq user	*Real*		0.00000 … 10.00000	p.u.
98.08	PM flux user	*Real*		0.00000 … 2.00000	p.u.
98.09	Rs user SI	*Real*		0.00000 … 100.00000	ohm
98.10	Rr user SI	*Real*		0.00000 … 100.00000	ohm
98.11	Lm user SI	*Real*		0.00 … 100000.00	mH
98.12	SigmaL user SI	*Real*		0.00 … 100000.00	mH
98.13	Ld user SI	*Real*		0.00 … 100000.00	mH
98.14	Lq user SI	*Real*		0.00 … 100000.00	mH
98.15	Position offset user	*Real*		0…360	° electrical
99 Motor data					
99.03	Motor type	*List*		0…1	-
99.04	Motor ctrl mode	*List*		0…1	-

No.	Name	Type	Data len.	Range	Unit
99.06	Motor nominal current	*Real*		0.0 … 6400.0	A
99.07	Motor nominal voltage	*Real*		0.0 … 800.0	V
99.08	Motor nominal frequency	*Real*		0.0 … 500.0	Hz
99.09	Motor nominal speed	*Real*		0 … 30000	rpm
99.10	Motor nominal power	*Real*		-10000.00 … 10000.00	kW
99.11	Motor nominal cosfii	*Real*		0.00 … 1.00	-
99.12	Motor nominal torque	*Real*		0.00 … 4294672329.296	N•m
99.13	Identification run request	*List*		0…6	-
99.14	Identification run performed	*List*		0…6	-
99.15	Motor polepairs	*Real*		0…1000	-
99.16	Phase order	*List*		0…1	-
100 Safety					
This group contains parameters related to the optional FSO-xx safety functions module. For details on the parameters in this group, refer to the documentation of the FSO-xx module.					

8

Fault tracing

What this chapter contains

The chapter lists the warning and fault messages including possible causes and corrective actions.

The warning/fault code is displayed on the control panel of the drive, as well as the Drive composer PC tool. A warning or a fault message indicates abnormal drive status. Most warning and fault causes can be identified and corrected using the information in this chapter. If not, an ABB representative should be contacted.

In this chapter, the warnings and faults are sorted by code.

Safety

WARNING! Only qualified electricians are allowed to service the drive. Read the *Safety instructions* on the first pages of the Hardware manual before working on the drive.

How to reset

After the cause of the fault has been corrected, the active fault can be reset from the control panel or Drive composer PC tool. When the fault has been removed, the drive can be restarted.

Faults can also be reset from an external source selected by parameter *31.11 Fault reset selection*.

Warning/fault history

Event log

When a warning or fault is detected, it is stored in the Event log with a time stamp. The Event log stores information on the 16 latest faults and 16 latest warnings that occurred. The Event log can be reset using the Drive composer PC tool.

Parameters that contain warning/fault information

The codes of active warnings and faults (maximum five each), and five previously occurred warnings and faults are stored in the parameters of groups *04 Warnings and faults* (page *51*).

Warning messages

Code (hex)	Warning	Cause	What to do
A2A1	Current calibration	Current measurement calibration will occur at next start.	Informative warning.
A2B1	Overcurrent	Output current has exceeded internal fault limit.	Check motor load. Check acceleration times in parameter group *23 Speed reference ramp*. Check motor and motor cable (including phasing and delta/star connection). 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 encoder cable (including phasing).
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. 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. Check there are no power factor correction capacitors or surge absorbers in motor cable.
A2BA	IGBT overload	Excessive IGBT junction to case temperature. This warning protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable.
A3A1	DC link overvoltage	Excessive intermediate circuit DC voltage	Check that overvoltage controller is on, parameter *30.30 Overvoltage control*. Check mains for static or transient overvoltage. Check brake chopper and resistor (if used). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit frequency converter with brake chopper and brake resistor.
A3A2	DC link undervoltage	Intermediate circuit DC voltage is not sufficient due to missing mains phase, blown fuse or rectifier bridge internal fault.	Check supply and fuses.
A3AA	DC not charged	The voltage of the intermediate DC circuit has not yet risen to operating level.	Check the supply voltage setting (parameter *95.01 Supply voltage*). Check the supply voltage. If the problem persists, contact your local ABB representative.

Code (hex)	Warning	Cause	What to do
A3C1	DC voltage difference	Difference in DC voltages between parallel-connected inverter modules.	Contact your local ABB representative.
A491	External temperature	Measured temperature 1 or 2 has exceeded warning limit.	Check the values of parameters *35.02 Measured temperature 1* and *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the warning limits for measured temperatures 1 and 2 in parameter group *35 Motor thermal protection*.
A4A1	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4A9	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity of drive. See appropriate *Hardware Manual*. 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.
A5A0	Safe torque off Programmable warning: *31.22 STO diagnostics*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is lost.	Check safety circuit connections. For more information, see appropriate drive hardware manual, description of parameter *31.22 STO diagnostics* (page *119*).
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.

Code (hex)	Warning	Cause	What to do
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 until the motor data is entered.
A6A6	Voltage category unselected	The input voltage has not been defined.	Define input voltage (parameter *95.01 Supply voltage*).
A6D1	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*.
A6E5	AI parametrization	The current/voltage jumper setting of an analog input does not correspond to parameter settings.	Adjust either the jumper 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 jumper 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.
A782	FEN temperature	Error in temperature measurement when temperature sensor (KTY or PTC) connected to encoder interface FEN-xx is used.	Check that parameter *35.11 Supervision 1 source* / *35.21 Supervision 2 source* setting corresponds to actual encoder interface installation:
		Error in temperature measurement when KTY sensor connected to encoder interface FEN-01 is used.	FEN-01 does not support temperature measurement with KTY sensor. Use PTC sensor or other encoder interface module.
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 braking cycle meets allowed limits.
A794	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.
A79B	BC short circuit	Short circuit in brake chopper IGBT	Replace brake chopper. Ensure brake resistor is connected and not damaged.

Code (hex)	Warning	Cause	What to do
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 that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
A7A1	Mechanical brake closing failed Programmable warning: *44.17 Brake fault function*	Mechanical brake control warning. Warning is activated e.g. if brake acknowledgement is not as expected during brake closing.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgement signal matches actual status of brake.
A7A2	Mechanical brake opening failed Programmable warning: *44.17 Brake fault function*	Mechanical brake control warning. Warning is activated e.g. if brake acknowledgement is not as expected during brake opening.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgement signal matches actual status of brake.
A7A5	Mechanical brake opening not allowed Programmable warning: *44.17 Brake fault function*	Open conditions of mechanical brake cannot be fulfilled (for example, brake has been prevented from opening by parameter *44.11 Force brake closed*).	Check mechanical brake settings in parameter group *44 Mechanical brake control* (especially *44.11 Force brake closed*). Check that acknowledgement signal (if used) matches actual status of brake.
A7B0	Motor speed feedback Programmable warning: *90.45 Motor feedback fault*	No motor speed feedback is received.	Check the settings of the parameters in groups *90 Feedback selection*, *91 Encoder module settings*, *92 Encoder 1 configuration* and *93 Encoder 2 configuration*. Check encoder installation. See the description of warning *A7E1* for more information.
A7C1	FB A communication	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.

Code (hex)	Warning	Cause	What to do
A7E1	Encoder 1	Encoder 1 has been activated by parameter but the encoder interface (FEN-xx) cannot be found.	Check that the parameter settings in groups *92 Encoder 1 configuration* are correct. **Note:** New settings will only take effect after parameter *91.10 Encoder parameter refresh* is used or after the drive control unit is powered up the next time.
A7E2	Encoder 2	Encoder 2 has been activated by parameter but the encoder interface (FEN-xx) cannot be found.	Check that the parameter settings in groups *93 Encoder 2 configuration* are correct. **Note:** New settings will only take effect after parameter *91.10 Encoder parameter refresh* is used or after the drive control unit is powered up the next time.
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. Replace control panel in mounting platform.
A981	External warning 1 Programmable warning: *31.01 External event 1 source* *31.02 External event 1 type*	Warning generated by an external device. (This information is configured through one of programmable digital inputs.)	Check external devices.
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. Return emergency stop push button to normal position. Restart drive.
AFE2	Emergency stop (off1 or off3)	Drive has received an emergency stop (mode selection off1 or off3) command.	
AFEA	Enable start signal missing	No enable start signal received.	Check the setting of (and the source selected by) parameter *20.19 Enable start command*.
AFEB	Run enable missing	No run enable signal is received.	Check setting of parameter *20.12 Run enable 1*. Switch signal on (e.g. in the fieldbus Control Word) or check wiring of selected source.
AFF6	Identification run	Motor ID run will occur at next start.	Informative warning.
AFF7	Autophasing	Autophasing will occur at next start.	Informative warning.

Fault messages

Code (hex)	Fault	Cause	What to do
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*. Check motor and motor cable (including phasing and delta/star connection). 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 encoder cable (including phasing).
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 that there is no earth fault in motor or motor cables: Measure insulation resistances of motor and motor cable. If no earth fault can be detected, contact your local ABB representative.
2340	Short circuit	Short-circuit in motor cable(s) or motor	Check motor and motor cable. Check there are no power factor correction capacitors or surge absorbers in motor cable.
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.
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 input power supply imbalance.
3180	Charge relay lost	No acknowledgement received from charge relay.	Contact your local ABB representative.
3181	Cross connection Programmable fault: *31.23 Cross connection*	Incorrect input power and motor cable connection (i.e. input power cable is connected to drive motor connection).	Check input power connections.

Code (hex)	Fault	Cause	What to do
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.
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.
3291	DC voltage difference	Difference in DC voltages between parallel-connected inverter modules.	Contact your local ABB representative.
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.
3385	Autophasing	Autophasing routine (see section *Autophasing* on page *30*) has failed.	Try other autophasing modes (see parameter *21.13 Autophasing mode*) if possible.
4210	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity of drive. See appropriate *Hardware Manual.* 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.
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).
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.

