ACS800

Firmware Manual
ACS800 Motion Control Application Program 7.x

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Table of Contents

Basic program features

Motion control features

Application macros

Actual signals and parameters

Fieldbus control

Introduction to the manual

Chapter overview

This chapter describes the contents of this manual. In addition it contains information about the compatibility, safety and intended audience.

The Motion Control Application Program is commonly used in conjunction with three-phase drives for motion control of squirrel cage electric motors.

Compatibility

The manual is compatible with Motion Control Application Program version apxr7000 or later.

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 given at the beginning of the Hardware Manual.
- Read the **software function specific warnings and notes** before changing the default settings of the function. For each function, the warnings and notes are given in this manual in the subsection describing the related user-adjustable parameters.

Reader

The reader of the manual is expected to know the standard electrical wiring practices, electronic components, and electrical schematic symbols.

Contents

The manual consists of the following chapters:

- *Start-up* instructs in setting up the application program, and how to start, stop and regulate the speed of the drive.
- *Control panel* gives instructions for using the panel.
- *Basic program features* contains the basic feature descriptions and the reference lists of the user settings and diagnostic signals.
- *Motion control features* contains the motion control feature descriptions.
- *Application macros* contains a short description of each macro together with a connection diagram.
- *Actual signals and parameters* describes the actual signals and parameters of the drive.
- *Fieldbus control* describes communication through the serial communication links.
- *Fault tracing* lists the warning and fault messages with the possible causes and remedies.
- *Control block diagrams*

Start-up

Chapter overview

The chapter instructs how to:

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

How to start-up the drive

The start-up procedure presented on the following pages uses the Control Panel. Parameter settings can also be given from DriveWindow PC tool.

Before you start, ensure you have the motor nameplate data at your hand.

	SAFETY	
	The start-up may only be carried out by a qualified electrician. The safety instructions must be followed during the start-up procedure. See the appropriate hardware manual for safety instructions.	
☐	Check the installation. See the installation checklist in the appropriate hardware/installation manual.	
☐	Check that the starting of the motor does not cause any danger. **De-couple the driven machine** if: - there is a risk of damage in case of incorrect direction of rotation, or - a Standard ID Run needs to be performed during the drive start-up. (ID Run is essential only in applications which require the ultimate in motor control accuracy.)	
	POWER-UP	
☐	Apply mains power. The control panel first shows the panel identification data …	`CDP312 PANEL Vx.xx` `.......`
	… then the Identification Display of the drive …	`ACS800` `ID NUMBER 1`

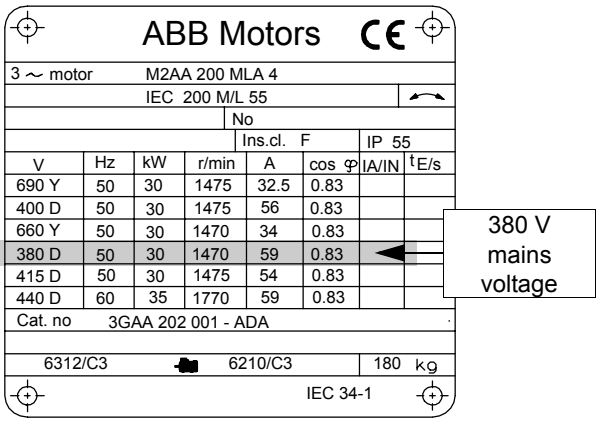
	… then the Actual Signal Display …	`1 -> 0.0 rpm O`
		`SPEED 0.0 RPM`
		`TORQUE 0.00 %`
		`MODE ACK SPEED`

	…after which the display suggests starting the Language Selection.
	(If no key is pressed for a few seconds, the display starts to alternate between the Actual Signal Display and the suggestion on selecting the language.)
	The drive is now ready for the start-up.
		`1 -> 0.0 rpm O`
		`*** INFORMATION ***`
		`Press FUNC to start`
		`Language Selection`

	Press ACT to remove the suggestion on starting the language selection.
	The drive is now ready for the limited start-up.
		`1 -> 0.0 rpm O`
		`SPEED 0.0 RPM`
		`TORQUE 0.00 %`
		`MODE ACK SPEED`

	MANUAL START-UP DATA ENTERING (parameter group 99)	

☐	Select the language. The general parameter setting procedure is described below.
	The general parameter setting procedure:
	- Press ***PAR*** to select the Parameter Mode of the panel.
	- Press the double-arrow keys (⏫ or ⏬) to scroll the parameter groups.
	- Press the arrow keys (🔼 or 🔽) to scroll parameters within a group.
	- Activate the setting of a new value by ***ENTER.***
	- Change the value by the arrow keys (🔼 or 🔽), fast change by the double-arrow keys (⏫ or ⏬).
	- Press ***ENTER*** to accept the new value (brackets disappear).
		`1 -> 0.0 rpm O`
		`99 START-UP DATA`
		`01 LANGUAGE`
		`ENGLISH`
		
		`1 -> 0.0 rpm O`
		`99 START-UP DATA`
		`01 LANGUAGE`
		`[ENGLISH]`

☐	Enter the motor data from the motor nameplate:  	**Note:** Set the motor data to exactly the same value as on the motor nameplate.

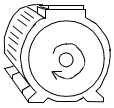
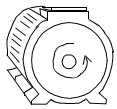
	- motor nominal voltage
	Allowed range: 1/2 · U_N … 2 · U_N of ACS800. (U_N refers to the highest voltage in each of the nominal voltage ranges: 415 VAC for 400 VAC units, 500 VAC for 500 VAC units and 690 VAC for 600 VAC units.)
		`1 -> 0.0 rpm O`
		`99 START-UP DATA`
		`03 MOTOR NOM VOLT`
		`[ ]`

	- motor nominal current
	Allowed range: approx. 1/6 · I_{2hd} … 2 · I_{2hd} of ACS800
		`1 -> 0.0 rpm O`
		`99 START-UP DATA`
		`04 MOTOR NOM CURR`
		`[ ]`

	- motor nominal frequency
	Range: 8… 300 Hz
		`1 -> 0.0 rpm O`
		`99 START-UP DATA`
		`05 MOTOR NOM FREQ`
		`[ ]`

	- motor nominal speed
	Range: 1…18000 rpm
		`1 -> 0.0 rpm O`
		`99 START-UP DATA`
		`06 MOTOR NOM SPEED`
		`[ ]`

	-motor nominal power Range: 0…9000 kW When the motor data has been entered, two displays (warning and information) start to alternate. Move to next step without pressing any key.	1 -> 0.0 rpm O 99 START-UP DATA 07 MOTOR NOM POWER [ ] 1 -> 0.0 rpm O ACS800 ** WARNING ** ID MAGN REQ 1 L-> 0.0 rpm I *** Information *** Press green button to start ID MAGN
☐	Select the motor identification method. The default value ID MAGN (ID Magnetisation) is suitable for most applications. It is applied in this basic start-up procedure. If your selection is ID Magnetisation, move to next step without pressing any key. The ID Run (STANDARD or REDUCED) should be selected if: - the operation point is near zero speed, and/or - operation at torque range above the motor nominal torque within a wide speed range and without any measured speed feedback is required. If your selection is ID Run, continue by following the separate instructions given a few pages ahead in subsection *How to perform the ID Run*.	1 -> 0.0 rpm O 99 START-UP DATA 08 ID RUN [ ]
	IDENTIFICATION MAGNETISATION (with Motor ID Run selection ID MAGN)	
☐	Press the ***LOC/REM*** key to change to local control (L shown on the first row). Press ⏵ to start the Identification Magnetisation. The motor is magnetised at zero speed for 20 to 60 s. Three warnings are displayed: The first warning is displayed when the magnetisation starts. The second warning is displayed while the magnetisation is on. The third warning is displayed after the magnetisation is completed.	1 L -> 1242.0 rpm I ** WARNING ** MOTOR STARTS 1 L-> 0.0 rpm I ** WARNING ** ID MAGN 1 L-> 0.0 rpm O ** WARNING ** ID DONE
	DIRECTION OF ROTATION OF THE MOTOR	
☐	Check the direction of rotation of the motor. - Press ***ACT*** to get the status row visible. - Increase the speed reference from zero to a small value (e.g. 50 rpm) by pressing ***REF*** and then the arrow keys (⏶, ⏷, ⏶ or ⏷). - Press ⏵ to start the motor. - Check that the motor is running in the desired direction. - Stop the motor by pressing ⏹.	1 -> 0.0 rpm O SPEED xx RPM TORQUE xxx % MODE ACK SPEED

	To change the direction of rotation of the motor: - Disconnect mains power from the drive, and wait 5 minutes for the intermediate circuit capacitors to discharge. Measure the voltage between each input terminal (U1, V1 and W1) and earth with a multimeter to ensure that the frequency converter is discharged. - Exchange the position of two motor cable phase conductors at the motor terminals or at the motor connection box. - Verify your work by applying mains power and repeating the check as described above.	 forward direction  reverse direction
ENCODER SETTINGS (if used)		
☐	Set encoder interface parameters.	See group 50 ENCODER MODULES
☐	Check the functioning of the encoder interface: Set parameter 19.02 SPEED ACT FB SEL to INTERNAL and compare signals 03.06 SPEED MEAS ENC1 and 03.05 SPEED ESTIMATED. If signal values differ: - Check encoder interface parameters (group 50 ENCODER MODULES) - Check that the sign of signal 03.06 SPEED MEAS ENC1 matches the rotation direction. The sign is affected by cable phasing. Check the encoder hardware configuration. (See the encoder Hardware Manual)	
The drive is now ready for use.		

How to control the drive through the I/O interface

The table below instructs how to operate the drive through the digital and analogue inputs, when:

- the motor start-up is performed, and
- the default (factory) parameter settings are valid.

PRELIMINARY SETTINGS	
Ensure the Factory macro is active.	See parameter 99.02.
Ensure the control connections are wired according to the connection diagram given for the Factory macro.	See chapter *Application macros*.
Ensure the drive is in external control mode. Press the ***LOC/REM*** key to change between external and local control.	In External control, there is no L visible on the first row of the panel display.
STARTING AND CONTROLLING THE SPEED OF THE MOTOR	

Start by switching digital input DI1 on.	`1 -> 0.0 rpm I`
	`SPEED 0.0 RPM`
	`TORQUE 0.00 %`
	`MODE ACK SPEED`

Regulate the speed by adjusting the voltage of analogue input AI1.	`1 ->1242.0 rpm I`
	`SPEED 1242.00 rpm`
	`TORQUE 10.00 %`
	`MODE ACK SPEED`

CHANGING THE DIRECTION OF ROTATION OF THE MOTOR	

Forward direction: Switch digital input DI2 off.	`1 ->1242.0 rpm I`
	`SPEED 1242.00 rpm`
	`TORQUE 10.00 %`
	`MODE ACK SPEED`

Reverse direction: Switch digital input DI2 on.	`1 <- 1242.0 rpm I`
	`SPEED 1242.00 rpm`
	`TORQUE 10.00 %`
	`MODE ACK SPEED`

STOPPING THE MOTOR	

Switch off digital input DI1.	`1 -> 500.0 rpm O`
	`SPEED 0.0 RPM`
	`TORQUE 0.00 %`
	`MODE ACK SPEED`

How to perform the ID Run

The drive performs the ID Magnetisation automatically at the first start. In most applications there is no need to perform a separate ID Run. The ID Run (Standard or Reduced) should be selected if:

- the operation point is near zero speed, and/or
- operation at torque range above the motor nominal torque within a wide speed range and without any measured speed feedback is required.

The Reduced ID Run is to be performed instead of the Standard if it is not possible to disengage the driven machine from the motor.

ID Run Procedure

Note*:* If parameter values (Group 10 to 98) are changed before the ID Run, check that the new settings meet the following conditions:

- 20.01 MIN SPEED $\leq$ 0 rpm
- 20.02 MAX SPEED > 80% of motor rated speed
- 20.05 MAX CURRENT $\geq$ 100% · I_{hd}
- 20.07 TORQ MAX LIM > 50%

- Ensure that the panel is in the local control mode (L displayed on the status row). Press the ***LOC/REM*** key to switch between modes.
- Change the ID Run selection to STANDARD or REDUCED.
- Press ***ENTER*** to verify selection. The following message will be displayed on the control panel:

```
1 L ->1242.0 rpm      O
ACS800
**WARNING**
ID RUN SEL
```

- To start the ID Run, start the drive. The Run Enable signal must be active (see parameter 10.07 RUN ENABLE).

Control panel warnings

Warning when the ID Run is started	Warning during the ID Run	Warning after a successfully completed ID Run
1 L -> 1242.0 rpm I ACS800 **WARNING** MOTOR STARTS	1 L -> 1242.0 rpm I ACS800 **WARNING** ID RUN	1 L -> 1242.0 rpm I ACS800 **WARNING** ID DONE

In general it is recommended not to press any control panel keys during the ID run. However:

- The Motor ID Run can be stopped at any time.

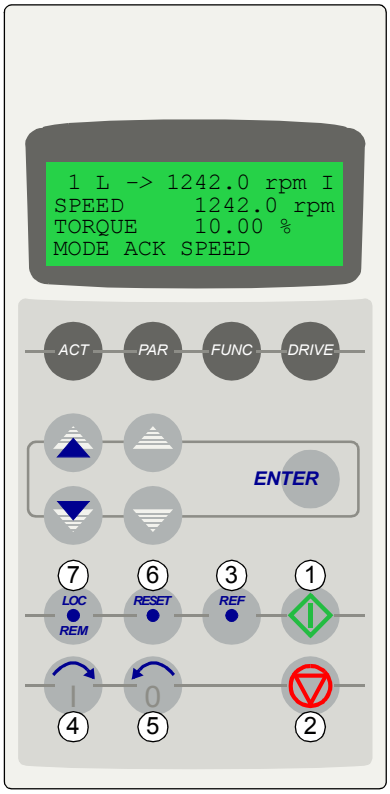
Control panel

What this chapter contains

The chapter describes how to use the control panel CDP 312R.

The same control panel is used with all ACS800 series drives, so the instructions given apply to all ACS800 types. The display examples shown are based on the Motion Control Application Program; displays produced by other application programs may differ slightly.

Overview of the panel



The LCD type display has 4 lines of 20 characters.

The language is selected at start-up (parameter 99.01 LANGUAGE).

The control panel has four operation modes:

- Actual Signal Display Mode (ACT key)
- Parameter Mode (PAR key)
- Function Mode (FUNC key)
- Drive Selection Mode (DRIVE key)

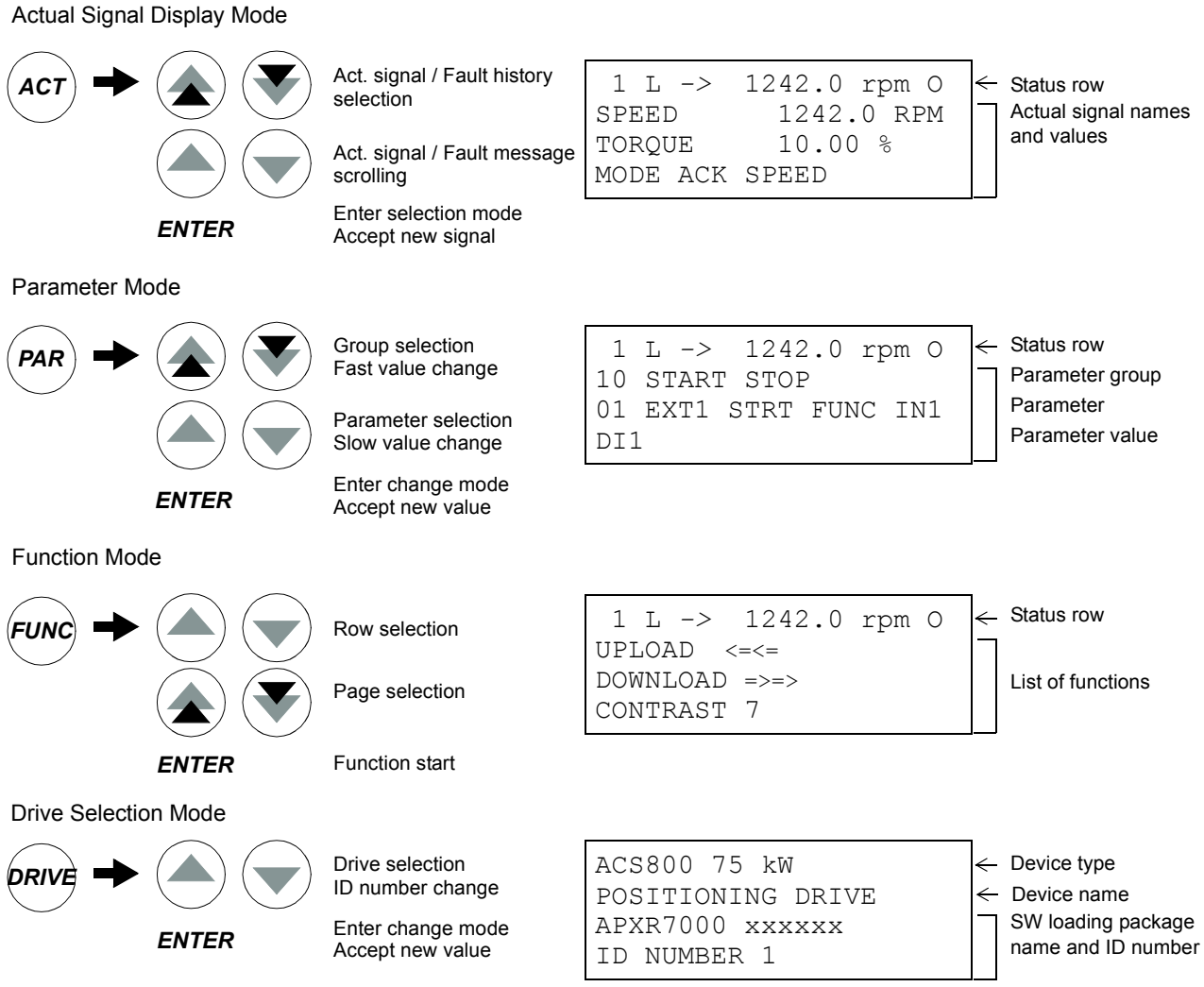
The use of single arrow keys, double arrow keys and ENTER depend on the operation mode of the panel.