Code (hex)	Fault	Cause	What to do
4981	External temperature	Measured temperature 1 or 2 has exceeded fault limit.	Check the values of parameters *35.02 Measured temperature 1* and *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the fault limits for measured temperatures 1 and 2 in parameter group *35 Motor thermal protection*.
5080	Fan	Fan is not able to rotate freely or fan is disconnected. Fan operation is monitored by measuring fan current.	Check fan operation and connection.
5090	STO hardware failure	Safe torque off hardware failure.	Contact your local ABB representative.
5091	Safe torque off Programmable fault: *31.22 STO diagnostics*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is broken during start or , or while drive is stopped and parameter *31.22 STO diagnostics* is set to *Fault*.	Check safety circuit connections. For more information, see appropriate drive hardware manual.
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.
6306	FBA A mapping file	Fieldbus adapter A mapping file read error.	Contact your local ABB representative.
6481	Task overload	Internal fault. **Note:** This fault cannot be reset.	Contact your local ABB representative.
6487	Stack overflow	Internal fault. **Note:** This fault cannot be reset.	Contact your local ABB representative.
64A1	Internal file load	File read error. **Note:** This fault cannot be reset.	Contact your local ABB representative.
64A2	Internal record load	Internal record load error.	Contact your local ABB representative.
64A3	Application loading	Application file incompatible or corrupted. **Note:** This fault cannot be reset.	Check the fault logger for a fault code extension.

Code (hex)	Fault	Cause	What to do
64E1	Kernel overload	Operating system error. **Note:** This fault cannot be reset.	Contact your local ABB representative.
6581	Parameter system	Parameter load or save failed.	Try forcing a save using parameter *96.07 Param save*. 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*.
6881	Text data overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6682	Text 32-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6683	Text 64-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6685	Text file overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
7080	Option module comm loss	Communication between drive and option module (FEN-xx and/or FIO-xx) is lost.	Check that option modules are properly connected to the option slots. Check that option modules or slot connectors are not damaged. To pinpoint the problem, try each module in each slot.
7081	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. Replace control panel in mounting platform.
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.
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.

Code (hex)	Fault	Cause	What to do
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 the *Hardware manual*. 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 the dimensioning and cooling of the cabinet. 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.
71A2	Mechanical brake closing failed Programmable fault: *44.17 Brake fault function*	Mechanical brake control fault. Activated eg. if brake acknowledgement is not as expected during brake closing.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgement signal matches actual status of brake.
71A3	Mechanical brake opening failed Programmable fault: *44.17 Brake fault function*	Mechanical brake control fault. Activated eg. if brake acknowledgement is not as expected during brake opening.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgement signal matches actual status of brake.
71A5	Mechanical brake opening not allowed Programmable fault: *44.17 Brake fault function*	Open conditions of mechanical brake cannot be fulfilled (for example, brake has been prevented from opening by parameter *44.11 Force brake closed*).	Check mechanical brake settings in parameter group *44 Mechanical brake control* (especially *44.11 Force brake closed*). Check that acknowledgement signal (if used) matches actual status of brake.
7301	Motor speed feedback Programmable fault: *90.45 Motor feedback fault*	No motor speed feedback received.	Check the setting of parameter *90.41 Motor feedback selection*, and the actual source selected.
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).
7380	Encoder internal	Internal fault.	Contact your local ABB representative.A

Code (hex)	Fault	Cause	What to do
7381	Encoder 1	Encoder 1 feedback fault.	If fault appears during first start-up before encoder feedback is used: - Check cable between encoder and encoder interface module (FEN-xx) and order of connector signal wires at both ends of cable. If fault appears after encoder feedback has already been used or during drive : - Check that encoder connection wiring or encoder is not damaged. - Check that encoder interface module (FEN-xx) connection or module is not damaged. - Check earthings (when disturbances are detected in communication between encoder interface module and encoder). For more information on encoders, see parameter groups *90 Feedback selection*, *91 Encoder module settings*, *92 Encoder 1 configuration* and *93 Encoder 2 configuration*.
7391	Encoder 2	Encoder 2 feedback fault.	See fault *7381*.
73A0	Speed feedback configuration	Speed feedback configuration incorrect, eg. an encoder that is not present is selected as the feedback interface.	Check the feedback source selection parameters in group *90 Feedback selection*. In case the source is an encoder interface, check parameter settings in groups *91 Encoder module settings*, *92 Encoder 1 configuration* and *93 Encoder 2 configuration*.
73A1	Load speed feedback	No load speed feedback received.	Check the setting of parameter *90.51 Load feedback selection*, and the actual source selected. In case the source is an encoder interface, check parameter settings in groups *91 Encoder module settings*, *92 Encoder 1 configuration* and *93 Encoder 2 configuration*.
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.
9081	External fault 1 Programmable fault: *31.01 External event 1 source* *31.02 External event 1 type*	Fault in external device 1. (This information is configured through one of programmable digital inputs.)	Check external devices for faults. Check setting of parameter *31.01 External event 1 source*.

Code (hex)	Fault	Cause	What to do
FA81	Safe torque off 1	Safe Torque Off function is active, i.e. STO circuit 1 is broken.	Check safety circuit connections. For more information, see appropriate drive hardware manual, description of parameter *31.22* (page *119*).
FA82	Safe torque off 2	Safe Torque Off function is active, i.e. STO circuit 2 is broken.	
FF61	ID run	Motor ID run was not completed successfully.	Check the fault logger for a fault code extension. See appropriate actions for each extension below.
	Extension: 1	The ID run cannot be completed because the maximum current setting and/or internal current limit of the drive is too low.	Check setting of parameters *99.06 Motor nominal current* and *30.17 Maximum current*. Make sure that *30.17 Maximum current* > *99.06 Motor nominal current*. Check that the drive is dimensioned correctly according to the motor.
	Extension: 2	The ID run cannot be completed because the maximum speed setting and/or calculated field weakening point is too low.	Check setting of parameters *99.07 Motor nominal voltage*, *99.08 Motor nominal frequency*, *99.09 Motor nominal speed*, *30.12 Maximum speed* and *30.11 Minimum speed*. Make sure that • *30.12 Maximum speed* > (0.55 × *99.09 Motor nominal speed*) > (0.50 × synchronous speed), • *30.11 Minimum speed* ≤ 0, and • supply voltage ≥ (0.66 × *99.07 Motor nominal voltage*).
	Extension: 3	The ID run cannot be completed because the maximum torque setting is too low.	Check setting of parameter *99.12 Motor nominal torque* and torque limits defined in parameter group *30 Limits*. Make sure that the maximum torque (*30.20 Maximum torque*) > 100%.
	Extension: 4	Current measurement calibration did not finish within reasonable time.	Contact your local ABB representative.
	Extension: 5…8	Internal error.	Contact your local ABB representative.
	Extension: 9	Asynchronous motors only: Acceleration did not finish within reasonable time.	Contact your local ABB representative.
	Extension: 10	Asynchronous motors only: Deceleration did not finish within reasonable time.	Contact your local ABB representative.
	Extension: 11	Asynchronous motors only: Speed dropped to zero during ID .	Contact your local ABB representative.
	Extension: 12	Permanent magnet motors only: First acceleration did not finish within reasonable time.	Contact your local ABB representative.
	Extension: 13	Permanent magnet motors only: Second acceleration did not finish within reasonable time.	Contact your local ABB representative.
	Extension: 14…16	Internal error.	Contact your local ABB representative.

Code (hex)	Fault	Cause	What to do
FF81	FB A force trip	A fault trip command has been received through fieldbus adapter A.	Check the fault information provided by the PLC.
FF82	FB B force trip	A fault trip command has been received through fieldbus adapter B.	Check the fault information provided by the PLC.
FF8E	EFB force trip	A fault trip command has been received through the embedded fieldbus interface.	Check the fault information provided by the PLC.

9

Fieldbus control through the embedded fieldbus interface (EFB)

This feature is not supported by the current firmware version.

10

Fieldbus control through a fieldbus adapter

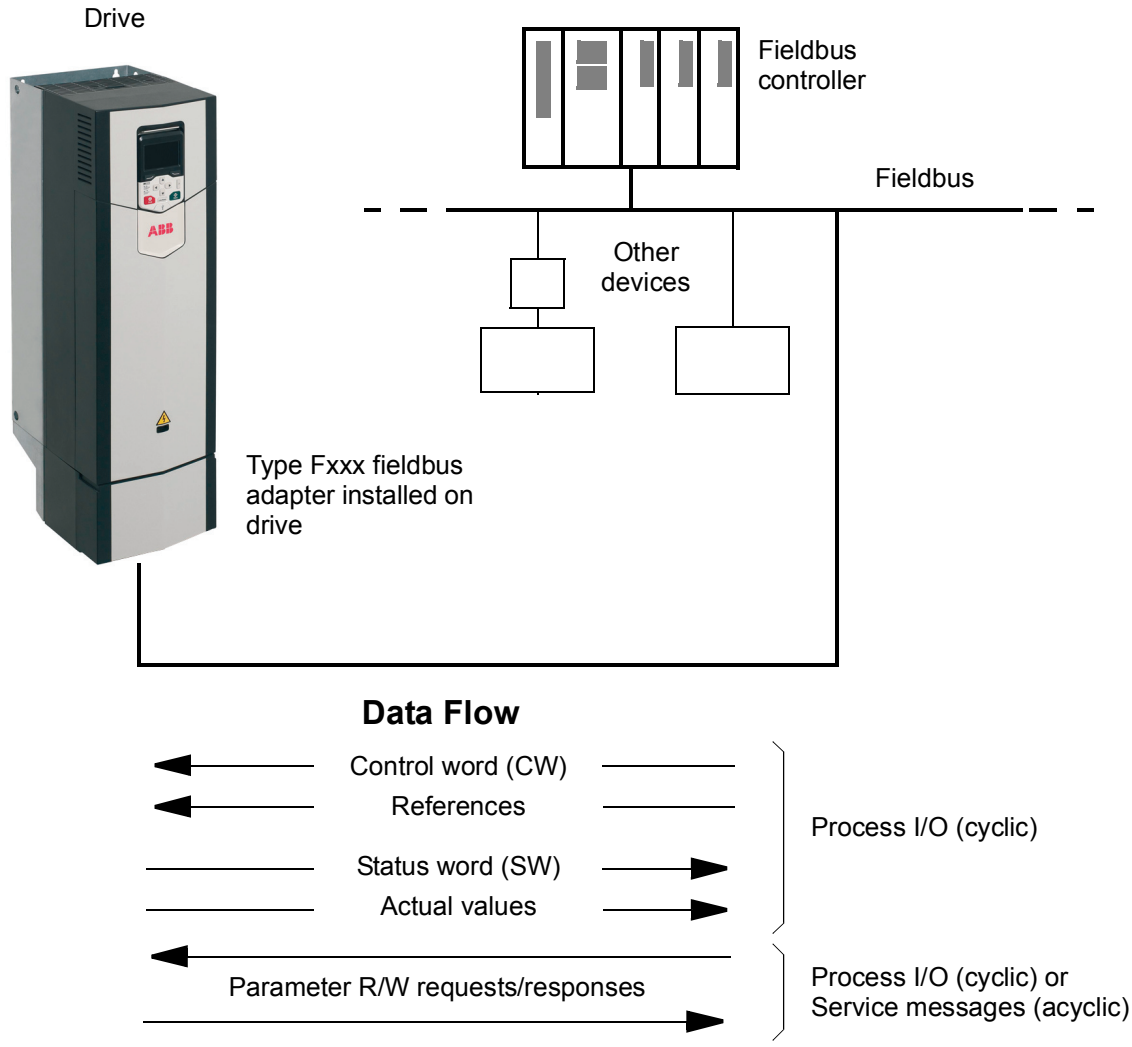
What this chapter contains

This chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) through an optional fieldbus adapter module.

The fieldbus control interface of the drive is described first, followed by a configuration example.

System overview

The drive can be connected to an external control system through a serial communication link using a fieldbus adapter. The fieldbus adapter can be installed into any free drive slot.



The drive can be set 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.

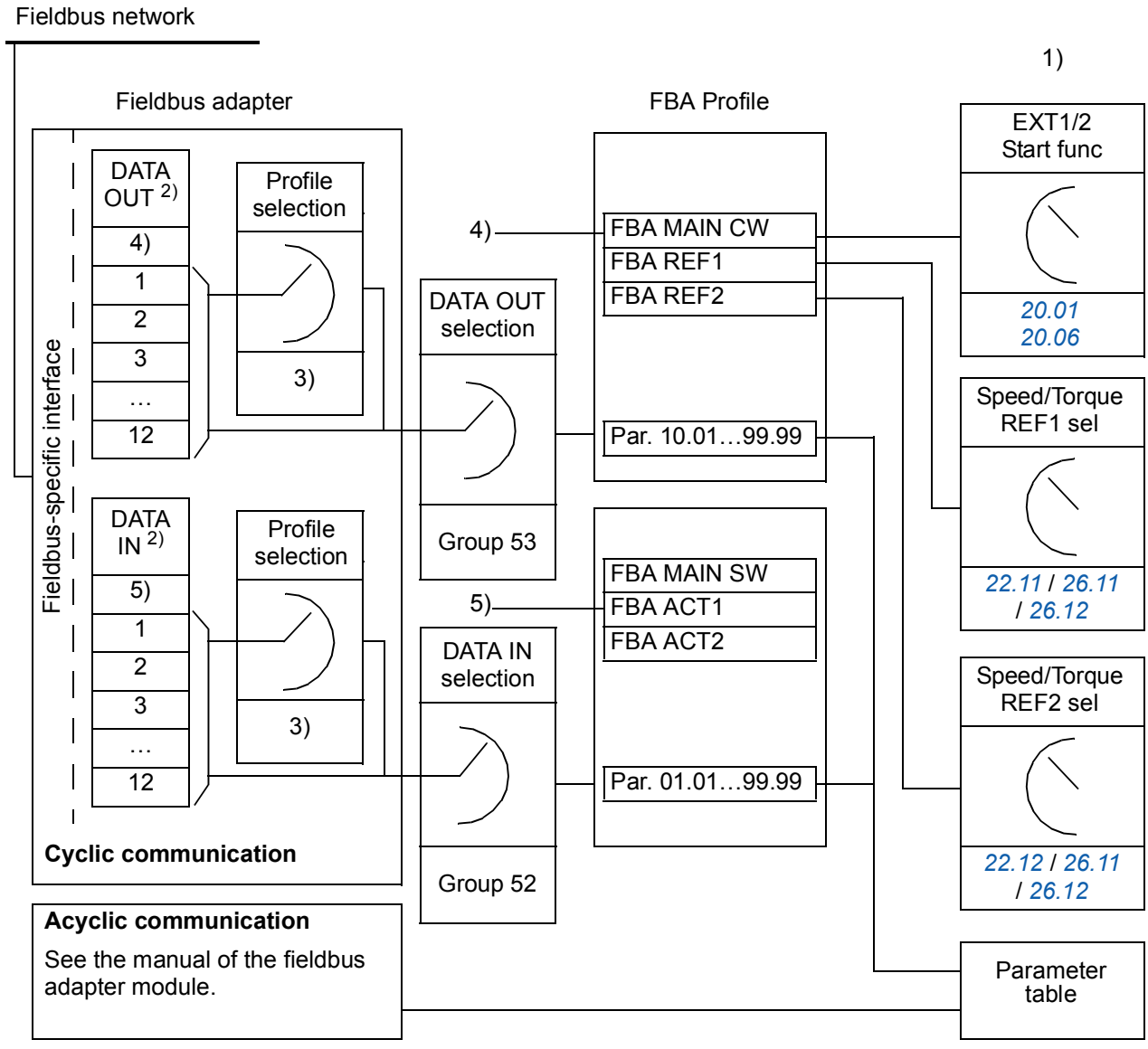
Fieldbus adapters are available for various serial communication systems and protocols, for example

- PROFIBUS DP (FPBA-xx adapter)
- CANopen (FCAN-xx adapter)
- DeviceNet (FDNA-xx adapter)
- LONWORKS® (FLON-xx adapter)
- Modbus/TCP, EtherNet/IP, PROFINET IO (FENA-11 adapter).

Basics of the fieldbus control interface

The cyclic communication between a fieldbus system and the drive consists of 16/32-bit input and output data words. The drive supports at the maximum the use 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 data in1* … *52.12 FBA data in12*. The data transmitted from the fieldbus controller to the drive is defined by parameters *53.01 FBA data out1* … *53.12 FBA data out12*.



1) See also other parameters which can be controlled from fieldbus.
2) The maximum number of used data words 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 on 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 *233* and *234* respectively. The drive states are presented in the state diagram (page *235*).

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*.

References

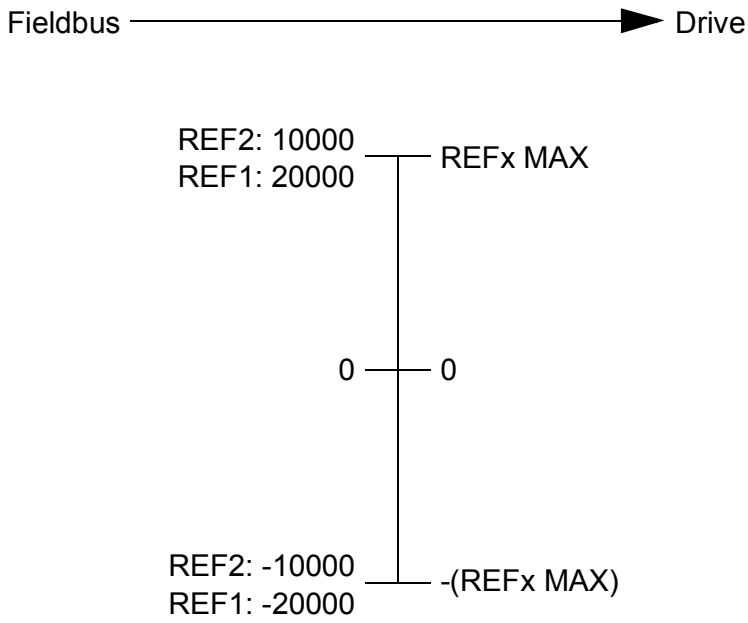
References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

ABB drives can receive control information from multiple sources including analogue 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, e.g. Reference.

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 shown below. The values REFx MIN and REFx MAX are set by parameters *46.10…46.13*; 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*.

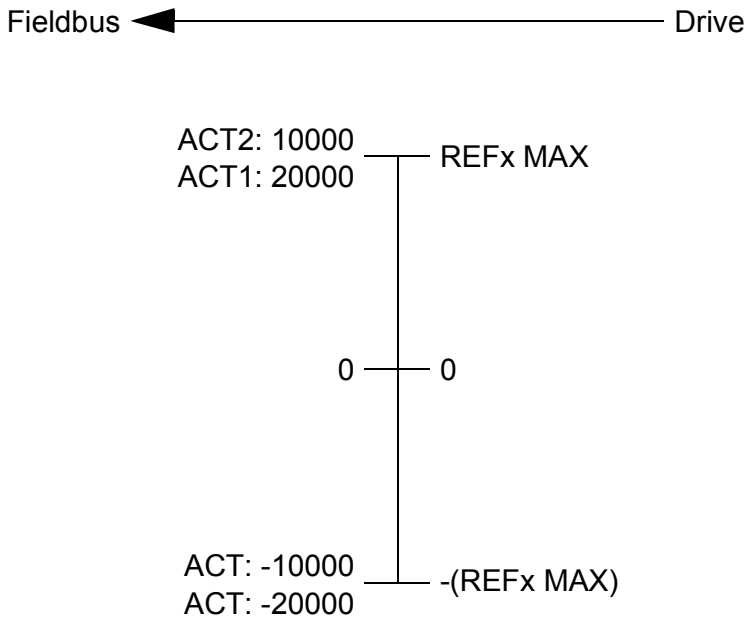
Actual values

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*.