The drive control keys are:

No.	Use
1	Start
2	Stop
3	Activate reference setting
4	Forward direction of rotation
5	Reverse direction of rotation
6	Fault reset
7	Change between Local / Remote (external) control

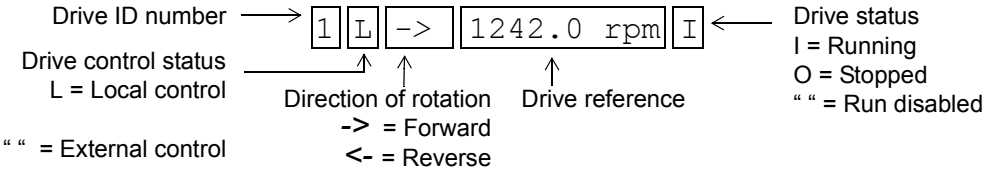
Panel operation mode keys and displays

The figure below shows the mode selection keys of the panel, and the basic operations and displays in each mode.



Status row

The figure below describes the status row digits.



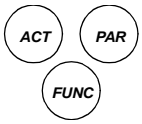
Drive control with the panel

The user can control the drive with the panel as follows:

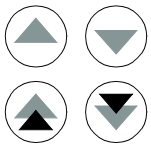
- start, stop, and change direction of the motor
- give the motor speed reference
- reset the fault and warning messages
- change between local and external drive control.

The panel can be used for control of the drive always when the drive is under local control and the status row is visible on the display.

How to start, stop and change direction

Step	Action	Press Key	Display
1.	To show the status row.		1 ->1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
2.	To switch to local control. (only if the drive is not under local control, i.e. there is no L on the first row of the display.)		1 L ->1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
3.	To stop		1 L ->1242.0 rpm O SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
4.	To start		1 L ->1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
5.	To change the direction to reverse.		1 L <-1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
6.	To change the direction to forward.		1 L ->1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED

How to set speed reference

Step	Action	Press Key	Display
1.	To show the status row.	ACT PAR FUNC	1 ->1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
2.	To switch to local control. (Only if the drive is not under local control, i.e. there is no L on the first row of the display.)	LOC REM	1 L ->1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
3.	To enter the Reference Setting function.	REF	1 L ->[1242.0 rpm]I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
4.	To change the reference. (slow change) (fast change)		1 L ->[1325.0 rpm]I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
5.	To save the reference. (The value is stored in the permanent memory; it is restored automatically after power switch-off.)	***ENTER***	1 L -> 1325.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED

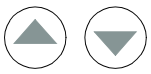
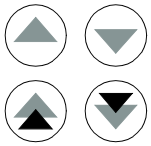
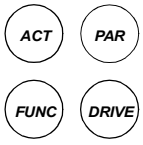
Actual signal display mode

In the Actual Signal Display Mode, the user can:

- show three actual signals on the display at a time
- select the actual signals to display
- view the fault history
- reset the fault history.

The panel enters the Actual Signal Display Mode when the user presses the ***ACT*** key, or if he does not press any key within one minute.

How to select actual signals to the display

Step	Action	Press key	Display
1.	To enter the Actual Signal Display Mode.		1 L -> 1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
2.	To select a row (a blinking cursor indicates the selected row).		1 L -> 1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
3.	To enter the actual signal selection function.	***ENTER***	1 L -> 1242.0 rpm I 1 ACTUAL SIGNALS 06 TORQUE 10.00 %
4.	To select an actual signal. To change the actual signal group.		1 L -> 1242.0 rpm I 1 ACTUAL SIGNALS 05 CURRENT 80.00 A
5.a	To accept the selection and to return to the Actual Signal Display Mode.	***ENTER***	1 L -> 1242.0 rpm I SPEED 1242.00 rpm CURRENT 80.00 A MODE ACK SPEED
5.b	To cancel the selection and keep the original selection. The selected keypad mode is entered.		1 L -> 1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED

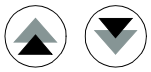
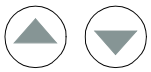
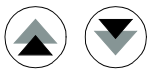
How to display the full name of the actual signals

Step	Action	Press key	Display
1.	To display the full name of the three actual signals.	**Hold** 	1 L -> 1242.0 rpm I SPEED TORQUE MODE ACK SPEED
2.	To return to the Actual Signal Display Mode.	**Release** 	1 L -> 1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED

How to view and reset the fault history

The fault history includes information on at least 16 of the latest faults and warnings.

Note: The fault history cannot be reset if there are active faults or warnings.

Step	Action	Press key	Display
1.	To enter the Actual Signal Display Mode.		1 L -> 1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
2.	To enter the Fault History Display.		1 L -> 1242.0 rpm I 1 LAST FAULT +OVERCURRENT 6451 H 21 MIN 23 S
3.	To select the previous (UP) or the next fault/warning (DOWN). To clear the Fault History.	 	1 L -> 1242.0 rpm I 2 LAST FAULT +OVERVOLTAGE 1121 H 1 MIN 23 S 1 L -> 1242.0 rpm I 2 LAST FAULT H MIN S
4.	To return to the Actual Signal Display Mode.		1 L -> 1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED

How to display and reset an active fault

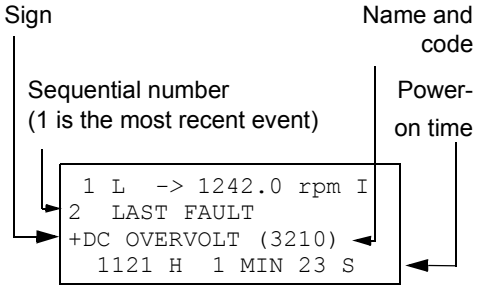
WARNING! If an external source for start command is selected and it is ON, the drive will start immediately after fault reset. If the cause of the fault has not been removed, the drive will trip again.

Step	Action	Press Key	Display
1.	To display an active fault.	ACT	1 L -> 1242.0 rpm ACS800 75 kW ** FAULT ** ACS800 TEMP
2.	To reset the fault.	RESET	1 L -> 1242.0 rpm O SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED

About the fault history

The fault history restores information on the latest events (faults, warnings and resets) of the drive. The table below shows how the events are stored in the fault history.

A Fault History View



Event	Information on display
Drive detects a fault and generates a fault message.	Sequential number of the event and LAST FAULT text. Name of the fault and a “+” sign in front of the name. Total power-on time.
User resets the fault message.	Sequential number of the event and LAST FAULT text. -RESET FAULT text. Total power-on time.
Drive generates a warning message.	Sequential number of the event and LAST WARNING text. Name of the warning and a “+” sign in front of the name. Total power-on time.
Drive deactivates the warning message.	Sequential number of the event and LAST WARNING text. Name of the warning and a “-” sign in front of the name. Total power-on time.

Parameter mode

In the Parameter Mode, the user can:

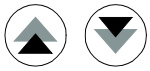
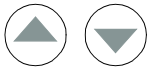
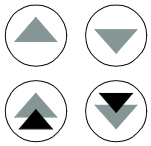
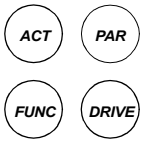
- view the parameter values
- change the parameter settings.

The panel enters the Parameter Mode when the user presses the ***PAR*** key.

Note: Some parameter values cannot be changed while the drive is running. If this is attempted, the following warning will be displayed:

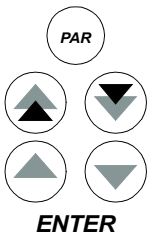
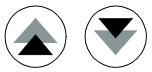
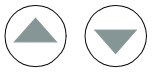
```
 **WARNING**
WRITE ACCESS DENIED
PARAMETER SETTING
NOT POSSIBLE
```

How to select a parameter and change the value

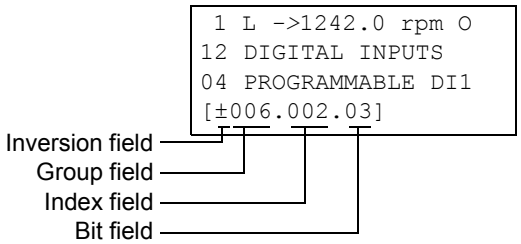
Step	Action	Press key	Display
1.	To enter the Parameter Mode.		1 L -> 1242.0 rpm O 10 START STOP 01 EXT1 START FUNC IN1
2.	To select a group.		1 L -> 1242.0 rpm O 11 CONTROL PLACES 01 CNTROL PLACE SEL DI2
3.	To select a parameter within a group.		1 L -> 1242.0 rpm O 11 CONTROL PLACES 02 EXT1 CONTROL MODE SPEED
4.	To enter the parameter setting function.	***ENTER***	1 L -> 1242.0 rpm O 11 CONTROL PLACES 02 EXT1 CONTROL MODE [SPEED]
5.	To change the parameter value. - (slow change for numbers and text) - (fast change for numbers only)		1 L -> 1242.0 rpm O 11 CONTROL PLACES 02 EXT1 CONTROL MODE [TORQUE]
6a.	To save the new value.	***ENTER***	1 L -> 1242.0 rpm O 11 CONTROL PLACES 02 EXT1 CONTROL MODE TORQUE
6b.	To cancel the new setting and keep the original value, press any of the mode selection keys. The selected mode is entered.		1 L -> 1242.0 rpm O 11 CONTROL PLACES 02 EXT1 CONTROL MODE SPEED

How to adjust a source selection (pointer) parameter

Most parameters define values that are used directly in the drive application program. Source selection (pointer) parameters are exceptions: They point to the value of another parameter. The parameter setting procedure differs somewhat from that of the other parameters.

Step	Action	Press Key	Display
1.	See the table above to - enter the Parameter Mode - select the correct parameter group and parameter - enter the parameter setting mode		1 L ->1242.0 rpm O 12 DIGITAL INPUTS 04 PROGRAMMABLE DI1 [±000.000.00]
2.	To scroll between the inversion, group, index and bit fields.[1)]		1 L ->1242.0 rpm O 12 DIGITAL INPUTS 04 PROGRAMMABLE DI1 [±000.000.00]
3.	To adjust the value of a field.		1 L ->1242.0 rpm O 12 DIGITAL INPUTS 04 PROGRAMMABLE DI1 [±000.002.00]
4.	To accept the value.	***ENTER***	

1)



Inversion field inverts the selected parameter value. Plus sign (+): no inversion, minus (-) sign: inversion.

Bit field selects the bit number (relevant only if the parameter value is a packed boolean word).

Index field selects the parameter index.

Group field selects the parameter group.

Note: Instead of pointing to another parameter, it is also possible to define a constant by the source selection parameter. Proceed as follows:

- Change the inversion field to C. The appearance of the row changes. The rest of the line is now a constant setting field.

- Give the constant value to the constant setting field.

- Press Enter to accept.

Function mode

In the Function Mode, the user can:

- upload the drive parameter values and motor data from the drive to the panel
- download group 10 to 97 parameter values from the panel to the drive [1)]
- adjust the contrast of the display.

The panel enters the Function Mode when the user presses the ***FUNC*** key.

[1)] The parameter groups 98, 99 and the results of the motor identification are not included by default. The restriction prevents downloading of unfit motor data. In special cases it is, however, possible to download all. For more information, please contact your local ABB representative.

How to upload data from a drive to the panel

Note:

- Upload before downloading.
- Ensure the DTC software (see par. 33.01 SOFTWARE VERSION) of the destination drive are the same as the software versions of the source drive.
- Before removing the panel from a drive, ensure the panel is in remote operating mode (change with the LOC/REM key).
- Stop the drive before downloading.

Before upload, repeat the following steps in each drive:

- Setup the motors.
- Activate the communication to the optional equipment. (See parameters 70.01 COMM MODULE LINK and 70.02 COMM PROFILE.

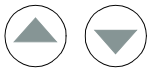
Before upload, do the following in the drive from which the copies are to be taken:

- Set the parameters in groups 10 to 97 as preferred.
- Proceed to the upload sequence (below).

Step	Action	Press Key	Display
1.	Enter the Function Mode.	FUNC	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
2.	Select the upload function (a flashing cursor indicates the selected function).	▲ ▼	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
3.	Enter the upload function.	ENTER	1 L -> 1242.0 rpm O UPLOAD <=<=
4.	Switch to external control. (No L on the first row of the display.)	LOC REM	1 -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
5.	Disconnect the panel and reconnect it to the drive into which the data will be downloaded.		

How to download data from the panel to a drive

Consider the notes in section *How to upload data from a drive to the panel* above.

Step	Action	Press Key	Display
1.	Connect the panel containing the uploaded data to the drive.		
2.	Ensure the drive is in local control (L shown on the first row of the display). If necessary, press the ***LOC/REM*** key to change to local control.		1 L -> 1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED
3.	Enter the Function Mode.		1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
4.	Select the download function (a flashing cursor indicates the selected function).		1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
5.	Start the download.	***ENTER***	1 L -> 1242.0 rpm O DOWNLOAD =>=>

How to set the contrast of the display

Step	Action	Press Key	Display
1.	Enter the Function Mode.	FUNC	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
2.	Select a function (a flashing cursor indicates the selected function).	▲ ▼	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
3.	Enter the contrast setting function.	***ENTER***	1 L -> 1242.0 rpm O CONTRAST [4]
4.	Adjust the contrast.	▲ ▼	1 L -> 1242.0 rpm CONTRAST [6]
5.a	Accept the selected value.	***ENTER***	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 6
5.b	Cancel the new setting and retain the original value by pressing any of the mode selection keys. The selected mode is entered.	ACT PAR FUNC DRIVE	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4

Drive selection mode

In normal use the features available in the Drive Selection Mode are not needed; the features are reserved for applications where several drives are connected to one panel link. (For more information, see the *Installation and Start-up Guide for the Panel Bus Connection Interface Module, NBCI* [3AFY58919748 (English)].

In the Drive Selection Mode, the user can:

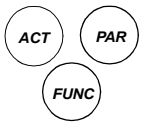
- select the drive with which the panel communicates through the panel link
- change the identification number of a drive connected to the panel link
- view the status of the drives connected on the panel link.

The panel enters the Drive Selection Mode when the user presses the ***DRIVE*** key.

Each on-line station must have an individual identification number (ID). By default, the ID number of the drive is 1.

Note: The default ID number setting of the drive should not be changed unless the drive is to be connected to the panel link with other drives on-line.

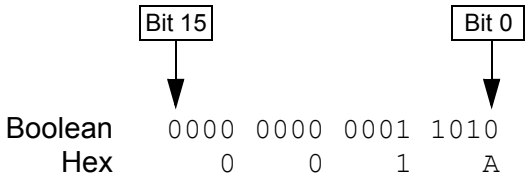
How to select a drive and change its panel link ID number

Step	Action	Press key	Display
1.	To enter the Drive Selection Mode.		ACS800 75 kW POSITIONING DRIVE APXR7000 xxxxxx ID NUMBER 1
2.	To select the next drive/view. The ID number of the station is changed by first pressing ***ENTER*** (the brackets round the ID number appear) and then adjusting the value with arrow buttons. The new value is accepted with ***ENTER***. The power of the drive must be switched off to validate its new ID number setting. The status display of all devices connected to the Panel Link is shown after the last individual station. If all stations do not fit on the display at once, press the double-arrow up to view the rest of them.		ACS800 75 kW positioning drive APXR7000 xxxxxx ID NUMBER 1 1 Status Display Symbols: = Drive stopped, direction forward = Drive running, direction reverse F = Drive tripped on a fault
3.	To connect to the last displayed drive and to enter another mode, press one of the mode selection keys. The selected mode is entered.		1 L -> 1242.0 rpm I SPEED 1242.00 rpm TORQUE 10.00 % MODE ACK SPEED

Reading and entering packed boolean values on the display

Some actual values and parameters are packed boolean, i.e. each individual bit has a defined meaning (explained at the corresponding signal or parameter). On the control panel, packed boolean values are read and entered in hexadecimal format.

In this example, bits 1, 3 and 4 of the packed boolean value are ON:



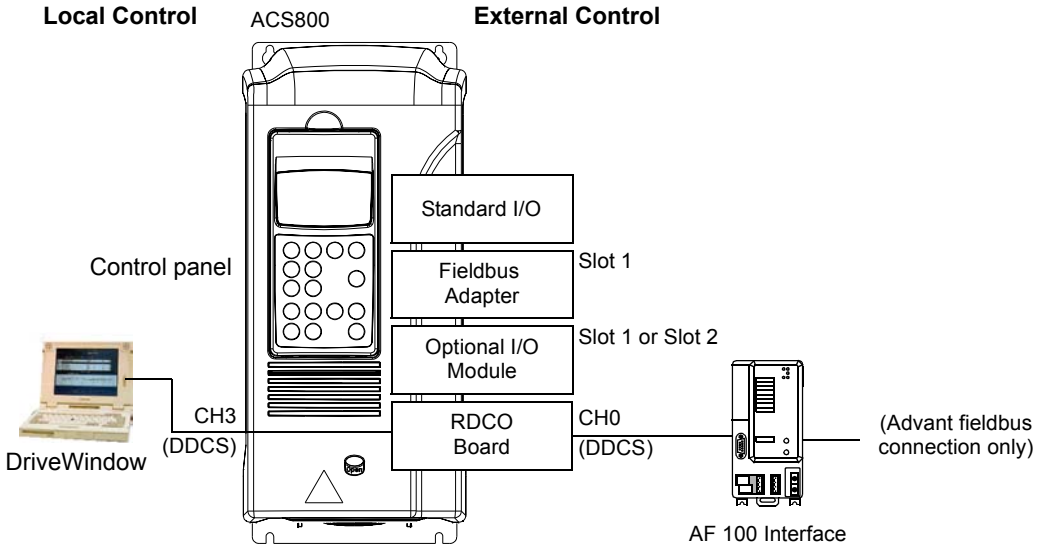
Basic program features

What this chapter contains

The chapter describes the basic program features. For each feature, there is a list of related user settings, actual signals, and fault and warning messages.

Local control vs. external control

The drive can receive start, stop and direction commands and reference values from the control panel or through digital and analogue inputs. An optional fieldbus adapter enables control over an open fieldbus link. A PC equipped with DriveWindow can also control the drive.



Local control

The control commands are given from the control panel keypad or from the DriveWindow PC tool when the drive is in local control. L indicates local control on the panel display. In local mode the drive is always speed controlled.

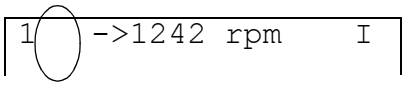
```
1 L ->1242 rpm    I
```

The control panel always overrides the external control signal sources when used in local mode.

External control

When the drive is in external control, the commands are given through the standard I/O terminals (digital and analogue inputs), optional I/O extension modules and/or the fieldbus interface.

External control is indicated by a blank on the panel display.



External Control through the Input/ Output terminals, or through the fieldbus interfaces

The user can connect the control signals to two external control locations, EXT1 or EXT2. Depending on the user selection, either one is active at a time.

Settings

Panel key	**Additional information**
LOC/REM	Selection between local and external control
Parameter	
10.01 EXT1 START FUNC... 10.03 EXT1 START IN2	Start and stop source for EXT1
10.04 EXT2 START FUNC... 10.06 EXT2 START IN2	Start and stop source for EXT2
11.01 CNTROL PLACE SEL	Selection between EXT1 and EXT2
11.02 EXT1 CONTROL MODE	Control mode for external control location 1 (EXT1): SPEED/TORQUE/MIN/MAX/ADD/POSITION/SYNCHRON
11.03 EXT2 CONTROL MODE	Control mode for external control location 2 (EXT2): SPEED/TORQUE/MIN/MAX/ADD/POSITION/SYNCHRON
12.01 DI/O EXT MODULE1	Activation of the optional I/O and serial communication
12.02 DI/O EXT MODULE2	
12.03 DI/O EXT MODULE3	
13.16 AI/O EXT MODULE	
70.01 COMM MODULE LINK	
70.02 COMM PROFILE	

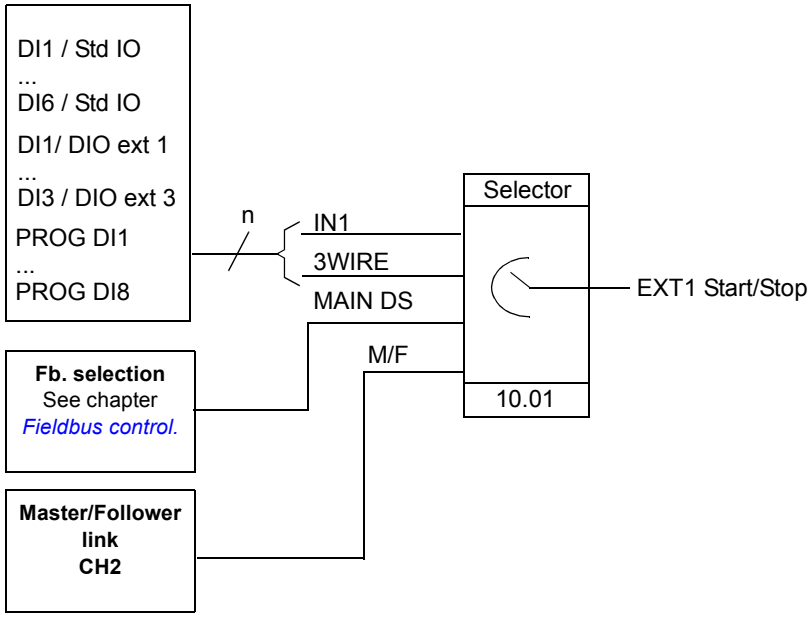
Diagnostics

Actual signals	**Additional information**
01.01 CTRL LOCATION	Active external control location: EXT1, EXT2 or Local
06.01 MAIN STATUS WORD bit 11	Selected external control location: EXT1/EXT2

See also chapter *Control block diagrams*.

Block diagram: start, stop source for EXT1

The figure below shows the parameters that select the interface for start and stop for external control location EXT1

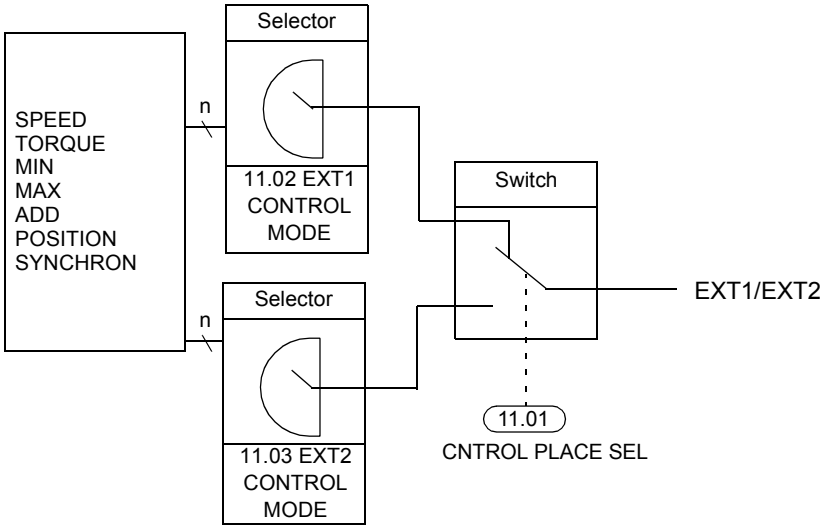


DI1 / Std IO = Digital input DI1 on the standard I/O terminal block

DI1 / DIO ext 1 = Digital input DI1 on the digital I/O extension module 1

PROG DI1 = Programmable digital input DI1

The figure below shows the parameters that select the control location EXT1/EXT2.



Reference types and processing

The drive can accept a variety of references in addition to the conventional analogue input signal and control panel signals.

- The drive accepts a bipolar analogue speed reference. This feature allows both the speed and direction to be controlled with a single analogue input. The minimum signal is full speed reversed and the maximum signal is full speed forward.
- The drive can form a reference out of two analogue input signals or the drive can form a reference out of an analogue input signal and a signal received through a serial communication interface.

It is possible to scale the external reference so that the signal minimum and maximum values correspond to a speed other than the minimum and maximum speed limits.

<table>
<tr><th>Selection</th><th>Torque reference</th><th>Speed reference</th><th>Position reference</th><th>Synchron reference</th></tr>
<tr><td>NOT SEL</td><td>0% = 0%</td><td>0 rpm = 0 rpm</td><td rowspan="19">-</td><td rowspan="6">-</td></tr>
<tr><td>AI1</td><td rowspan="5">100% = 100% of the nominal motor torque</td><td rowspan="5">100% = parameter 19.01 value</td></tr>
<tr><td>AI2</td></tr>
<tr><td>AI3</td></tr>
<tr><td>EXT AI1</td></tr>
<tr><td>EXT AI2</td></tr>
<tr><td>MAIN DS REF1</td><td rowspan="7">10000 = 100% of the nominal motor torque</td><td rowspan="7">20000 = parameter 19.01 value</td></tr>
<tr><td>MAIN DS REF2</td></tr>
<tr><td>AUX DS REF1</td></tr>
<tr><td>AUX DS REF2</td></tr>
<tr><td>AUX DS REF3</td></tr>
<tr><td>M/F REF1</td><td>See parameters 19.12...19.15 and group 41 SYNCHRON REFERENCE</td></tr>
<tr><td>M/F REF2</td><td>-</td></tr>
<tr><td>MEASURED SPEED</td><td rowspan="3">-</td><td rowspan="3">1 rpm = 1 rpm</td><td rowspan="2">See parameters 19.12...19.14 and group 41 SYNCHRON REFERENCE</td></tr>
<tr><td>ENC2</td></tr>
<tr><td>ENC 2 SYNC GEAR</td><td rowspan="4">-</td></tr>
<tr><td>ZERO</td><td rowspan="3">-</td><td rowspan="3">-</td><td>0 = 0</td></tr>
<tr><td>POS REF TABLE</td><td>See parameters 19.12...19.14</td></tr>
<tr><td>MAIN DS REF12</td><td>See parameters 19.12...19.15</td></tr>
</table>

Settings

Parameter	Additional information
Group 11 CONTROL PLACES	Control mode selection
Group 19 SIGNAL CALC	Speed scaling etc.
Group 21 SPEED REFERENCE	Speed reference source, type and scaling
Group 22 ACCEL/DECEL	Speed reference acceleration and deceleration ramps
Group 24 TORQUE CONTROL	Torque reference ramp times
Group 32 SUPERVISION	Reference supervision
Group 40 POS REFERENCE	Position reference
Group 41 SYNCHRON REFERENCE	Synchron reference

Diagnostics

Actual signal	Additional information
Groups 03 CONTROL VALUES and 04 POS CTRL VALUES	Reference values in different stages of the reference processing chain
Parameter	
Group 14 RELAY OUTPUTS	Active reference / reference loss through a relay output
Group 15 ANALOGUE OUTPUTS	Reference value

See also chapter *Control block diagrams*.

Programmable analogue inputs

The drive has three programmable analogue inputs: one voltage input (0/2 to 10 V or -10 to 10 V) and two current inputs (0/4 to 20 mA). Two extra inputs are available if an optional analogue I/O extension module is used. Each input can be inverted and filtered, and the maximum and minimum values can be adjusted.

Update cycles in the Motion Control Application Program

Input	Cycle
AI / standard	2 ms
AI / extension	6 ms (100 ms [1)])

[1)] Update cycle in the motor temperature measurement function. See group 35 MOT TEMP MEAS.

Settings

Parameter	Additional information
Group 13 ANALOGUE INPUTS	Processing of the standard inputs
21.02....21.04 SPEED REF1...3	AI as speed reference source
24.01...24.03 TORQ REF1...2	AI as torque reference source
28.07 START TORQ REF SEL	AI in a mechanical brake control function
Group 35 MOT TEMP MEAS	AI in a motor temperature measurement
40.12 POS SPEED MUL SEL	AI as positioning speed multiplier source

Diagnostics

Actual value	Additional information
02.01 AI1 [V] 02.03 AI2 [mA] 02.05 AI3 [mA]	Values of standard inputs
02.07 EXT AI1 [mA] 02.09 EXT AI2 [mA]	Values of optional inputs
02.02 AI1 SCALED 02.04 AI2 SCALED 02.06 AI3 SCALED 02.08 EXT AI1 SCALED 02.10 EXT AI2 SCALED 06.07 AI SUP STATUS	Scaled analogue input values
Warning	
AI < MIN FUNC	Analogue control signal below minimum allowed value
Fault	
I/O COMM ERR	Communication loss to I/O

Speed control through RAIO analogue extension module

Communication between the module and the drive is activated by parameter 13.16 AI/O EXT MODULE. For more information see *RAIO Module User's Manual* [3AFE64484567 (English)].

Basic checks

Ensure the drive is:

- installed and commissioned, and
- the external start and stop signals are connected.

Ensure the extension module:

- settings are adjusted (see below.)
- is installed and reference signal is connected to AI1
- is connected to the drive.

Settings of the analogue extension module and the drive

- Set the module node address to 5 (not required if installed to the option slot of the drive).
- Select the signal type for the module input AI1 (switch).
- Select the operation mode (unipolar/bipolar) of the module input (switch).
- Set the drive parameters in group 13 ANALOGUE INPUTS.

Analogue input signal conversion to a speed value in rpm

AI MIN	-10 V	0 V	0 V	0 V	0 V
AI MAX	10 V	10 V	10 V	10 V	10 V
AI MIN SCALE (13.03 AI1 MIN SCALE)	-100%	-100%	0%	0%	-100%
AI MAX SCALE (13.04 AI1 MAX SCALE)	100%	100%	100%	200%	200%
Integer range*	-20000...20000	-20000...20000	0...20000	0...40000	-20000...40000
Speed scale (19.01 AI1 MIN SCALE)	1500 rpm	1500 rpm	1500 rpm	1500 rpm	1500 rpm
rpm range**	-1500...1500	-1500...1500	0...1500	0....3000	-1500...3000

*Conversion of analogue signal to an integer value
AI MIN...AI MAX ≙ AI MIN SCALE * 20000...AI MAX SCALE * 20000

**Conversion of integer to rpm value
-20000...20000 ≙ -SPEED SCALE...SPEED SCALE

Programmable analogue outputs

Two programmable current outputs (0/4 to 20 mA) are available as standard, and two outputs can be added by using an optional analogue I/O extension module. Analogue output signals can be inverted and filtered.

The analogue output signals can be proportional to motor speed, process speed (scaled motor speed), output frequency, output current, motor torque, motor power, etc.

It is possible to write a value to an analogue output through a serial communication link.

Update cycles in the Motion Control Application Program

Output	Cycle
AO / standard	24 ms
AO / extension	24 ms (1000 ms [1])

[1] Update cycle in the motor temperature measurement function. See group 35 MOT TEMP MEAS.

Settings

Parameter	Additional information
13.16 AI/O EXT MODULE	Communication to analogue I/O extension module (optional)
Group 15 ANALOGUE OUTPUTS	AO value selection and processing (standard outputs)
Group 35 MOT TEMP MEAS	AO in motor temperature measurement
Note: If motor 1 temperature measurement is selected by parameter 35.01, analogue output AO1 value is set to a constant current value.	

Any actual signal can be selected as the source for analogue output. See *Actual signals.*

Diagnostics

Actual value	Additional information
02.11 AO1 [mA], 02.12 AO2 [mA]	Values of the standard outputs
02.13 EXT AO1 [mA], 02.14 EXT AO2 [mA]	Values of the optional outputs
Warning	
POINTER ERROR	Source selection (pointer) parameter points to a non-existing parameter index.
Fault	
I/O COMM ERR	Communication loss to I/O

Programmable digital inputs

The drive has six programmable digital inputs as a standard. Six extra inputs are available if optional digital I/O extension modules are used.