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 shown below. The values REFx MIN and REFx MAX are set by parameters *46.10…46.13*; which scaling is in use depends on the setting of parameters *50.04* and *50.05*.



Contents of the fieldbus Control word

The upper case boldface text refers to the states shown in the state diagram (page *235*).

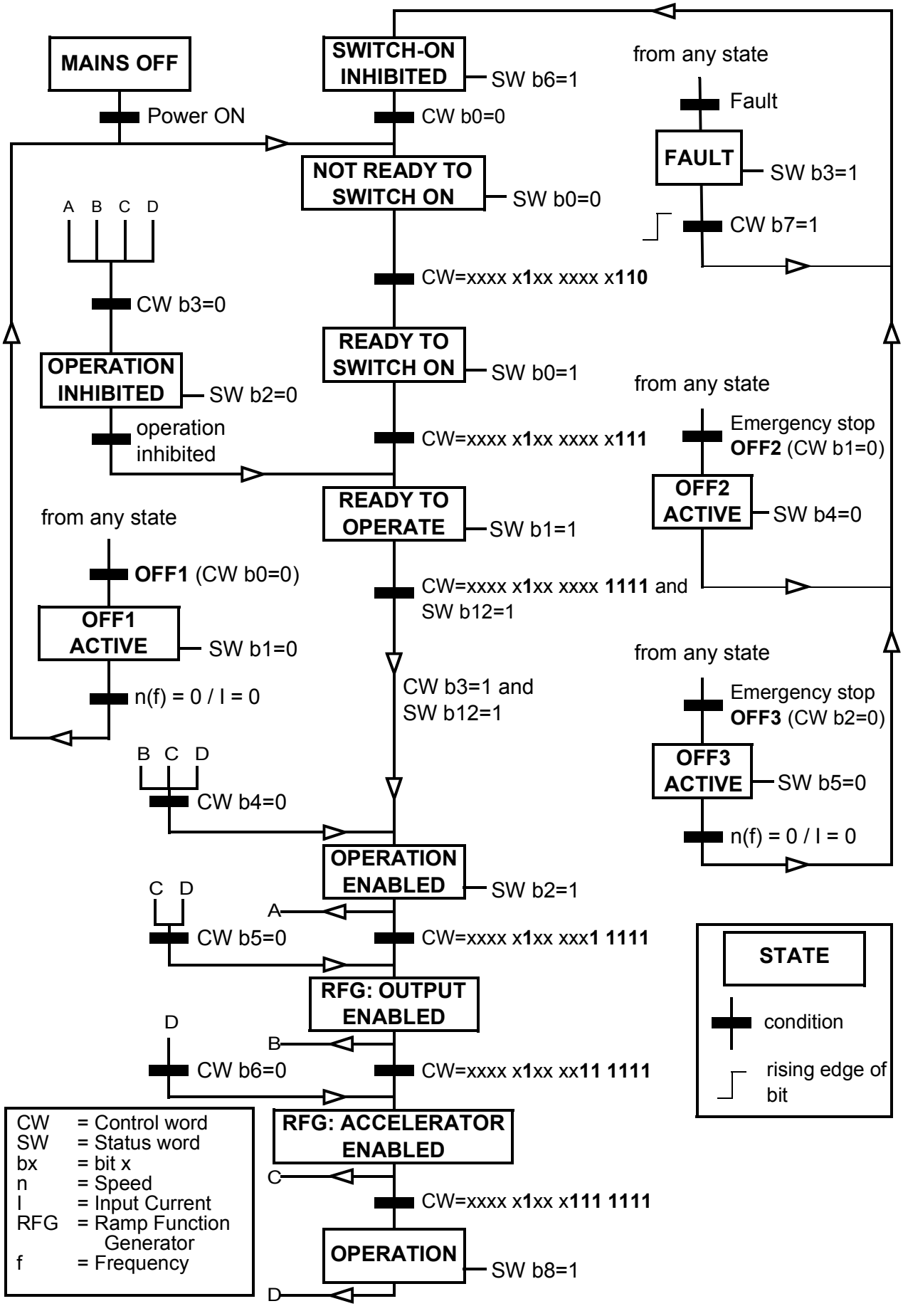
Bit	Name	Value	STATE/Description
0	OFF1_ CONTROL	1	Proceed to **READY TO OPERATE**.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2_ CONTROL	1	Continue operation (OFF2 inactive).
		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	INHIBIT_ OPERATION	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. Drive ramps to a 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.
8	INCHING 1	1	Accelerate to inching (jogging) setpoint 1.
		0	Inching (jogging) 1 disabled.
9	INCHING 2	1	Accelerate to inching (jogging) setpoint 2.
		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 OFF1, OFF2 and OFF3.
11	EXT_CTRL_ LOC	1	Select External Control Location EXT2. Effective if control location parameterized to be selected from fieldbus.
		0	Select External Control Location EXT1. Effective if control location parameterized to be selected from fieldbus.
12 to 15	Reserved.		

Contents of the fieldbus Status word

The upper case boldface text refers to the states shown in the state diagram (page 235).

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, i.e. in speed control, speed error is 10% max. of nominal motor speed.
		0	Actual value differs from reference = is outside tolerance limits.
9	Remote	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	Above limit	1	Actual frequency or speed equals or exceeds supervision limit. Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	User bit 0	-	See parameter *06.30 User bit 0 selection*.
12	User bit 1	-	See parameter *06.31 User bit 1 selection*.
13	User bit 2	-	See parameter *06.32 User bit 2 selection*.
14	User bit 3	-	See parameter *06.33 User bit 3 selection*.
15	Reserved		

The state diagram



Setting up the drive for fieldbus control

Before configuring the drive for fieldbus control, the adapter module must be mechanically and electrically installed according to the instructions given in the *User's manual* of the appropriate fieldbus adapter module.

1. Power up the drive.
2. Enable the communication between the drive and the fieldbus adapter module by setting parameter *50.01 FBA A enable* to *Enable*.
3. 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.
4. With *50.03 FBA A comm loss t out*, define the time between communication break detection and the selected action.
5. 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.
6. Set the fieldbus adapter module configuration parameters in group *51 FBA A settings*. At the minimum, set the required node address and the communication profile.
7. 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: The adapter module sets the Status word and Control word automatically into parameters *52.01* and *53.01* respectively.
8. Save the valid parameter values to permanent memory by setting parameter *96.07 Param save* to *Save*.
9. Validate the settings made in parameter groups 51 52 and 53 by setting parameter *51.27 FBA par refresh* to *Configure*.
10. Set the relevant drive control parameters to control the drive according to the application. 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 value ±16384 (4000h) corresponds to parameter *46.10 Speed scaling* in the forward and reverse directions.

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 ACS880 drives	Description
50.01 FBA A enable	**1** = *Enable*	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** = *Auto*	Selects the actual value type and scaling according to the currently active Ref1 mode defined in parameter *50.04*.
51.01 FBA 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
53.05 FBA data out5	23.13[2)]	Deceleration time 1

Drive parameter	Setting for ACS880 drives	Description
51.27 FBA par refresh	**1** = *Configure*	Validates the configuration parameter settings.
19.12 Ext1 control mode 1	**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.
22.11 Speed ref1 selection	**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:

- 47Eh (1150 decimal) –> READY TO SWITCH ON
- 47Fh (1151 decimal) –> OPERATING (Speed mode)

11

Drive-to-drive link

This feature is not supported by the current firmware version.