Update cycles in the Motion Control Application Program

Input	Cycle
DI / standard	1 ms
DI / extension	12 ms

Settings

Parameter	Additional information
Group 10 START/STOP	DI as start/stop, run enable and reset signal source
11.01 CNTROL PLACE SEL	DI as external control EXT1/EXT2 change signal source
Group 12 DIGITAL INPUTS	Processing of the inputs
16.03 USER MACRO IO CHG	DI as external user macro change signal source
Group 20 LIMITS	DI as speed reference enable command / torque limit source
Group 21 SPEED REFERENCE	DI as speed reference selection signal source
22.01 ACC/DEC SEL	DI as acceleration and deceleration time selection signal source
23.04 PI PAR 1/2 SEL	DI as PI controller parameter set 1/2 selection signal source
24.04 TORQ REF NEG SEL	DI as torque reference inversion signal source
28.02 BRAKE ACKNOWLEDGE	DI as mechanical brake acknowledgement signal source
30.02 EXTERNAL FAULT	DI as external fault source
30.04 MOT THERM P MODE	DI in motor overtemperature supervision
Group 40 POS REFERENCE	DI as positioning reference source
42.03 DYN LIM ENA	DI as dynamic limiter enable command source
Group 43 HOMING	DI as homing control signal source

Diagnostics

Actual value	Additional information
06.04 RMIO DI STATUS	Values of the standard digital inputs
06.05 EXT DI STATUS	Values of the optional digital inputs
06.06 PROG DI STATUS	Values of programmable digital inputs
Warning	
POINTER ERROR	Source selection (pointer) parameter points to a non-existing parameter index.
Fault	
I/O COMM ERR	Communication loss to I/O

Programmable relay outputs

As standard there are three programmable relay outputs. Six outputs can be added by using the optional digital I/O extension modules. By means of a parameter setting it is possible to choose which information to indicate through the relay output: ready, running, fault, warning, motor stall, etc.

It is possible to write a value to a relay output through a serial communication link.

Update cycles in the Motion Control Application Program

Output	Cycle
RO / standard	100 ms
RO / extension	100 ms

Settings

Parameter	Additional information
Group 14 RELAY OUTPUTS	RO value selections
12.01 DI/O EXT MODULE1	Activation of optional relay outputs
12.02 DI/O EXT MODULE2	
12.03 DI/O EXT MODULE3	

Any actual signal can be selected as the source for relay output. See *Actual signals.*

Diagnostics

Actual value	Additional information
06.09 RMIO RO STATUS	Standard relay output states
06.10 EXT RO STATUS	Optional relays output states
Warning	
POINTER ERROR	Source selection (pointer) parameter points to a non-existing parameter index.
Fault	
I/O COMM ERR	Communication loss to I/O

Actual signals

Several actual signals are available, including:

- Drive output frequency, current, voltage and power
- Motor speed and torque
- Mains voltage and intermediate circuit DC voltage
- Active control location (Local, EXT1 or EXT2)
- Reference values
- Drive temperature
- Operating time counter (h), kWh counter
- Digital I/O and Analogue I/O status

Three signals can be shown simultaneously on the control panel display. It is also possible to read the values through the serial communication link or through the analogue/relay outputs.

Settings

Parameter	Additional information
Group 10 START/STOP	Actual signal as start / stop / run enable signal
11.01 CNTROL PLACE SEL	Actual signal as external control EXT1/EXT2 change signal
Group 14 RELAY OUTPUTS	Selection of an actual signal to a relay output
Group 15 ANALOGUE OUTPUTS	Selection of an actual signal to an analogue output
16.03 USER MACRO IO CHG	Actual signal as external user macro change signal
Group 20 LIMITS	Actual signal as speed reference enable command / torque limit
Group 21 SPEED REFERENCE	Actual signal as speed reference selection signal
22.01 ACC/DEC SEL	Actual signal as acceleration and deceleration time selection signal
23.04 PI PAR 1/2 SEL	Actual signal as PI controller parameter set 1/2 selection signal
24.04 TORQ REF NEG SEL	Actual signal as torque reference inversion signal
26.04 FLUX REF PTR	Actual signal as flux reference
28.02 BRAKE ACKNOWLEDGE	Actual signal as mechanical brake acknowledgement signal
30.02 EXTERNAL FAULT	Actual signal as external fault signal
30.04 MOT THERM P MODE	Actual signal in motor overtemperature supervision
Group 32 SUPERVISION	Actual signal in supervision
Group 40 POS REFERENCE	Actual signal as positioning reference
42.03 DYN LIM ENA	Actual signal as dynamic limiter enable command
Group 43 HOMING	Actual signal as homing control signal
Group 92 DSET TR ADDR	Selection of an actual signal to a dataset (serial communication)

Diagnostics

Actual value	Additional information
Groups 01 ACTUAL SIGNALS … 07 ALARMS AND FAULTS	Lists of actual signals

Motor identification

The performance of Direct Torque Control is based on an accurate motor model determined during the motor start-up.

A motor Identification Magnetisation is automatically done the first time the start command is given. During this first start-up, the motor is magnetised at zero speed for several seconds to allow the motor model to be created. This identification method is suitable for most applications.

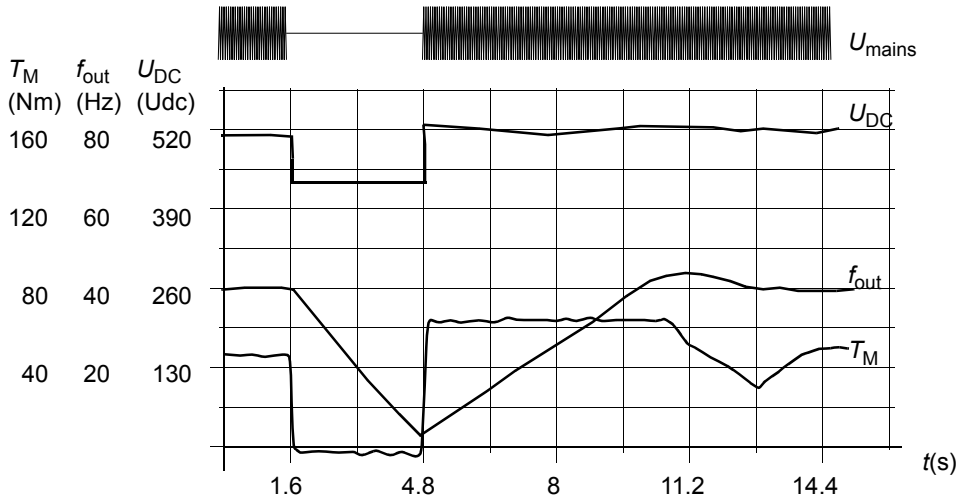
In demanding applications a separate Identification Run can be performed.

Settings

Parameter 99.08 ID RUN

Power loss ride-through

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



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

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

Note: Cabinet assembled units equipped with main contactor option have a “hold circuit” that keeps the contactor control circuit closed during a short supply break. The allowed duration of the break is adjustable. The factory setting is five seconds.

Automatic Start

Since the drive can detect the state of the motor within a few milliseconds, the starting is immediate under all conditions. There is no restart delay. E.g. the starting of turbining pumps or windmilling fans is easy.

Settings

Parameter 10.11 START FUNCTION

DC Magnetising

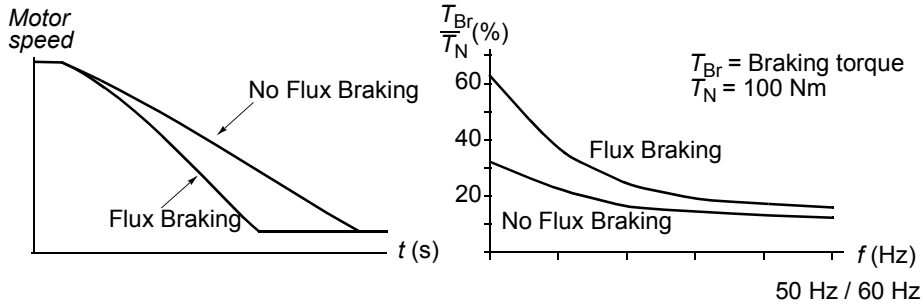
When DC Magnetising is activated, the drive automatically magnetises the motor before starting. This feature guarantees the highest possible breakaway torque, up to 200% of motor nominal torque. By adjusting the premagnetising time, it is possible to synchronise the motor start and e.g. a mechanical brake release. The Automatic Start feature and DC Magnetising cannot be activated at the same time.

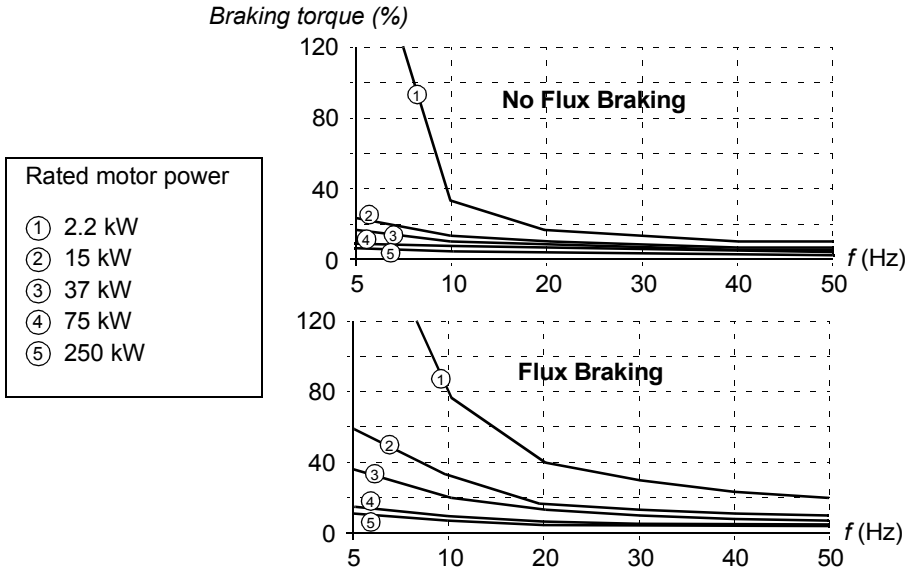
Settings

Parameters 10.11 START FUNCTION and 10.12 CONST DC MAGN TIME

Flux Braking

The drive can provide greater deceleration by raising the level of magnetisation in the motor. By increasing the motor flux, the energy generated by the motor during braking can be converted to motor thermal energy. This feature is useful in motor power ranges below 15 kW.





The drive monitors the motor status continuously, also during the 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 motor is efficient. The stator current of the motor increases during the Flux Braking, not the rotor current. The stator cools much more efficiently than the rotor.

Settings

Parameter 26.02 FLUX BRAKING

Flux Optimisation

Flux Optimisation reduces the total energy consumption and motor noise level when the drive operates below the nominal load. The total efficiency (motor and the drive) can be improved by 1...10%, depending on the load torque and speed.

Settings

Parameter 26.01 FLUX OPTIMIZATION

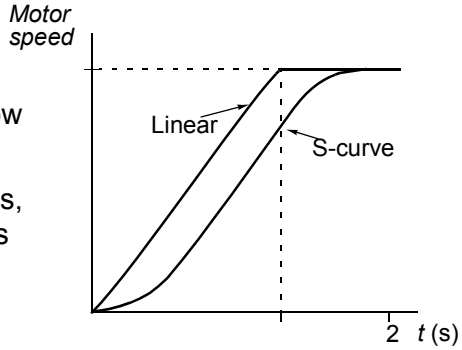
Acceleration and deceleration ramps

Two user-selectable acceleration and deceleration ramps are available. It is possible to adjust the acceleration/deceleration times and the ramp shape. Switching between the two ramps can be controlled via a digital input.

The available ramp shape alternatives are Linear and S-curve.

Linear: Suitable for drives requiring steady or slow acceleration/deceleration.

S-curve: Ideal for conveyors carrying fragile loads, or other applications where a smooth transition is required when changing the speed.

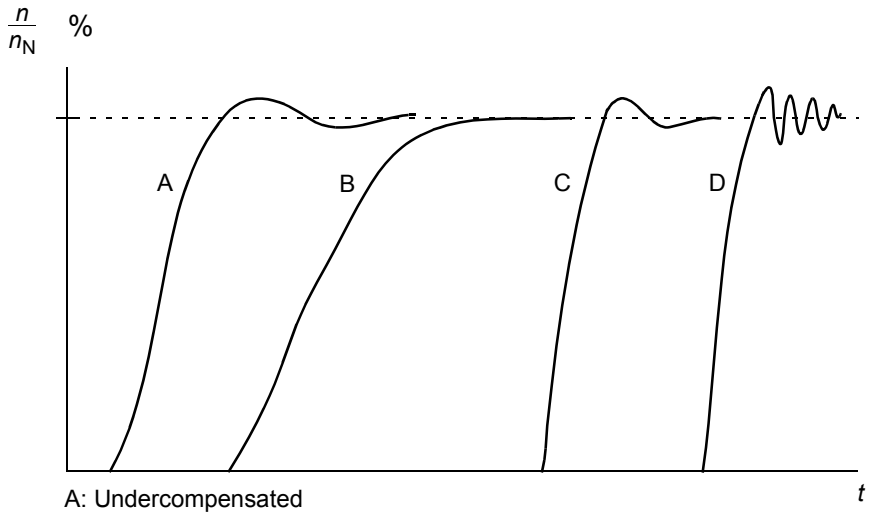


Settings

Parameter group 22 ACCEL/DECEL

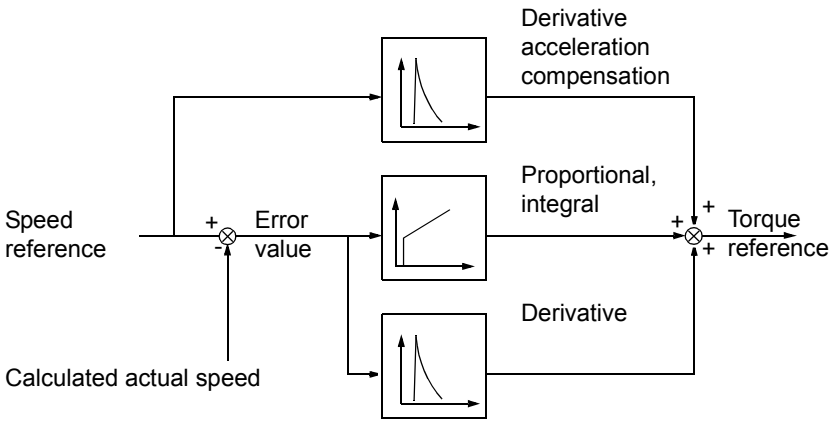
Speed controller tuning

During the motor identification, the speed controller is automatically tuned. It is, however, possible to manually adjust the controller gain, integration time and derivation time. or let the drive perform a separate speed controller PI tuning. In PI tuning, the speed controller is tuned based on the load and inertia of the motor and the machine.The figure below shows speed responses at a speed reference step (typically, 1 to 20%).



A: Undercompensated
B: Normally tuned (autotuning)
C: Normally tuned (manually). Better dynamic performance than with B
D: Overcompensated speed controller

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



Settings

Parameter groups 23 SPEED CTRL and 20 LIMITS

Diagnostics

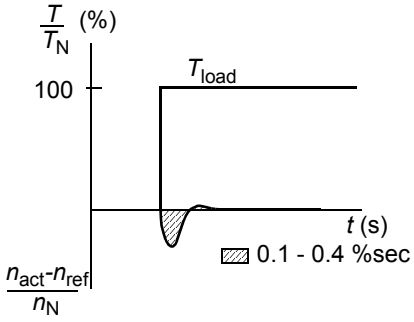
Actual signal 01.03 SPEED

Speed control performance figures

The table below shows typical performance figures for speed control when Direct Torque Control is used.

Speed Control	No Pulse Encoder	With Pulse Encoder
Static speed error, % of n_N	± 0.1 to 0.5% (10% of nominal slip)	±0.01%
Dynamic speed error	0.4 %sec.*	0.1 %sec.*

*Dynamic speed error depends on speed controller tuning.



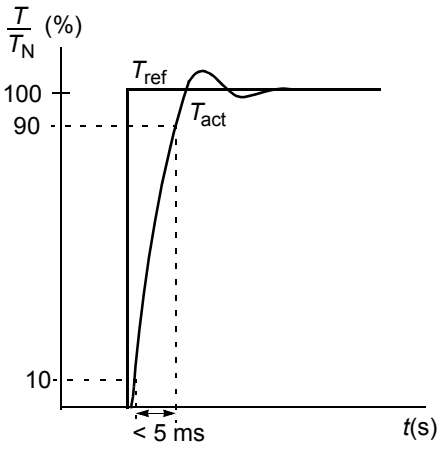
T_N = rated motor torque
n_N = rated motor speed
n_{act} = actual speed
n_{ref} = speed reference

Torque control performance figures

The drive can perform precise torque control without any speed feedback from the motor shaft. The table below shows typical performance figures for torque control, when Direct Torque Control is used.

Torque Control	No Pulse Encoder	With Pulse Encoder
Linearity error	±4%*	±3%
Repeatability error	±3%*	±1%
Torque rise time	1 to 5 ms	1 to 5 ms

*When operated around zero frequency, the error may be greater.



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

Hexagonal motor flux

Typically the drive controls the motor flux in such a way that the rotating flux vector follows a circular pattern. This is ideal in most applications. When operated above the field weakening point (FWP, typically 50 or 60 Hz), it is, however, not possible to reach 100% of the output voltage. The peak load capacity of the drive is lower than with the full voltage.