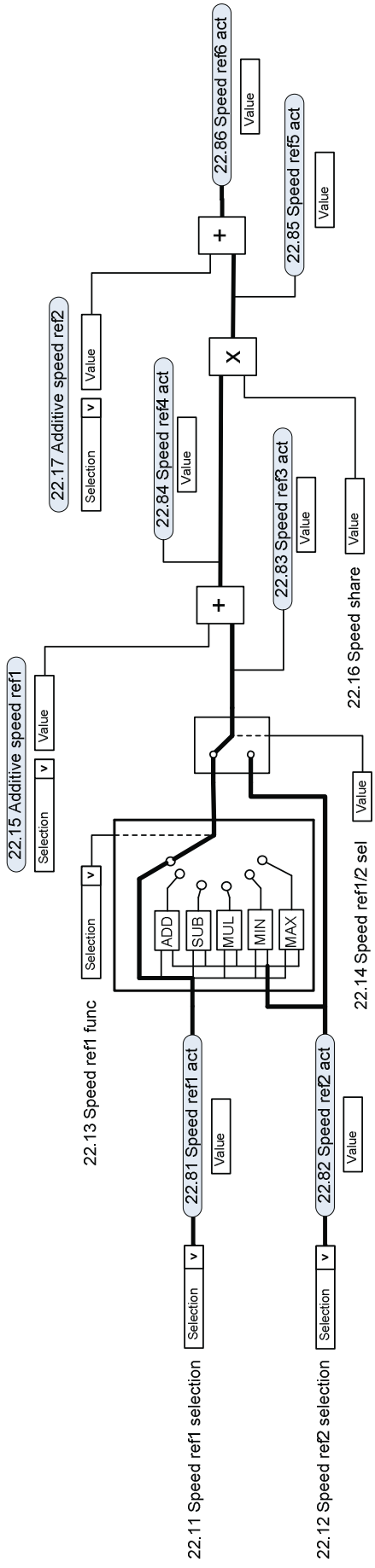
12

Control chain and drive logic diagrams

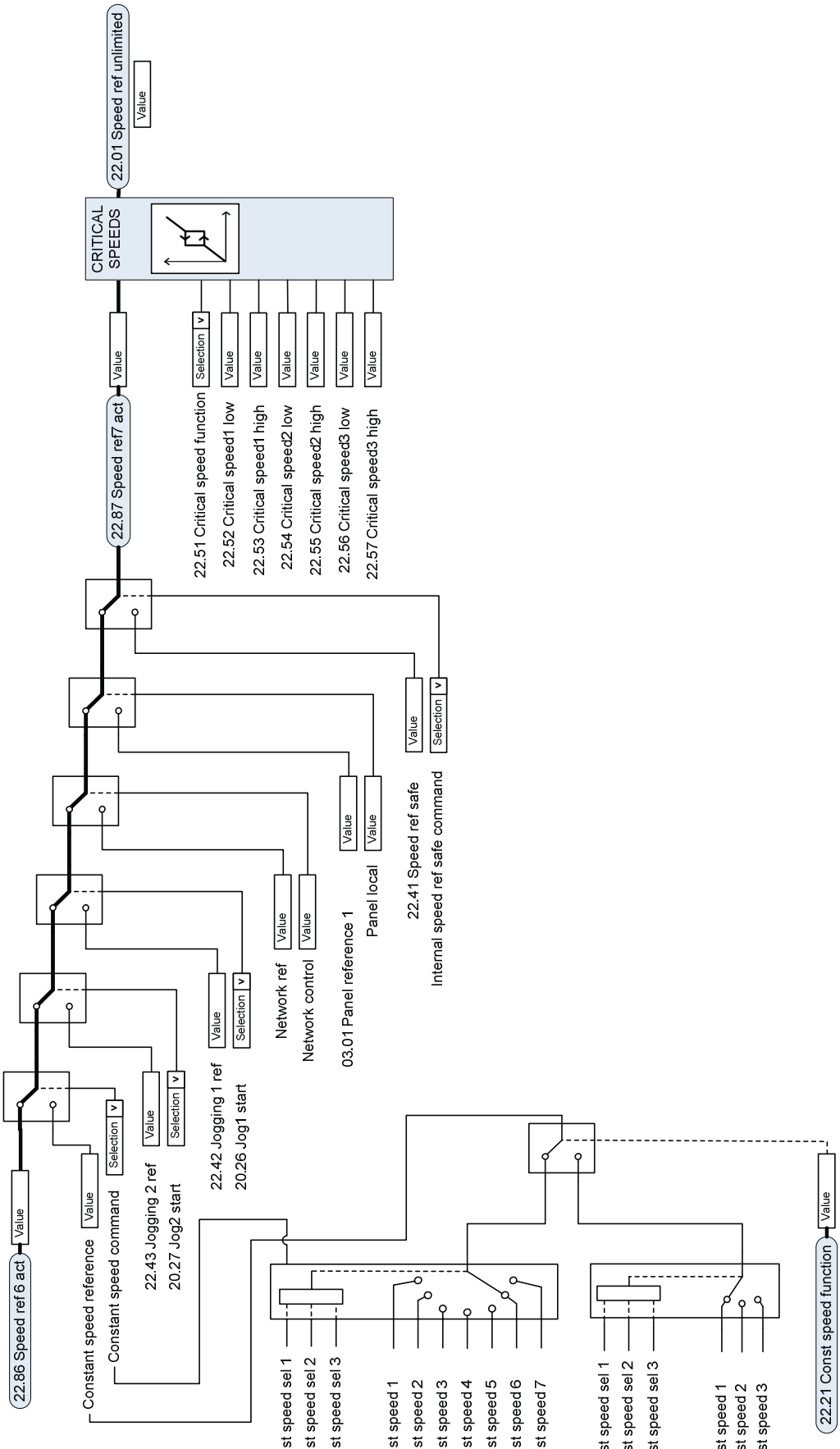
What this chapter contains

The chapter presents the drive control chain and logic. For an overall diagram, see section *Operating modes of the drive* (page *18*).