If hexagonal flux control is selected, the motor flux is controlled along a circular pattern below the field weakening point, and along a hexagonal pattern in the field weakening range. The applied pattern is changed gradually as the frequency increases from 100% to 120% of the FWP. Using the hexagonal flux pattern, the maximum output voltage can be reached; The peak load capacity is higher than with the circular flux pattern but the continuous load capacity is lower in the frequency range of FWP to 1.6 · FWP, due to increased losses.

Settings

Parameter 26.03 HEX FIELDWEAKENING

Programmable protection functions

AI<Min

AI<Min function defines the drive operation if an analogue input signal falls below the preset minimum limit.

Settings

Parameters 13.28 AI MIN FUNCTION and 13.29 AI MIN ACTIVATION

Panel Loss

Panel Loss function defines the operation of the drive if the control panel selected as control location for the drive stops communicating.

Settings

Parameter 30.01 PANEL LOSS

Position limit error

The actual position monitoring is active in Position and Synchron modes if the drive is enabled.

The actual position monitoring function is inactive if the absolute difference between the minimum and maximum positions (parameters 42.02 and 42.01) is less than 0.005 degrees (1/65536 of a revolution, or the corresponding translatory value).

Parameters 42.02 POSITION MIN and 42.01 POSITION MAX also limit the position reference. If the target position exceeds the position limits, a warning message is generated and the interpolator does not accept the reference.

Settings

Parameters 42.01 POSITION MAX and 42.02 POSITION MIN

Position error

The position error supervision is active in Position and Synchron modes. The drive is tripped on a fault POSITION ERR if the position error is exceeded.

Settings

Parameter 32.10 POS ERROR WINDOW

External Fault

External Faults can be supervised by defining one digital input as a source for an external fault indication signal.

Settings

Parameter 30.02 EXTERNAL FAULT

Motor Thermal Protection

The motor can be protected against overheating by activating the Motor Thermal Protection function and by selecting one of the motor thermal protection modes available.

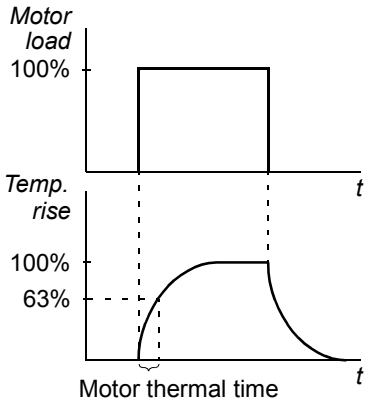
The Motor Thermal Protection modes are based either on a motor temperature thermal model or on an overtemperature indication from a motor thermistor.

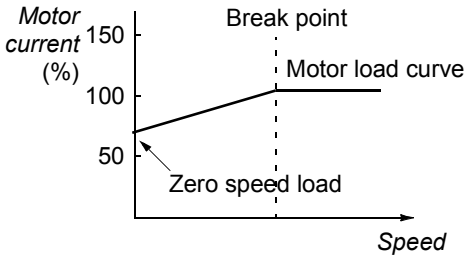
Motor temperature thermal model

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

1) The motor is in the ambient temperature of 30°C when power is applied to the drive.

2) Motor temperature is calculated using either the user-adjustable or automatically calculated motor thermal time and motor load curve (see the figures below). The load curve should be adjusted in case the ambient temperature exceeds 30°C.





Use of the motor thermistor

It is possible to detect motor overtemperature by connecting a motor thermistor (PTC) between the +24 VDC voltage supply offered by the drive and digital input DI6. In normal motor operation temperature, the thermistor resistance should be less than 1.5 kohm (current 5 mA). The drive stops the motor and gives a fault indication if the thermistor resistance exceeds 4 kohm. The installation must meet the regulations for protecting against contact.

Settings

Parameters 30.03 MOTOR THERM PROT...30.08 BREAK POINT

Note: It is also possible to use the motor temperature measurement function. See the subsection *Motor temperature measurement through the standard I/O*.

Stall Protection

The drive protects the motor in a stall situation. It is possible to adjust the supervision limits (frequency, time) and choose how the drive reacts to the motor stall condition (warning indication / fault indication & stop the drive / no reaction).

Settings

Parameters 30.09 STALL FUNCTION...30.11 STALL TIME

Underload Protection

Loss of motor load may indicate a process malfunction. The drive provides an underload function to protect the machinery and process in such a serious fault condition. Supervision limits - underload curve and underload time - can be chosen as well as the action taken by the drive upon the underload condition (warning indication / fault indication & stop the drive / no reaction).

Settings

Parameters 30.12 UNDERLOAD FUNC...30.14 UNDERLOAD CURVE

Motor Phase Loss

The Phase Loss function monitors the status of the motor cable connection. The function is useful especially during the motor start: the drive detects if any of the motor phases is not connected and refuses to start. The Phase Loss function also supervises the motor connection status during normal operation.

Settings

Parameter 30.15 MOTOR PHASE LOSS

Earth Fault Protection

The Earth Fault Protection detects earth faults in the motor or motor cable.

The Earth Fault protection is based on earth leakage current measurement with a summation current transformer at the output of the converter.

- An earth fault in the mains does not activate the protection.
- In an earthed (grounded) supply, the protection activates in 200 microseconds.
- In floating mains, the mains capacitance should be 1 microfarad or more.
- The capacitive currents due to screened copper motor cables up to 300 metres do not activate the protection.

Settings

Parameter 30.16 EARTH FAULT

Communication Fault

The Communication Fault function supervises the communication between the drive and an external control device (e.g. a fieldbus adapter module).

Settings

Parameters 70.03 COMM MOD FLT FUNC and 70.07 MAIN DS TIMEOUT

Preprogrammed faults

Overcurrent

The overcurrent trip limit for the drive is 1.65 to 2.17 · I_{max} depending on the drive type.

DC overvoltage

The DC overvoltage trip limit is 1.3 ·U_{1max}, where U_{1max} is the maximum value of the mains voltage range. For 400 V units, U_{1max} is 415 V. For 500 V units, U_{1max} is 500 V. For 690 V units, U_{1max} is 690 V. The actual voltage in the intermediate circuit corresponding to the mains voltage trip level is 728 VDC for 400 V units, 877 VDC for 500 V units, and 1210 VDC for 690 V units.

DC undervoltage

The DC undervoltage trip limit is 0.65 · U_{1min}, where U_{1min} is the minimum value of the mains voltage range. For 400 V and 500 V units, U_{1min} is 380 V. For 690 V units, U_{1min} is 525 V. The actual voltage in the intermediate circuit corresponding to the mains voltage trip level is 334 VDC for 400 V and 500 V units, and 461 VDC for 690 V units.

Drive temperature

The drive supervises the inverter module temperature. There are two supervision limits: warning limit and fault trip limit.

Short circuit

There are separate protection circuits for supervising the motor cable and the inverter short circuits. If a short circuit occurs, the drive will not start and a fault indication is given.

Input phase loss

Input phase loss protection circuits supervise the mains cable connection status by detecting intermediate circuit ripple. If a phase is lost, the ripple increases. The drive is stopped and a fault indication is given if the ripple exceeds 13%.

Ambient temperature

The drive will not start and a fault indication CTRL B TEMP is given if the ambient temperature is above 88°C.

Overfrequency

If the drive output frequency exceeds the preset level, the drive is stopped and a fault indication is given. The preset level is 50 Hz over the operating range absolute maximum speed limit.

Internal fault

If the drive detects an internal fault, the drive is stopped and a fault indication is given.

Operation limits

ACS800 has adjustable limits for speed, current (maximum), torque (maximum) and DC voltage.

Settings

Parameter group 20 LIMITS

Power limit

The maximum allowed motor power is 1.5 · P_{hd} or P_{cont} whichever value is greater (varies depending on the drive type). If the limit is exceeded, the motor torque is automatically restricted. The function protects the input bridge of the drive against overload.

Supervisions

The drive monitors whether certain user selectable variables are within the user-defined limits. The user may set limits for speed, current etc.

Settings

Parameter group 32 SUPERVISION

Diagnostics

Signals/Parameters	Additional information
Group 06 STATUS WORDS	Supervision limit indicating bits in a packed boolean word
Group 14 RELAY OUTPUTS	Supervision limit indication through a relay output
Group 92 DSET TR ADDR	Selection of an actual signal to a dataset

Parameter lock

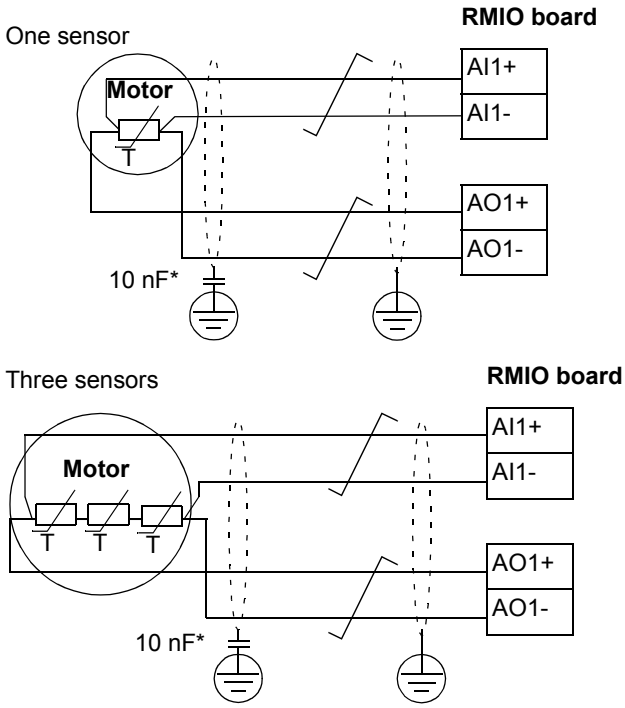
The user can prevent parameter adjustment by activating the parameter lock.

Settings

Parameters 16.01 PARAMETER LOCK and 16.02 PASS CODE

Motor temperature measurement through the standard I/O

This subsection describes the temperature measurement of one motor when the drive control board RMIO is used as the connection interface.



*The minimum voltage of the capacitor must be 630 VAC.

WARNING! According to IEC 664, the connection of the motor temperature sensor to the RMIO board, requires double or reinforced insulation between motor live parts and the sensor. Reinforced insulation entails a clearance and creepage distance of 8 mm (400 / 500 VAC equipment). If the assembly does not fulfil the requirement:

- the RMIO board terminals must be protected against contact and they may not be connected to other equipment

or

- the temperature sensor must be isolated from the RMIO board terminals.

Settings

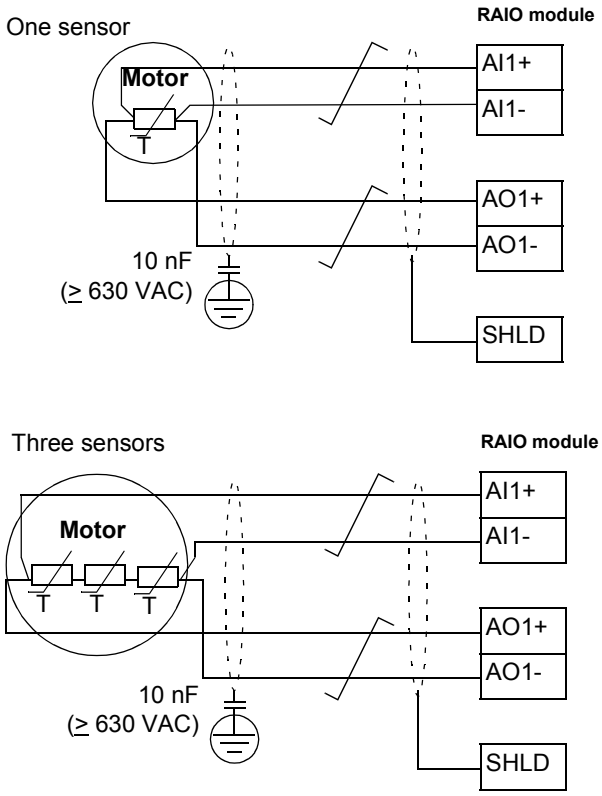
Parameter	Additional information
35.01 MOT 1 TEMP AI1 SEL …35.03 MOT 1 TEMP FLT L 35.04 MOT 2 TEMP AI1 SEL …35.06 MOT 2 TEMP FLT L	Settings of motor 1/2 temperature measurement
Other	
Parameters 13.01 AI1 MIN to 13.05 AI1 FILT TIME (AI1 processing) and 15.01 RMIO AO1 FUNC to 15.07 RMIO AO1 FILTER TIME (AO1 processing) are not effective.	
Note: If motor 1 temperature measurement is selected by parameter 35.01, analogue output AO1 value is set to a constant current value.	
At the motor end the cable shield should be earthed through a 10 nF capacitor. If this is not possible, the shield is to be left unconnected.	

Diagnostics

Actual values	Additional information
01.18 MOTOR 1 TEMP 01.19 MOTOR 2 TEMP	Temperature value
07.20 ALARM WORD 1	Warning bit state (T MEAS ALM)
07.14 FAULT WORD 4	Fault bit states (MOTOR 1/2 TEMP)
07.23 ALARM WORD 4	Warning bit states (MOTOR 1/2 TEMP)
Warnings	
MOTOR 1 TEMP / MOTOR 2 TEMP	Excessive motor temperature
T MEAS ALM	Motor temperature measurement out of acceptable range
Faults	
MOTOR 1 TEMP / MOTOR 2 TEMP	Excessive motor temperature

Motor temperature measurement through an analogue I/O extension

This subsection describes the motor temperature measurement of one motor when an optional analogue I/O extension module RAIO is used as the connection interface.



WARNING! According to IEC 664, the connection of the motor temperature sensor to the RAIO module, requires double or reinforced insulation between motor live parts and the sensor. Reinforced insulation entails a clearance and creepage distance of 8 mm (400 / 500 VAC equipment). If the assembly does not fulfil the requirement:

- the RAIO module terminals must be protected against contact and they may not be connected to other equipment

or

- the temperature sensor must be isolated from the RAIO module terminals.

Settings

Parameter	Additional information
35.01 MOT 1 TEMP AI1 SEL …35.03 MOT 1 TEMP FLT L 35.04 MOT 2 TEMP AI1 SEL …35.06 MOT 2 TEMP FLT L	Settings of motor 1/2 temperature measurement
35.08 AI/O MOTOR TEMP	Activation of optional analogue I/O for motor temperature measurement
Other	
Parameters 13.16 AI/O EXT MODULE1 to 13.20 EXT AI1 MAX SCALE (EXT AI1 processing) and 15.15 EXT AO1 FUNC to 15.21 EXT AO1 FILTER TIME (EXT AO1 signal selection and processing) are not effective.	
Note: If motor 1 temperature measurement is selected by parameter 35.01, analogue output AO1 value is set to a constant current value.	
At the motor end the cable shield should be earthed through a 10 nF capacitor. If this is not possible, the shield is to be left unconnected.	

Diagnostic

Actual values	Additional information
01.18 MOTOR 1 TEMP 01.19 MOTOR 2 TEMP	Temperature value
07.20 ALARM WORD 1	Warning bit state (T MEAS ALM)
07.14 FAULT WORD 4	Fault bit states (MOTOR 1/2 TEMP)
07.23 ALARM WORD 4	Warning bit states (MOTOR 1/2 TEMP)
Warnings	
MOTOR 1 TEMP / MOTOR 2 TEMP	Excessive motor temperature
T MEAS ALM	Motor temperature measurement out of acceptable range
Faults	
MOTOR 1 TEMP / MOTOR 2 TEMP	Excessive motor temperature

Control of a mechanical brake

The mechanical brake is used for holding the motor and driven machinery at zero speed when the drive is stopped, or not powered.

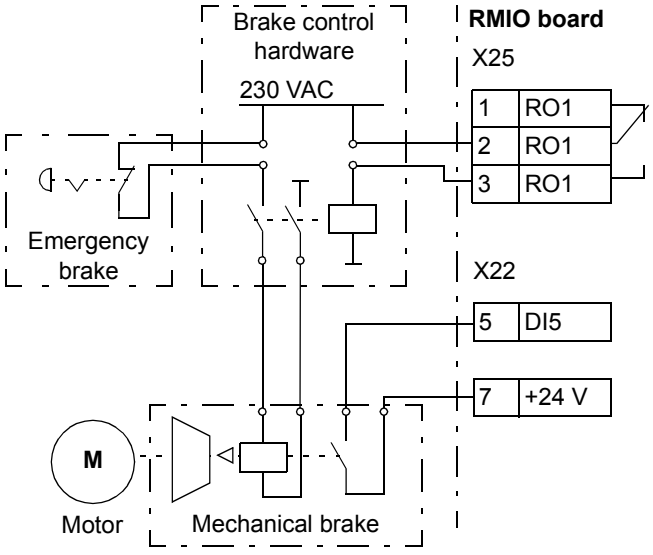
Example

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.