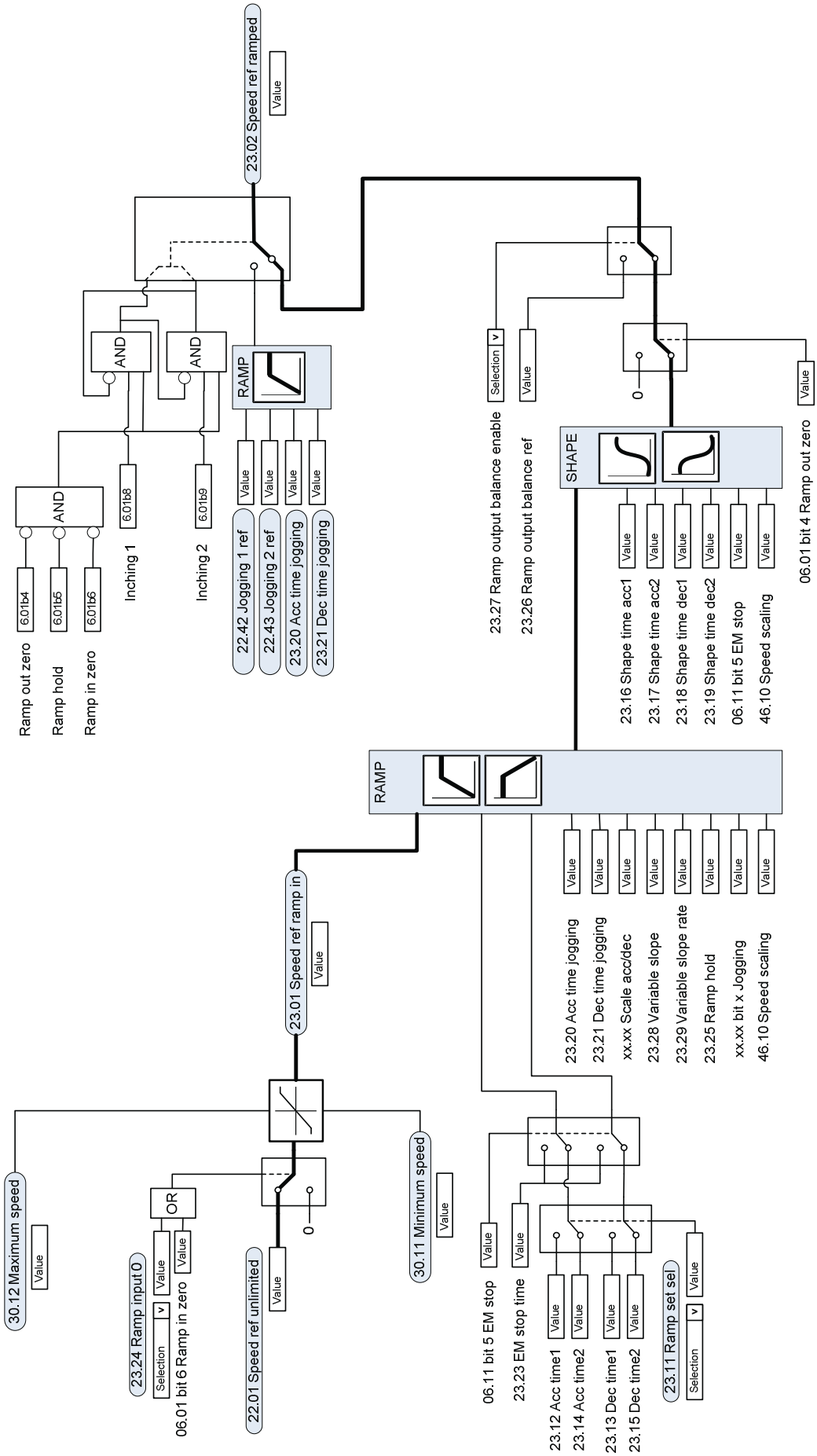
Speed reference source selection I



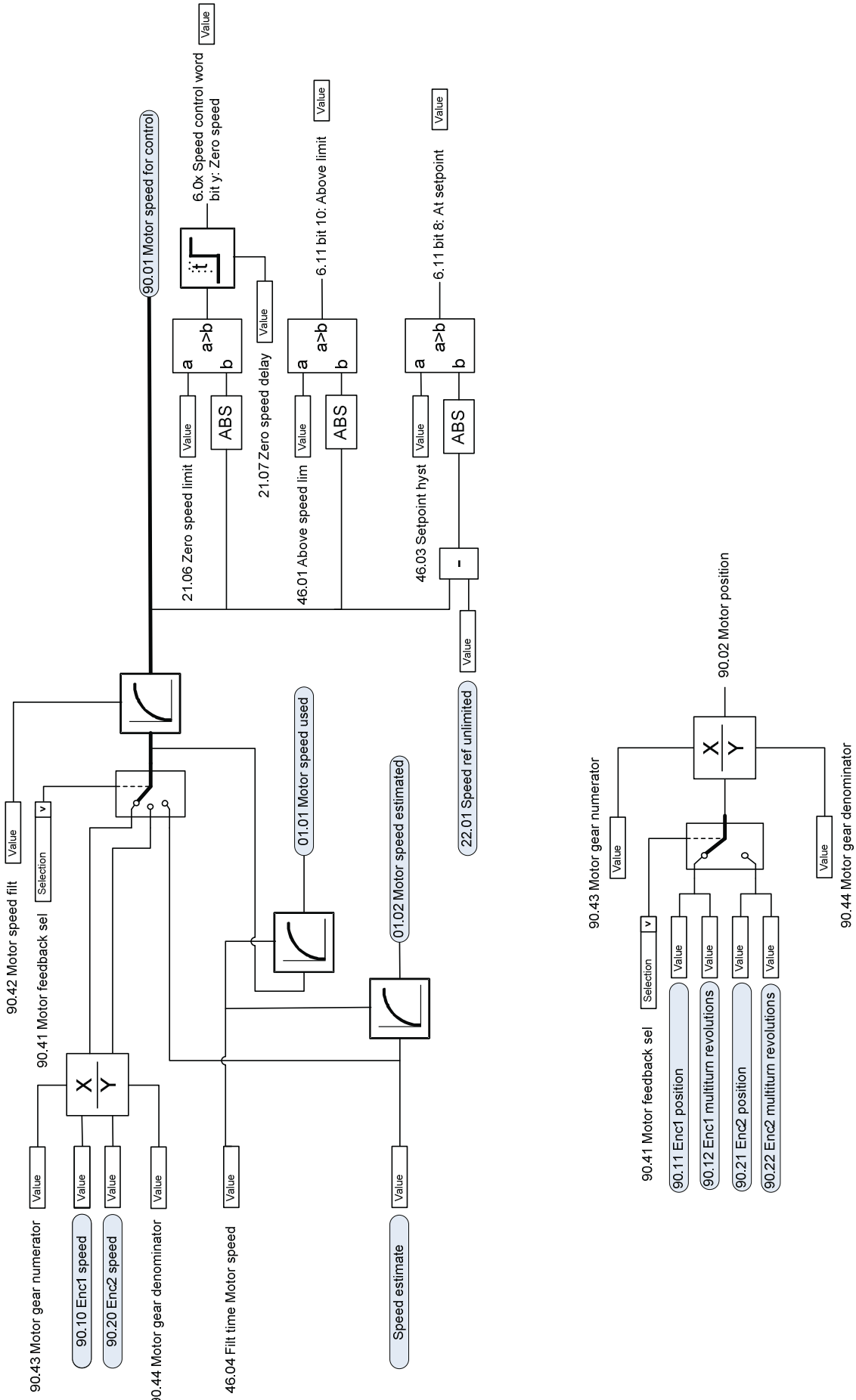
Speed reference source selection II



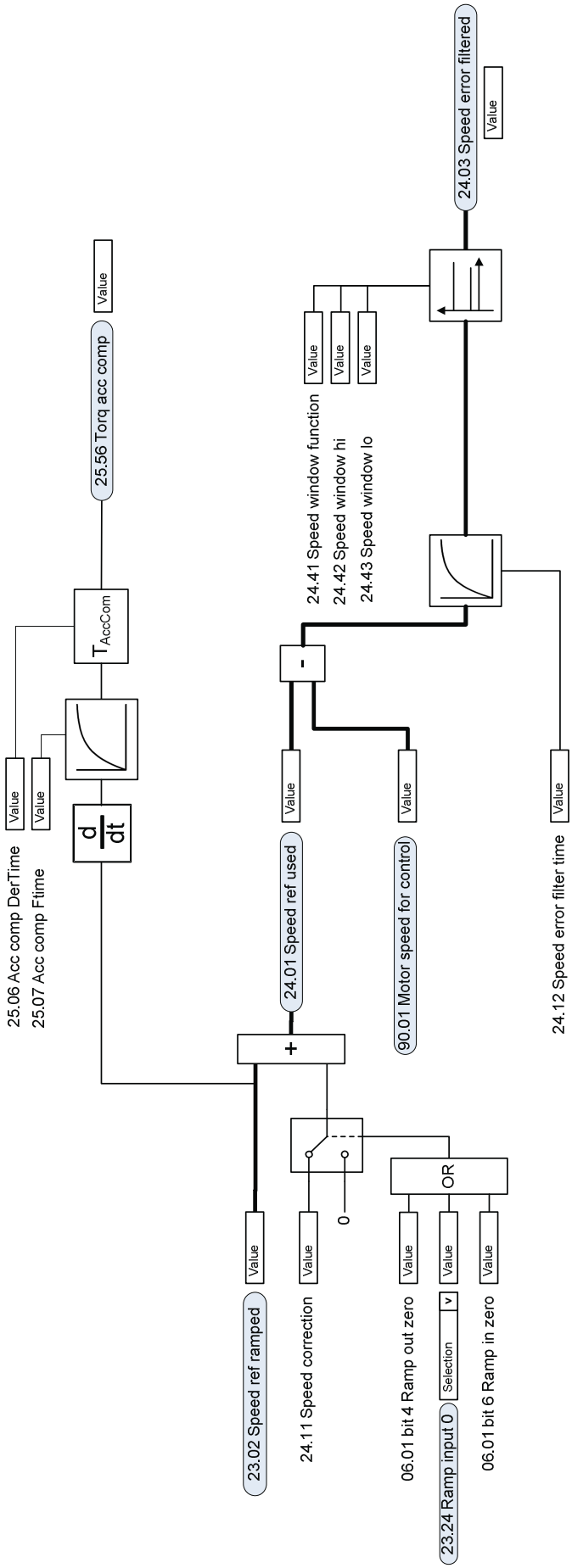
Speed reference ramping and shaping



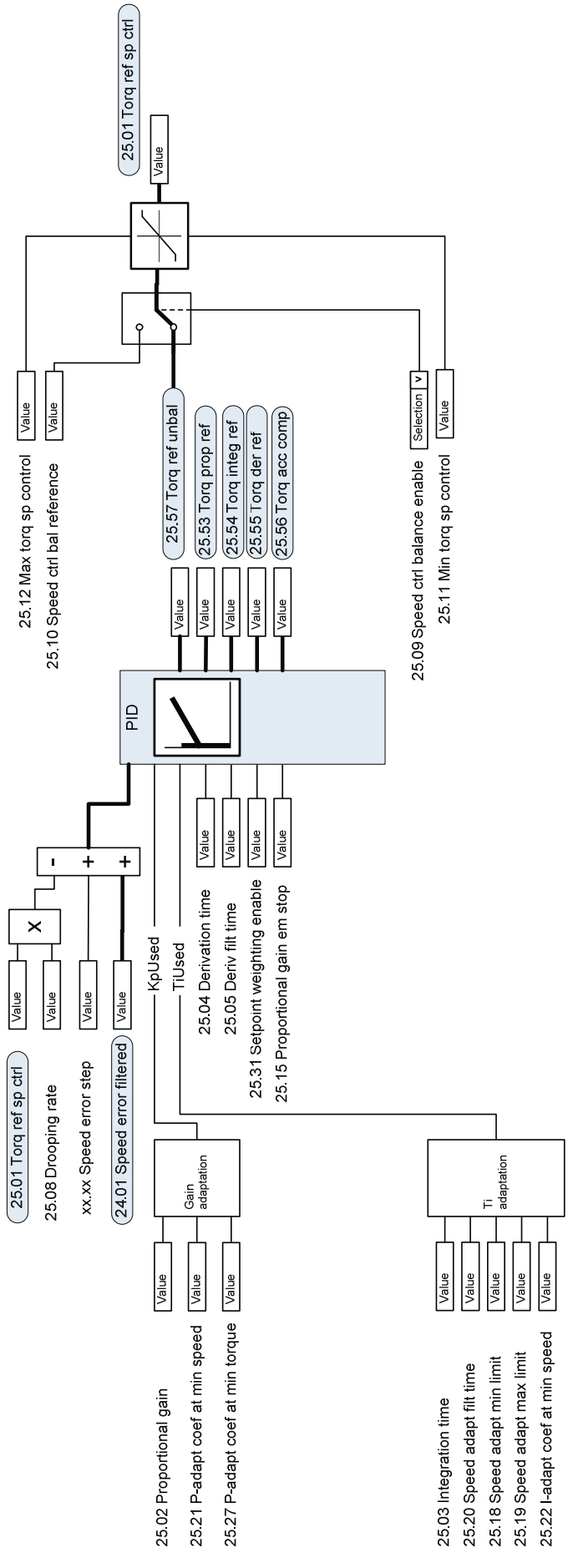