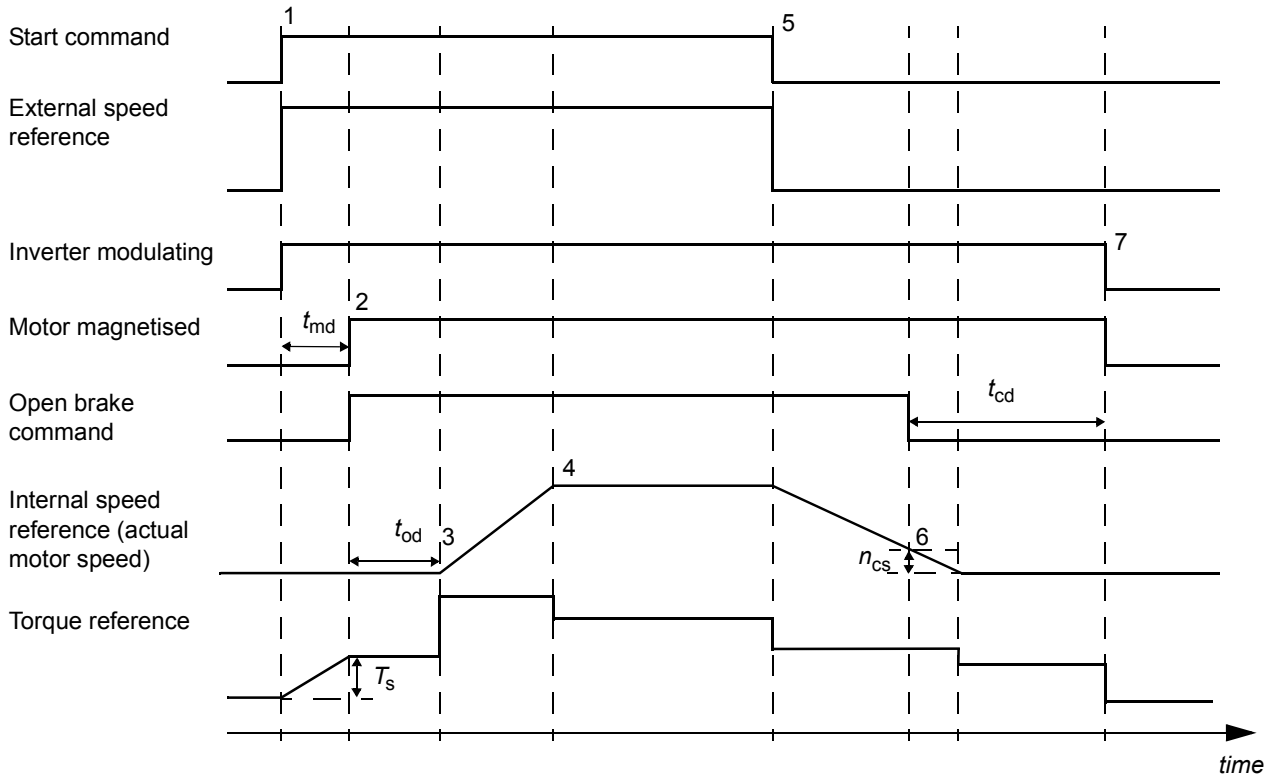
Brake control logic is integrated in the drive application program. The brake control hardware and wirings need to be done by the user.

- Brake on/off control through relay output RO1. (6.16 AUX STATUS WORD3 bit 6 OPEN BRAKE)
- Brake supervision through digital input DI5 (optional)
- Emergency brake switch in the brake control circuit



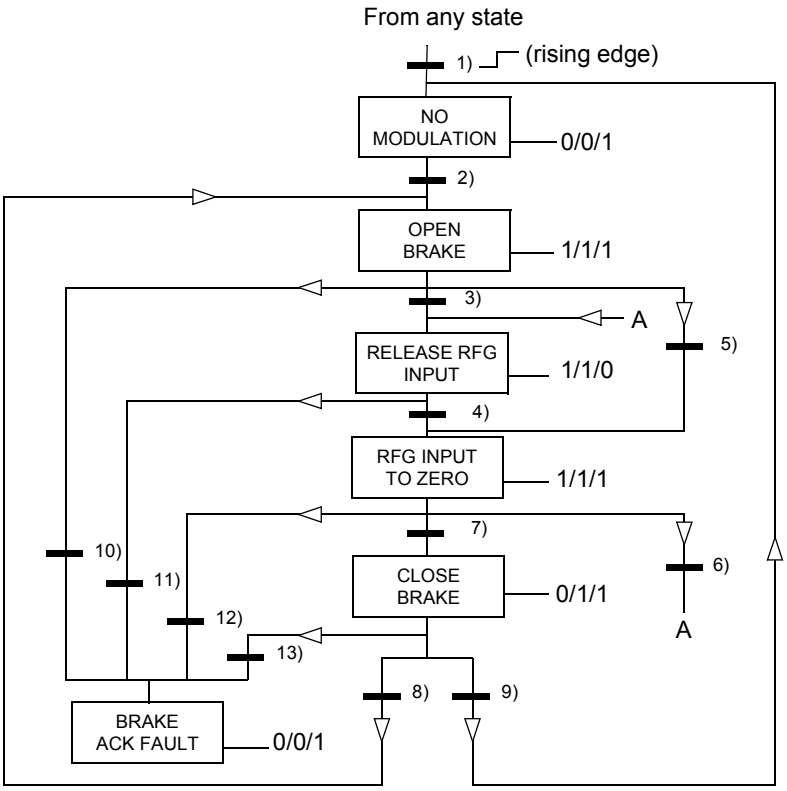
Operation time scheme

The time scheme below illustrates the operation of the brake control function. See also the state machine on the following page.



T_s	Start torque at brake release (parameters 28.07 START TORQ REF SEL and 28.08 START TORQ REF)
t_{md}	Motor magnetising delay
t_{od}	Brake open delay (parameter 28.03 BRAKE OPEN DELAY)
n_{cs}	Brake close speed (parameter 28.05 ABS BRAKE CLS SPD)
t_{cd}	Brake close delay (parameter 28.04 BRAKE CLOSE DELAY)

State shifts



RFG = Ramp Function Generator in the speed control loop (reference handling).

State (Symbol NN X/Y/Z)

- NN: State name
- X/Y/Z: State outputs/operations
  - X = 1 Open the brake. The relay output set to brake on/off control energises.
  - Y = 1 Forced start. The function keeps the internal Start on until the brake is closed in spite of the status of the external Start signal.
  - Z = 1 Ramp in zero. Forces the used speed reference (internal) to zero along a ramp.

State change conditions (Symbol ▬)

1) Brake control active 0 -> 1 OR Inverter is modulating = 0
2) Motor magnetised = 1 AND Drive running = 1
3) Brake acknowledgement = 1 AND Brake open delay passed AND Start = 1
4) Start = 0
5) Start = 0
6) Start = 1
7) |Actual motor speed| < Brake close speed AND Start = 0
8) Start = 1
9) Brake acknowledgement = 0 AND Brake close delay passed = 1 AND Start = 0

Only if parameter 28.02 BRAKE ACKNOWLEDGE ≠ OFF:

10) Brake acknowledgement = 0 AND Brake open delay passed =1
11) Brake acknowledgement = 0
12) Brake acknowledgement = 0
13) Brake acknowledgement = 1 AND Brake close delay passed = 1

Settings

Parameter	Additional information
Group 28 BRAKE CTRL	Brake function settings

Diagnostics

Actual value	Additional information
05.01 MAIN CONTROL WORD	Ramp in zero bit
06.16 AUX STATUS WORD 3	State of bit “brake open/close command“
07.14 FAULT WORD 4	Fault bit state
07.23 ALARM WORD 4	Warning bit state
Warnings	
BRAKE ACKN	Unexpected state of brake acknowledge signal
Faults	
BRAKE ACKN	Unexpected state of brake acknowledge signal

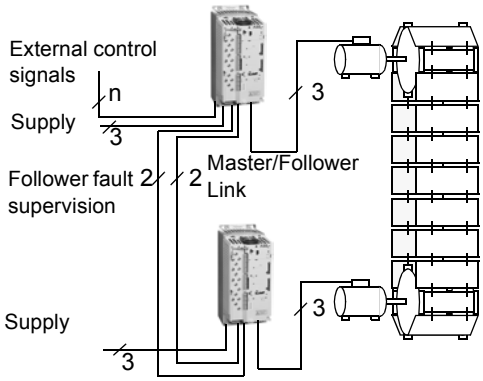
Master/Follower use of several drives

In a Master/Follower application, the system is run by several drives, the motor shafts of which are coupled to each other. The Master and Follower drives communicate via a fibre optic link. The figures below illustrate three basic application types.

M/F Application, Overview

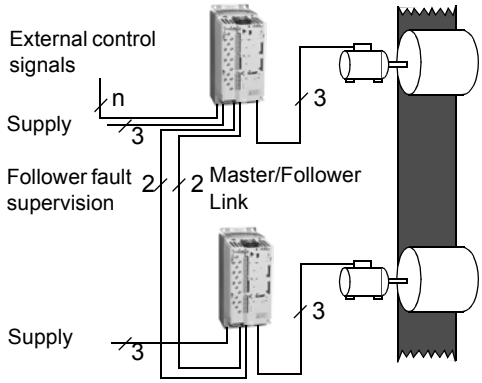
Solidly coupled motor shafts:

- Speed-controlled Master
- Follower follows the torque reference of the Master



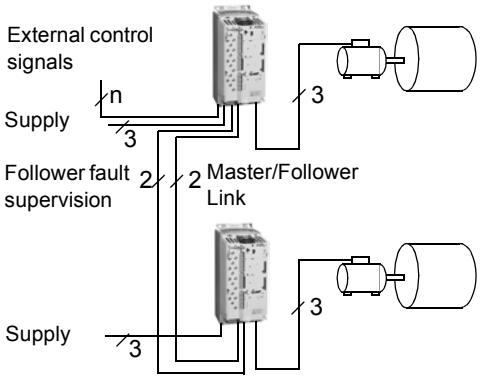
Flexibly coupled motor shafts:

- Speed-controlled Master
- Follower follows the speed reference of the Master



Freely coupled motor shafts:

- Speed- or position-controlled Master
- Follower follows the position reference of the Master in Synchron mode



Settings and diagnostics

Parameter	Additional information
10.01 EXT1 START FUNC 10.04 EXT2 START FUNC	Source of the start commands
21.02 SPEED REF1	Speed reference
24.02 TORQ REF1	Torque reference
41.01 SYNC POS REF SEL	Source of the synchron position reference (Master position) used in Synchron mode
70.08 CH2 M/F FUNC... 70.13 MASTER SIGNAL3	Master/Follower communication
Other	
For more information on the hardware installation of the Master/Follower application see *Master/ Follower Application Guide* [3AFE64590430 (English)].	

Motion control features

What this chapter contains

The chapter describes the motion control features.

Operating modes of the drive

The drive can operate in four different control modes.

Speed control mode

Motor rotates at a speed proportional to the speed reference given to the drive. This mode can be used without an encoder fitted to the motor (using estimated speed as feedback). An encoder can be used for better speed accuracy.

Torque control mode

Motor torque is proportional to the torque reference given to the drive. This mode requires no pulse encoder. However, an encoder can be fitted to provide the torque control model with actual motor speed feedback.

Position control mode

Load is positioned along a single axis from the start position to the defined target position. A position reference is given to the drive to indicate the target position.

An encoder must always be used in position control to determine the actual position of the load. The same encoder can also be used to provide speed feedback. It is also possible to have separate encoders for the load (position feedback) and motor sides (speed feedback).

Synchron control mode

Synchron control is used to synchronise two mechanical systems (axes). The control is similar to position control, but in synchron control the position reference is taken from a moving target.

An encoder must always be used in synchron control to determine the actual position of the load.

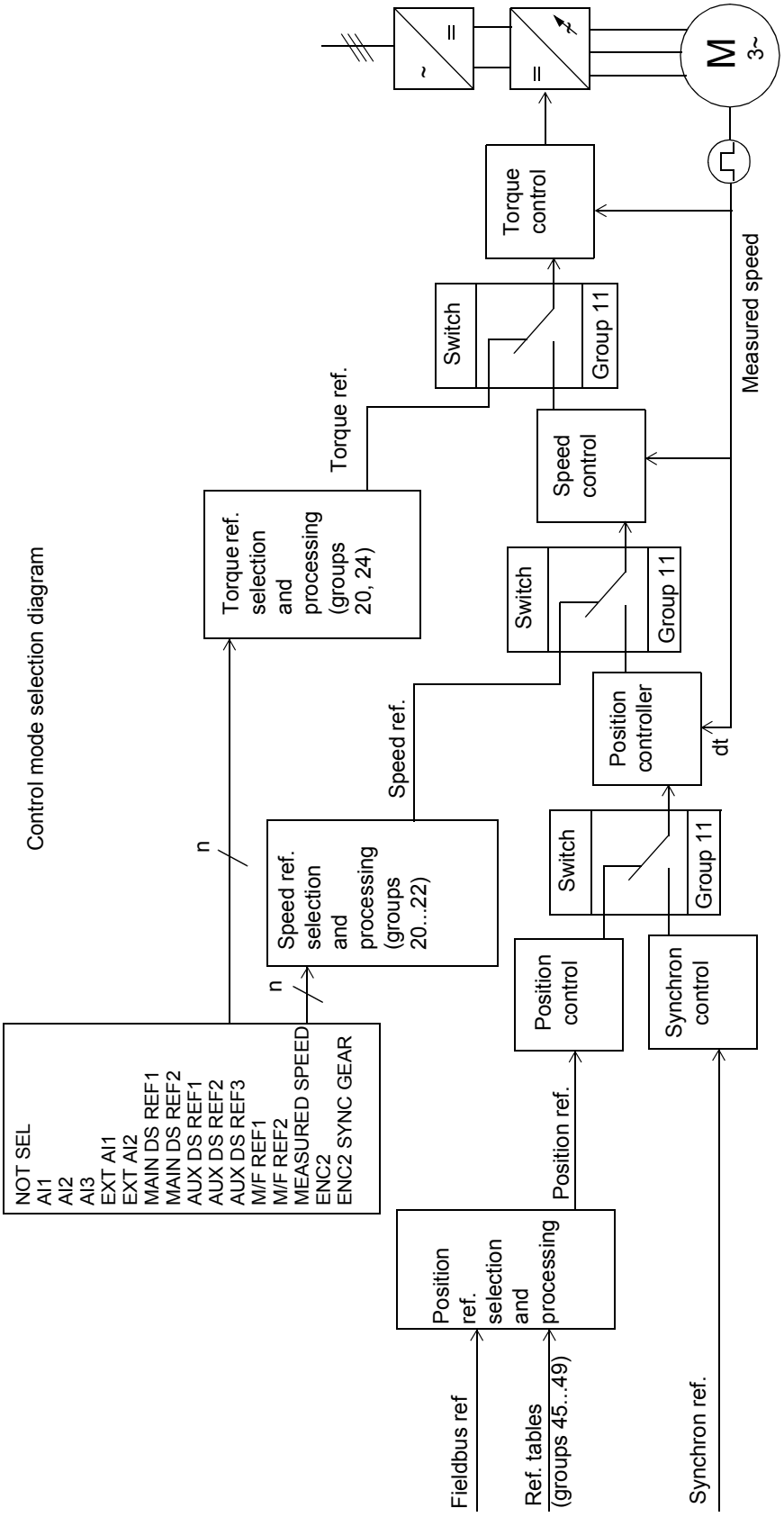
Settings

Parameter	Additional information
Group 11 CONTROL PLACES	Control mode selection
Group 21 SPEED REFERENCE	Speed control settings
Group 23 SPEED CTRL	
Group 24 TORQUE CONTROL	Torque control settings
Groups 40 POS REFERENCE... 49 POS PAR TABLE	Position/Synchron control settings

Diagnostics

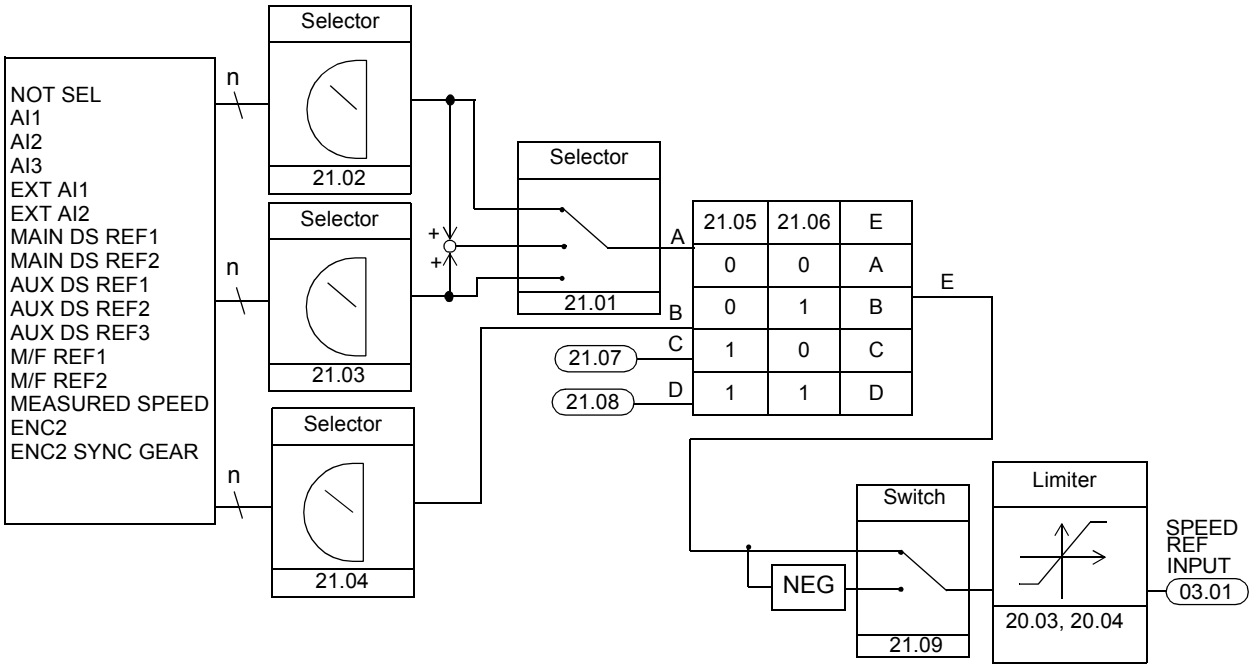
Actual signal	Additional information
01.02 CTRL MODE ACK	Active control mode

The following block diagram presents the control mode selection chain:



Speed control mode - reference selection

The following block diagram present the reference selection in speed control mode.



Settings

Parameter	Additional information
Group 21 SPEED REFERENCE	Speed reference selection

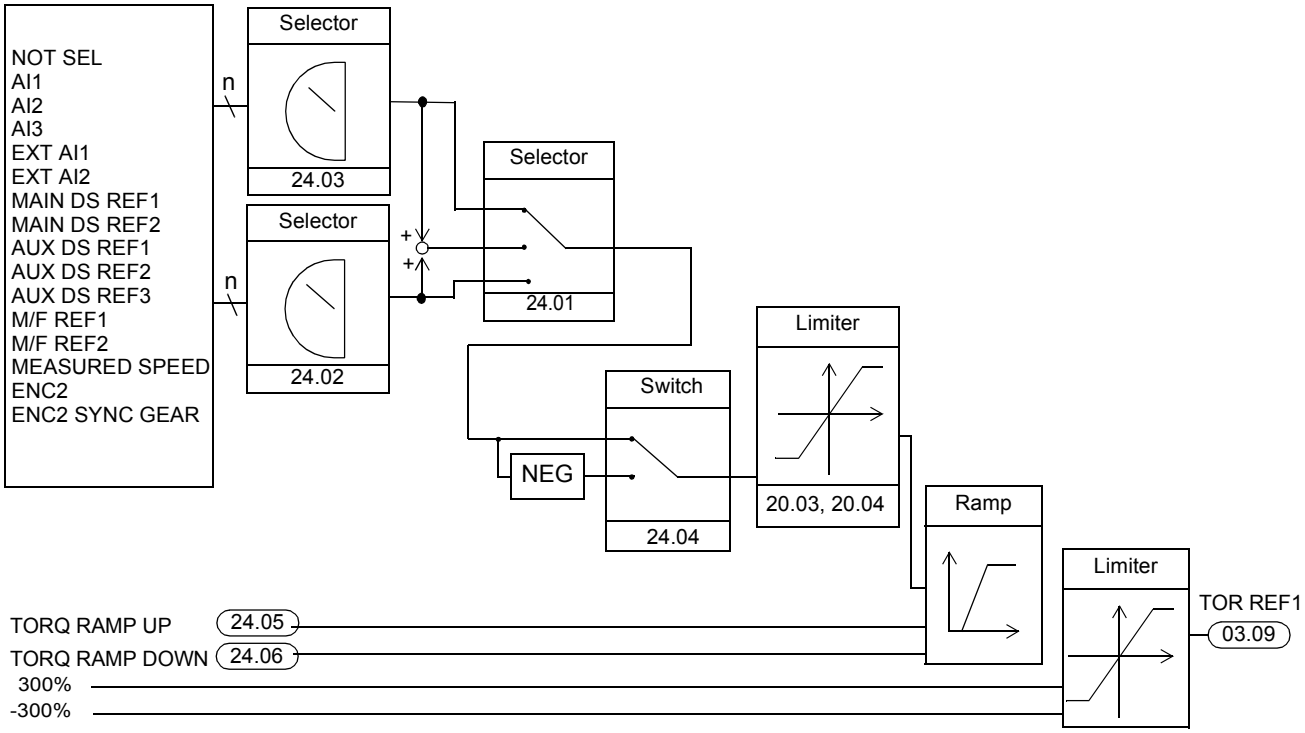
Diagnostics

Actual signal	Additional information
Group 01 ACTUAL SIGNALS	Basic signals for monitoring of the drive
Group 03 CONTROL VALUES	Speed and torque reference monitoring signals.

See also *Control block diagrams.*

Torque control mode - reference selection

The following block diagram present the reference selection in torque control mode.



Settings

Parameter	Additional information
Group 24 TORQUE CONTROL	Torque reference selection

Diagnostics

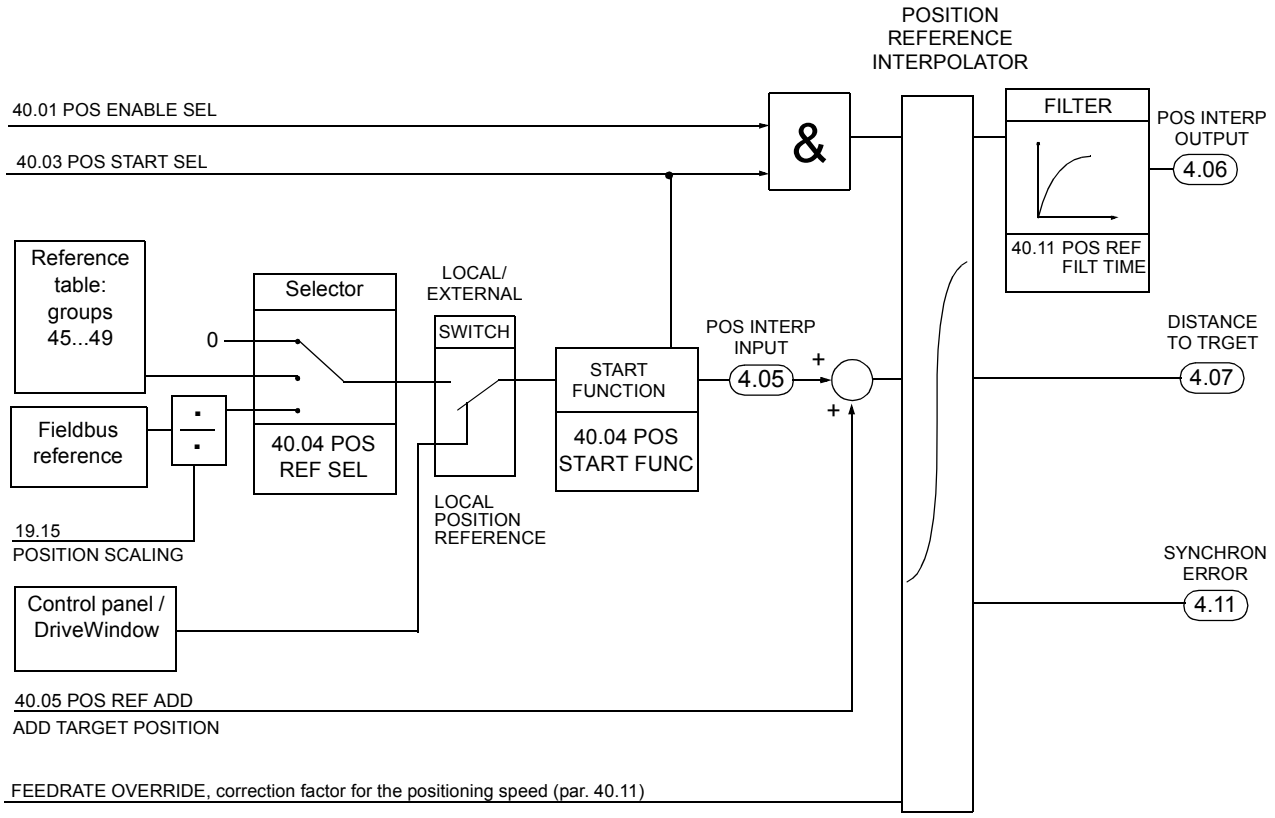
Actual signal	Additional information
Group 01 ACTUAL SIGNALS	Basic signals for monitoring of the drive
Group 03 CONTROL VALUES	Speed and torque reference monitoring signals.

See also *Control block diagrams.*

Position control mode - reference selection

Position reference can be defined with the reference table or received through fieldbus, DriveWindow or Control Panel.

The core of the positioning control loop is the positioning interpolator which generates an optimised reference value for the position controller from the given reference values.



Settings

Parameter	Additional information
Group 40 POS REFERENCE	Position reference selection
Groups 45 POS REF TABLE... 49 POS PAR TABLE	Position reference set selection

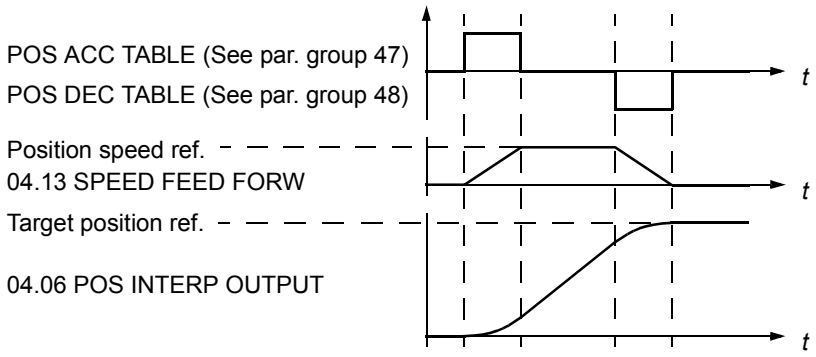
Diagnostics

Actual signal	Additional information
Group 04 POS CTRL VALUES	Position monitoring signals
06.11 POS SATUS WORD 1	Position status word
06.12 POS SATUS WORD 2	

See also *Control block diagrams.*

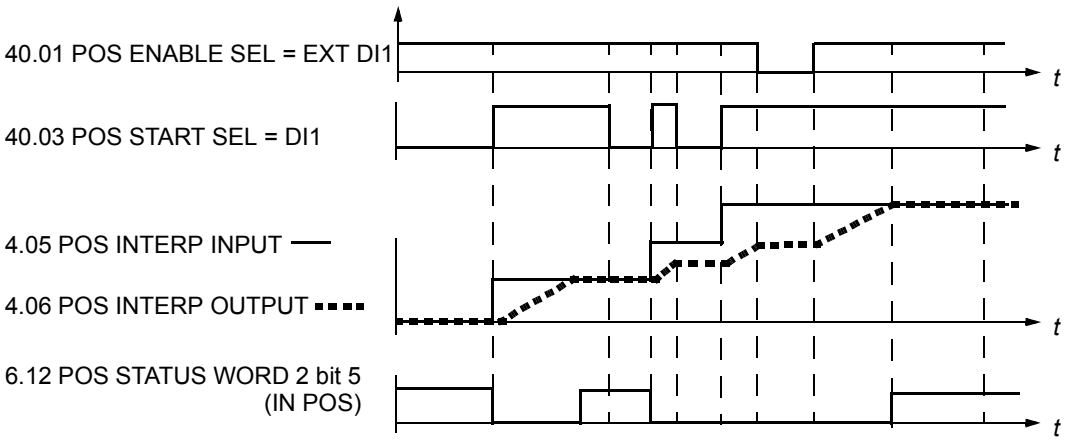
Position interpolator

The position interpolator calculates the speed from which the drive can decelerate to a stop within the target distance using the defined deceleration reference. The calculated speed is used to generate an optimised position reference, which guides the drive to its target position. The following figure shows how the position interpolator generates a position reference.

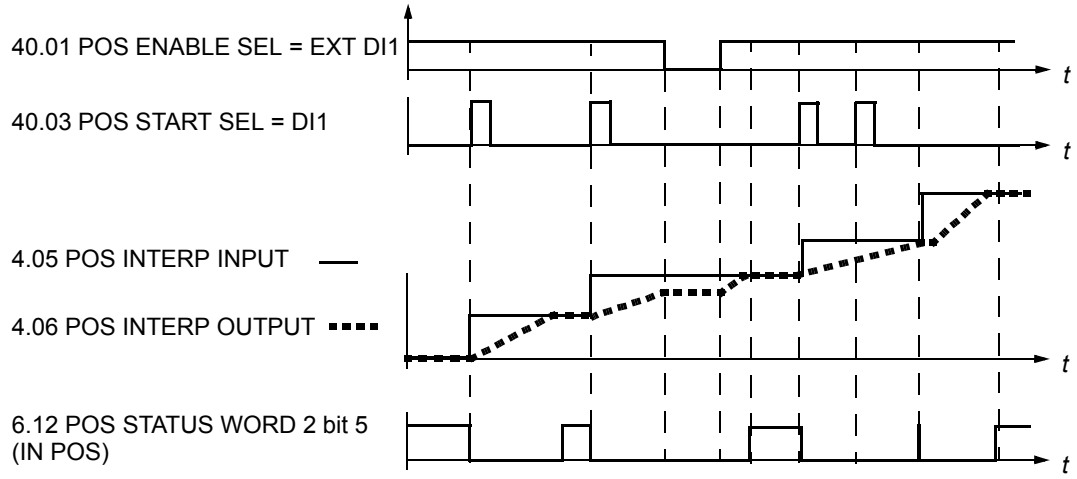


Position interpolator is also used to compensate synchronising errors.

Parameters 40.01 POS ENABLE SEL and 40.03 POS START SEL control the operation of the position interpolator. The following figure shows the positioning commands and signals when parameter 40.02 POS START FUNC is set to NORMAL.



The following figure shows the positioning commands and signals when parameter 40.02 POS START FUNC is set to PULSE.



Reference sets

The reference table contains 16 reference sets. Each reference set consists of

- position reference
- positioning speed reference
- positioning acceleration reference
- positioning deceleration reference
- position interpolator control signals.

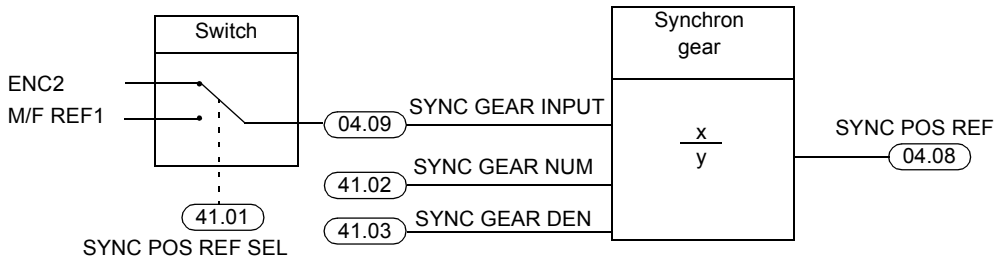
The table below shows how reference sets 1...16 are selected with parameters 40.06 POS TABLE SEL1...40.09 POS TABLE SEL4. The references sets are defined by parameter groups 45 POS REF TABLE to 49 POS PAR TABLE. One set is used at a time.

Par 40.09	Par 40.08	Par 40.07	Par 40.06	Function
0	0	0	0	Reference set 1
0	0	0	1	Reference set 2
0	0	1	0	Reference set 3
0	0	1	1	Reference set 4
0	1	0	0	Reference set 5
0	1	0	1	Reference set 6
0	1	1	0	Reference set 7
0	1	1	1	Reference set 8
1	0	0	0	Reference set 9
1	0	0	1	Reference set 10
1	0	1	0	Reference set 11
1	0	1	1	Reference set 12
1	1	0	0	Reference set 13
1	1	0	1	Reference set 14
1	1	1	0	Reference set 15
1	1	1	1	Reference set 16

Synchron control mode - reference selection

In synchron control, the position reference can be taken directly from an encoder or from another drive via the Master/Follower link (defined by parameter 41.01 SYNC POS REF SEL.)

Synchron control establishes a relationship between the master and the follower positions. The follower follows the position reference, which is relative to actual position of the master.