Motor feedback configuration



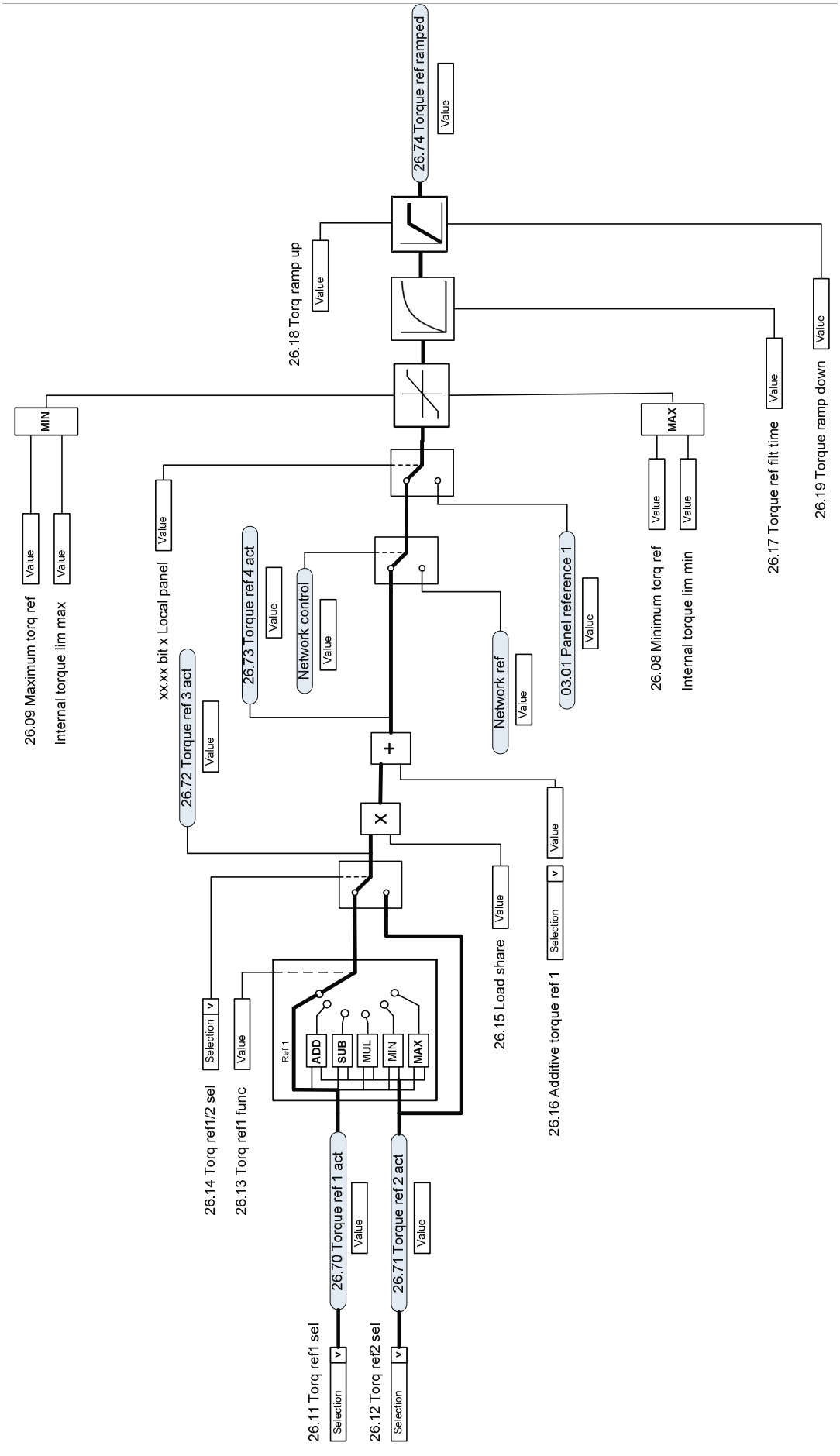
Speed error calculation



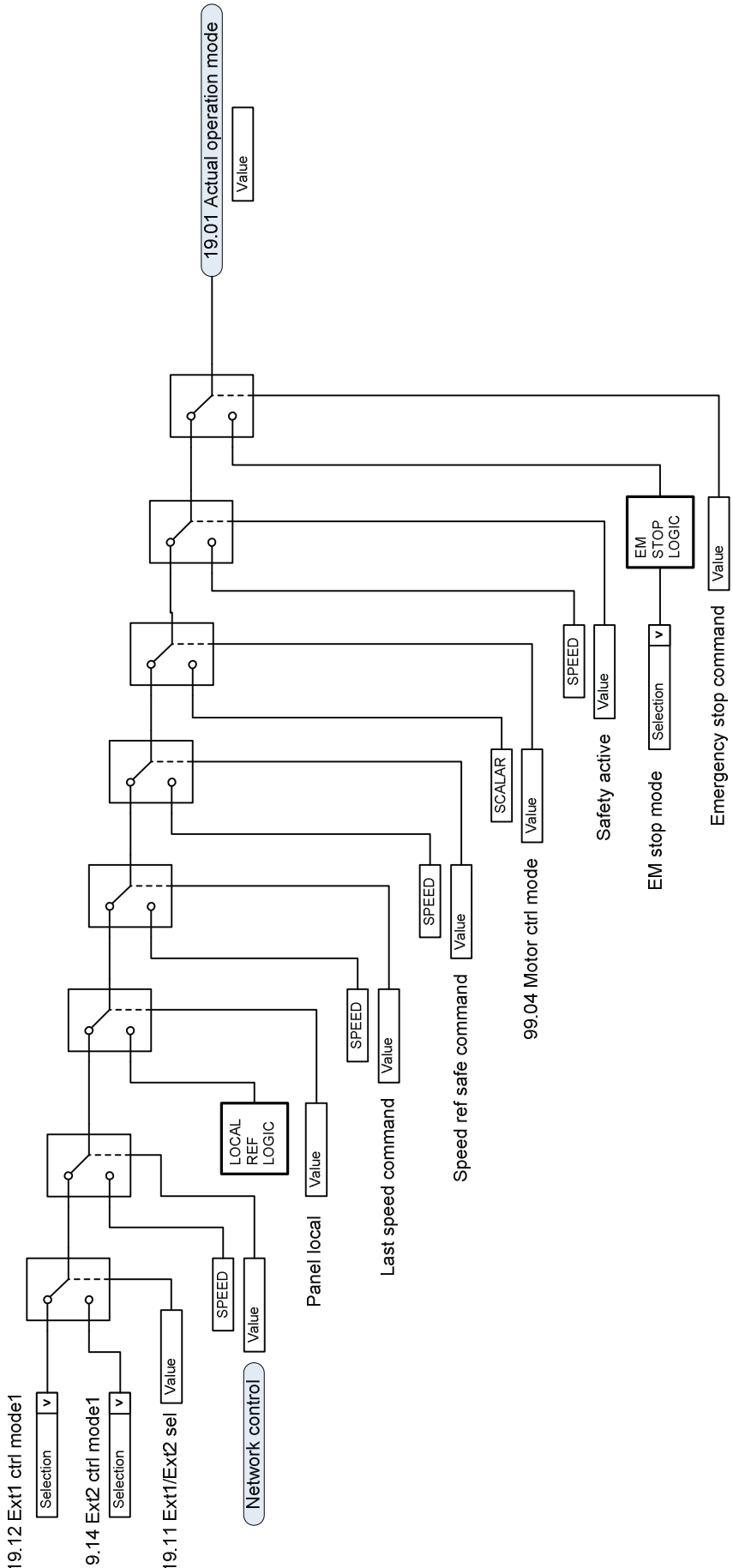
Speed controller



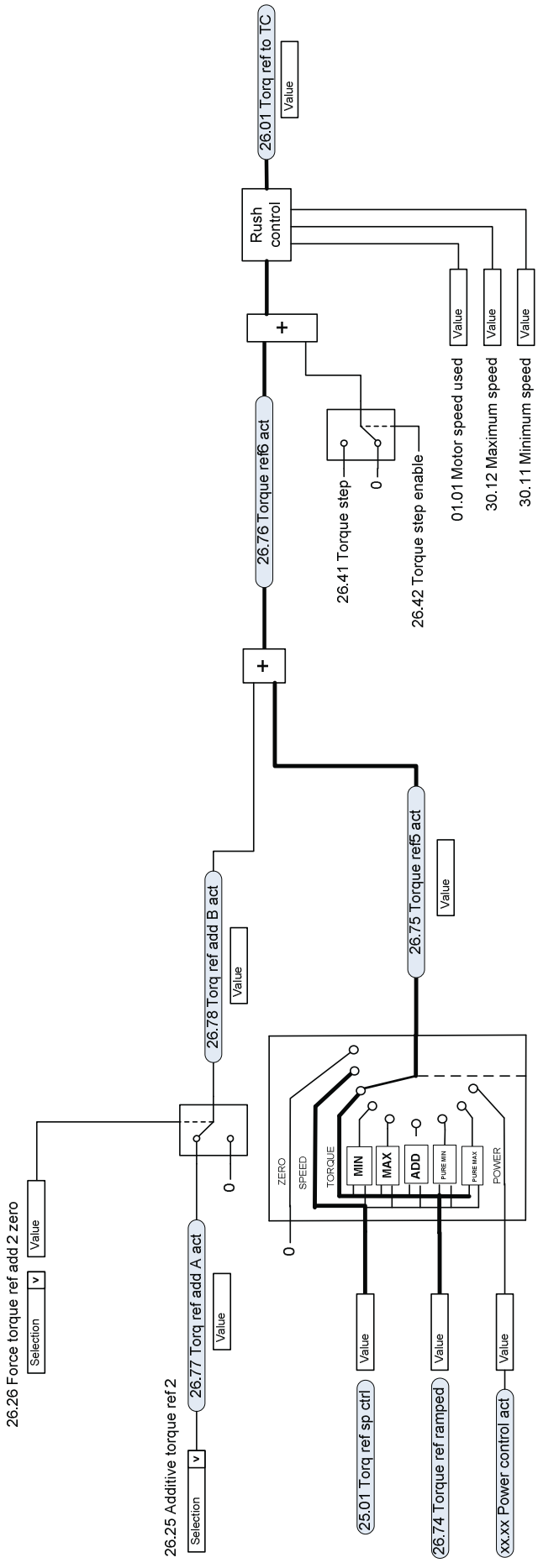
Torque reference source selection and modification



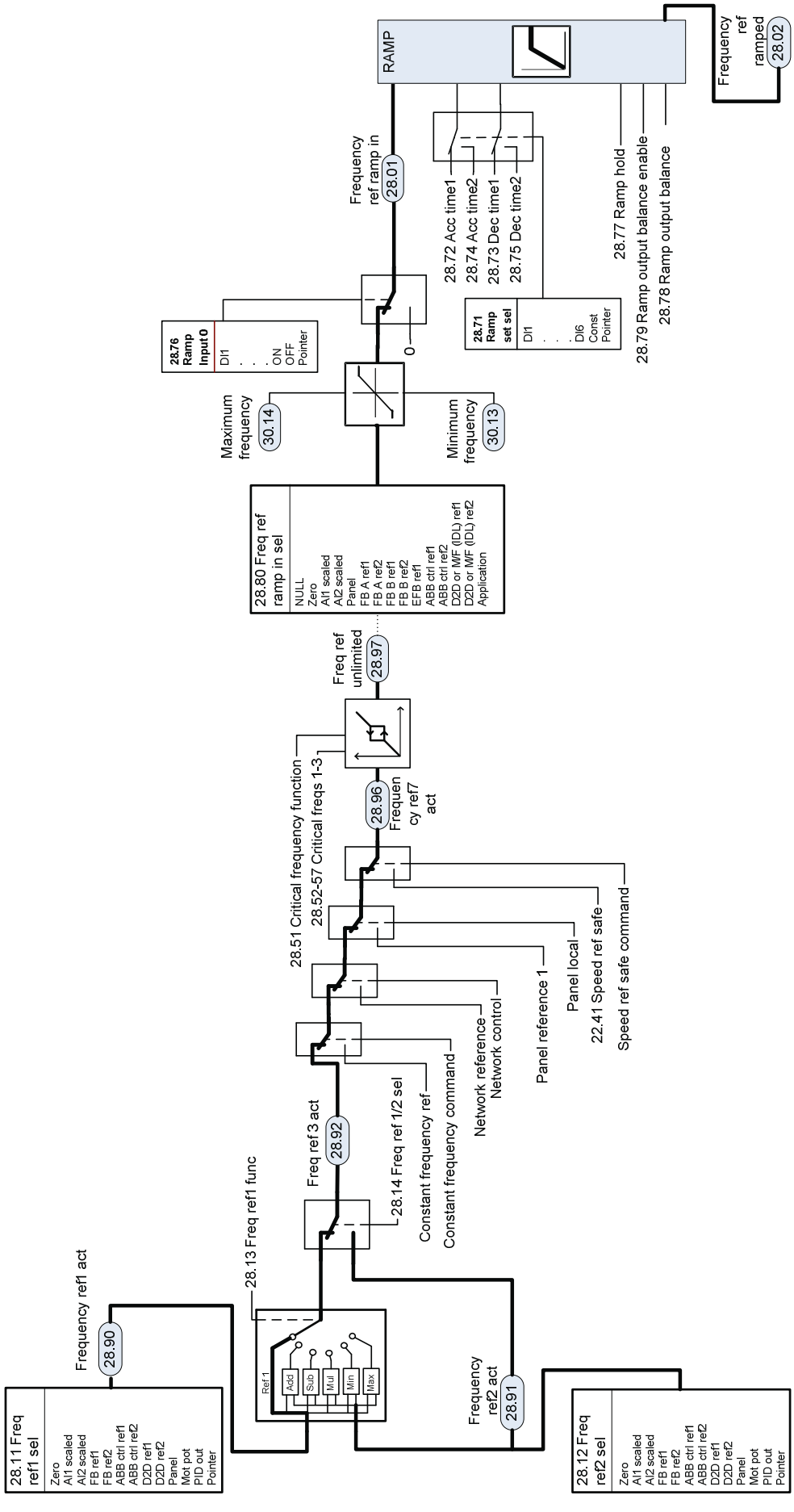
Reference selection for torque controller I



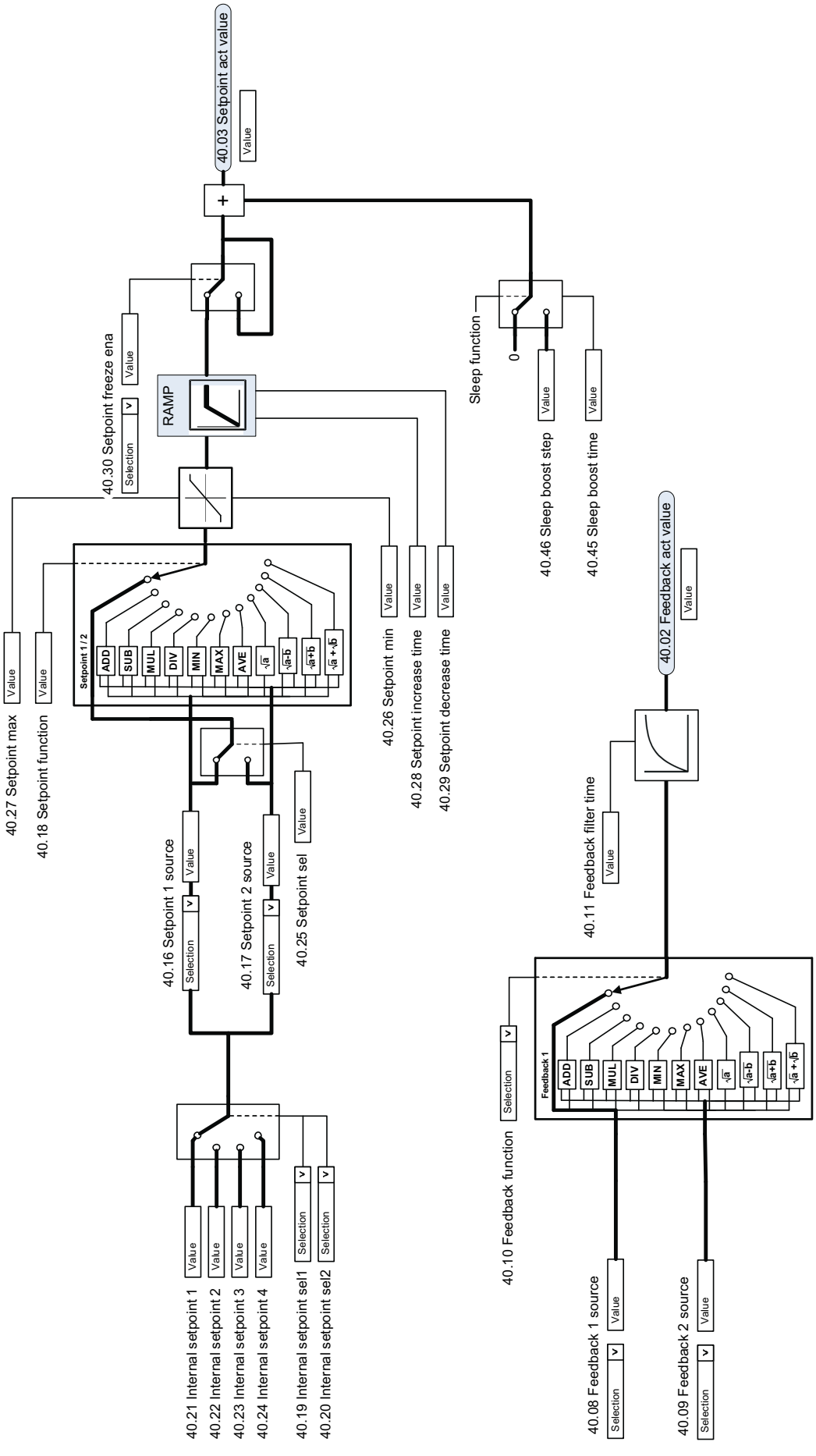
Reference selection for torque controller II



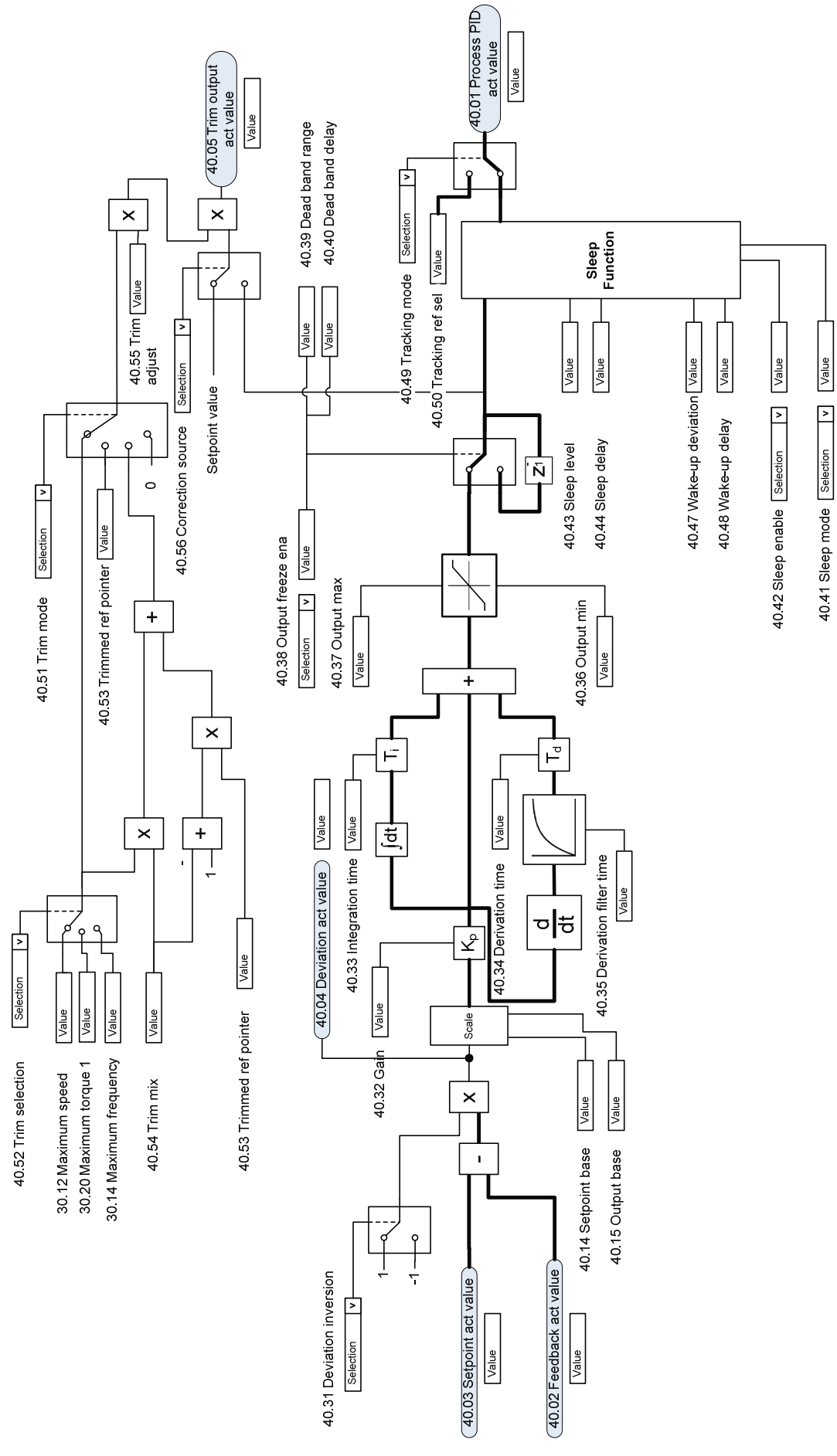
Frequency reference selection and modification



Process PID setpoint and feedback source selection



Process PID controller



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/drives and selecting *Sales, Support and Service network*.

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