Settings

Parameter	Additional information
Group 41 SYNCHRON REFERENCE	Synchron reference selection

Diagnostics

Actual signal	Additional information
Group 04 POS CTRL VALUES	Position monitoring signals
06.11 POS SATUS WORD 1	Position status
06.12 POS SATUS WORD 2	

See also *Control block diagrams.*

Dynamic limiter

Dynamic limiter controls the position reference ramping in the position control and synchron control modes. Dynamic limitation of the position reference causes a synchron error (04.11 SYNCHRON ERROR). The error is accumulated and fed back to the position interpolator.

Settings

Parameter	Additional information
42.03 DYN LIM ENA	Dynamic limiter enabling

Diagnostics

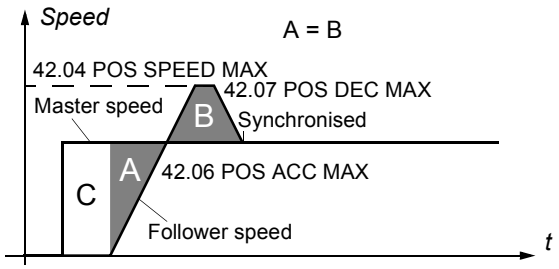
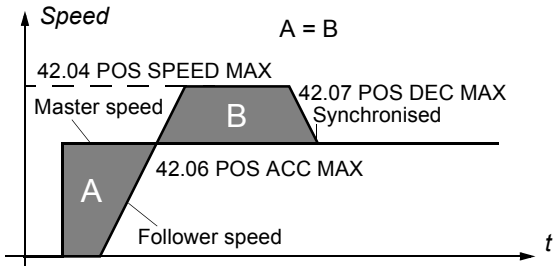
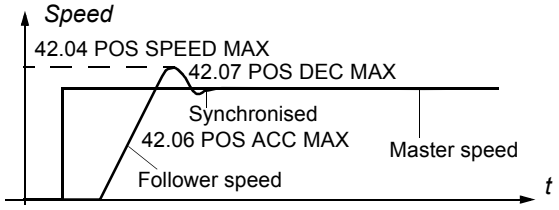
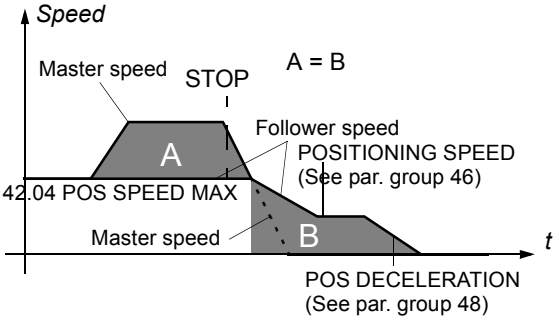
Actual signal	Additional information
06.11 POS STATUS WORD 1 bit 12	Dynamic limiter enable

See also *Control block diagrams*

Start/stop examples

The speed curves of the master and follower during the start and stop are presented in the figures below.

When the follower is in synchron control, the reference can be taken from the encoder or Master/Follower link (selected by parameter 41.01 SYNC POS REF SEL). The master can be in any control mode.

Start: linear axis, relative synchronisation Used when the master is to be distance C ahead of the follower at start. 19.12 POSITION FORMAT is set to LINEAR AXIS. 41.04 SYNCHRON FUNC is set to RELATIVE. To catch the master position, the follower accelerates up to its maximum allowed speed. Only master position changes which take place after the follower is started are taken into account.	
Start: linear axis, absolute synchronisation Used when the master and the follower are to be driven equal distances. 19.12 POSITION FORMAT is set to LINEAR AXIS. 41.04 SYNCHRON FUNC is set ABSOLUTE. To catch the master position, the follower accelerates up to its maximum allowed speed. Master position changes are taken not account when the master is started.	
Start: rollover axis 19.12 POSITION FORMAT is set to ROLLOVER AXIS. The follower accelerates until it has reached the master shaft position angle (position per one revolution, 0...360°). Rotations of the master are not counted.	
Stop: linear axis 19.12 POSITION FORMAT is set to LINEAR AXIS. The figure shows how the dynamic limiter works together with the position interpolator when the drives are stopped: Before the stop command of the master, the speed of the follower is limited by the dynamic speed limiter (42.04 POS SPEED MAX), which results in a position error. When the master starts to decelerate, the follower uses positioning deceleration, and, eventually, positioning speed to overcome the position error.	

Homing control

Homing control is usually needed in positioning applications. The internal actual position is set to zero at power-up (the physical position of the motor is not changed). Normally there is no relation between the internal position in the drive position control and the actual position of the driven machinery automatically. Homing establishes this relation. Incremental encoder is needed in homing control.

Besides the standard homing procedure (sequential logic), which is normally performed only once, there are three cyclic position system correction functions and three preset functions available. The cyclic functions can be used e.g. to compensate position errors due to slip between the load and motor side. The preset functions are used to set the position system according to a parameter value or actual position.

Because all homing functions use the same latching function, only one can be performed at a time. In applications where two functions are required, the user can switch on-line between two selected functions.

Preset functions

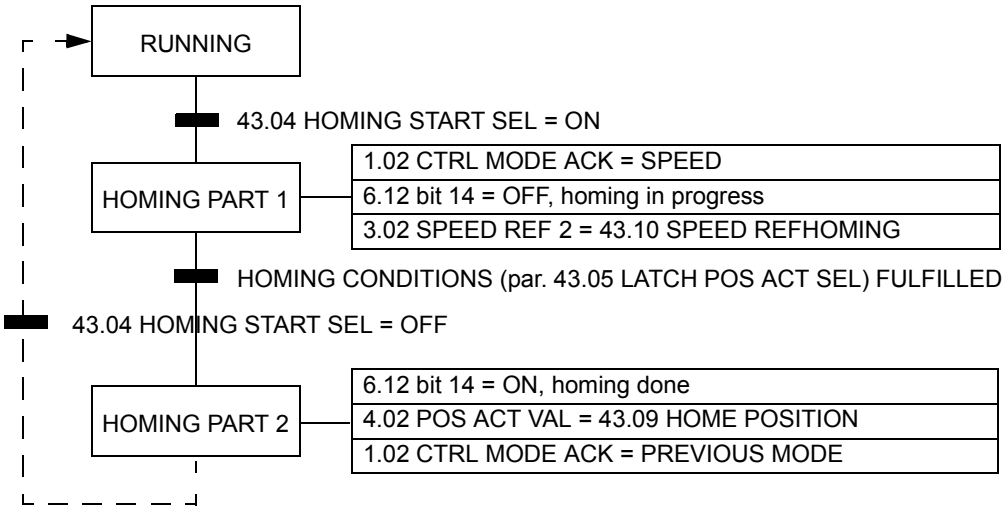
With preset functions the position system is set to the requested position, but the physical position of the motor is not changed. There are three different preset functions:

Position system is set to the value defined by

- 04.02 POSITION ACT VAL (=actual encoder position)
- 04.09 GEAR INPUT (=synchron control reference for the synchron gear). See *Control block diagrams*.
- 43.09 HOME POSITION.

Standard homing

The homing procedure can be started from any operating mode when the drive is running. Homing is started by the rising edge (OFF to ON) of the input selected with parameter 43.04 HOMING START SEL. The signal has to stay ON for the duration of the whole procedure. Parameter 43.10 SPEED REF HOMING selects the speed reference for the homing. When the latching conditions are fulfilled, the drive sets the position system to the value of parameter 43.09 HOME POSITION and returns to the original operating mode. The following figure illustrates the sequential logic of standard homing.



The behaviour of the drive after the homing procedure depends on the previous active operating mode:

Previous mode	Behaviour
TORQUE	Previous torque reference is used immediately.
SPEED	Previous speed reference is used immediately.
POSITION	If the selected position start source is OFF or the position interpolator is disabled: The motor is stopped according to parameter 48.01 POS DEC TABLE1. or If the selected position start source is ON (or par. 40.02 POS START FUNC is set to NORMAL/PULSE) and the position interpolator is enabled: The motor runs to the selected position target reference using the selected dynamic parameter set (in the reference table).
SYNCHRON	Dependent on the positioning format and parameter 41.04 SYNCHRON FUNC setting. Generally, the follower motor is synchronised with the master motor using the dynamic limiter settings.

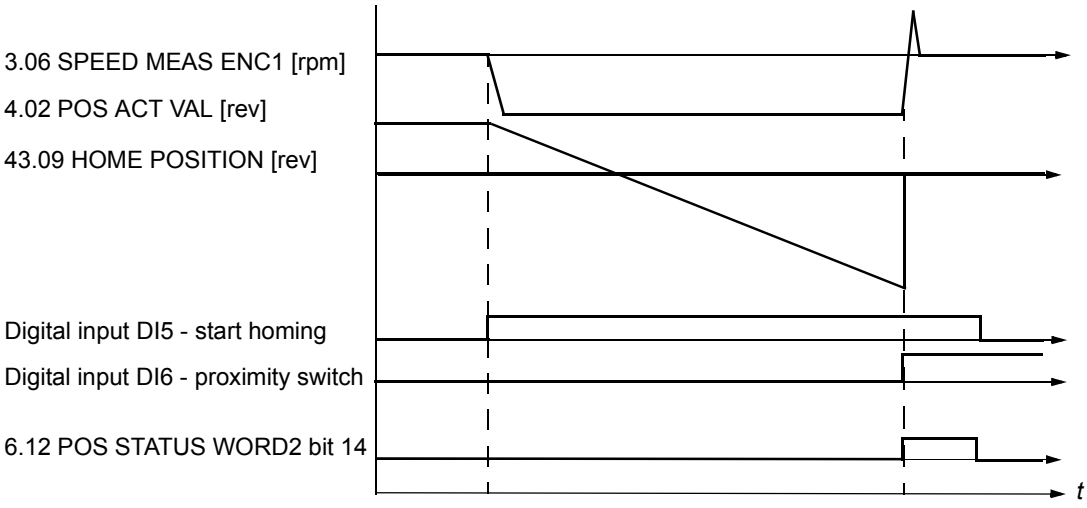
Linear axis application

In linear axis applications it is important to take the position of the proximity switch into account. It must be ensured that the motor runs in the right direction and finds the switch. The proximity switch signal connected to a digital input is selected as the source for the actual position latching command with parameter 43.05 LATCH POS ACT SEL.

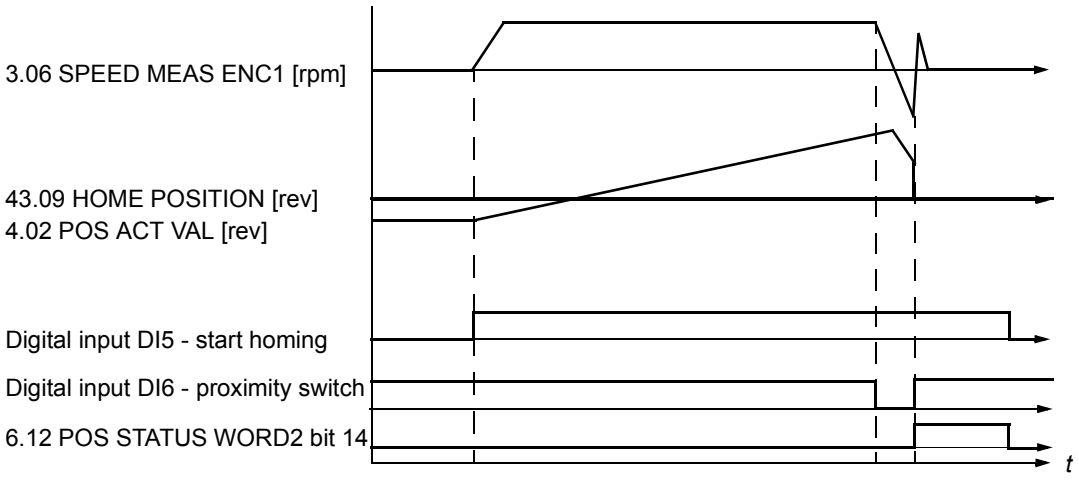
Motion Control program checks the status of the proximity switch signal when the homing is started, and changes the sign of the speed reference if necessary. If the defined input signal is zero at the start of the homing start command, homing is preformed as described in *Standard homing* above. If the proximity switch signal is on, the motor runs speed controlled to the opposite direction until the signal is switched off. Then the sign of the speed reference is changed and homing is performed as described in *Standard homing* above.

Example 1: Proximity signal is zero when homing is started

Parameter	Setting	Information
19.13 POS UNIT	REVOLUTIONS	All position values are in revolutions.
19.12 POSITION FORMAT	LINEAR	Positioning is between the minimum position 42.02 POSITION MIN and the maximum position 42.01 POSITION MAX.
43.01 HOMING MODE SEL	FALSE	Homing mode according to parameter 43.02 HOMING MODE 1
43.02 HOMING MODE1	STANDARD	Sequential homing logic
43.04 HOMING START SEL	DI5	Source of the start command
43.05 LATCH POS ACT SEL	DI6	Source of the actual position latching command (proximity switch signal source)
43.09 HOME POSITION	0 rev	Home position
43.10 SPEED REF HOMING	-150 rpm	Speed reference



Example 2: Proximity signal is ON when homing is started. See parameter settings in example 1 above.



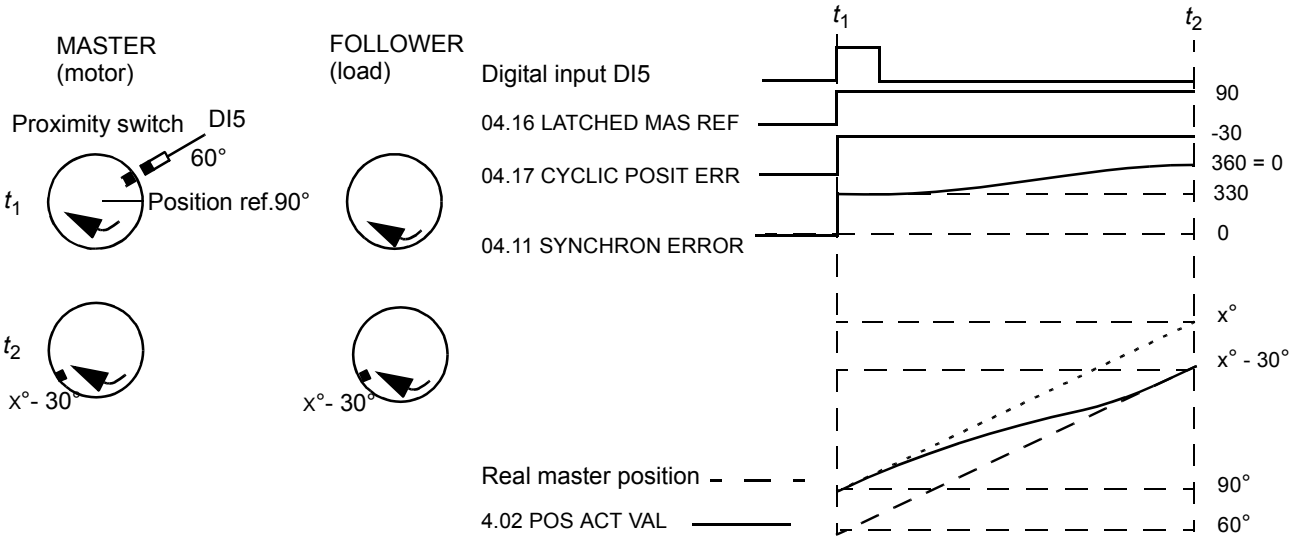
Cyclic correction function

There are three different cyclic position correction functions: Master Reference Correction, Actual Position Correction and Master/Follower Distance Correction, which is a combination of the first two correction functions.

Master Reference Correction function

Example

Parameter	Setting	Information
19.13 POS UNIT	DEGREE	All position values are in degrees.
19.12 POSITION FORMAT	ROLLOVER AXIS	Positioning is between 0 and 1 revolutions, i.e. after 360°, the position calculation starts from 0° again.
41.02 SYNC GEAR NUM	Same as for 41.03 SYNC GEAR DEN	Synchron gear ratio is 1.
43.01 HOMING MODE SEL	FALSE	Homing mode according to parameter 43.02 HOMING MODE 1
43.02 HOMING MODE1	CORR MAS REF	Master (motor) reference correction
43.05 LATCH POS ACT SEL	FALSE	Actual position latching command is not in use.
43.06 LATCH MAS REF SEL	DI5	Source of the master (motor) position reference latching command
43.08 POS MAS PROBE	60°	Reference position for the master (motor) position reference probe



t_1: Rising edge of digital input DI5 signal (proximity switch signal) is detected when the master (motor) position is 60°. The used position reference is 90° (stored to signal 04.16 LATCHED MAS REF).

The Master Reference Correction function calculates the position error 04.17 CYCLIC POSIT ERR, which is the difference between the master (motor) position and the reference position:

04.17 CYCLIC POSIT ERR = 43.08 POS MAS PROBE - 04.16 LATCHED MAS REF = 60° - 90° = -30°

The error is added to 04.11 SYNCHRON ERROR. The synchron error is corrected using the positioning parameter and the dynamic limiter settings.

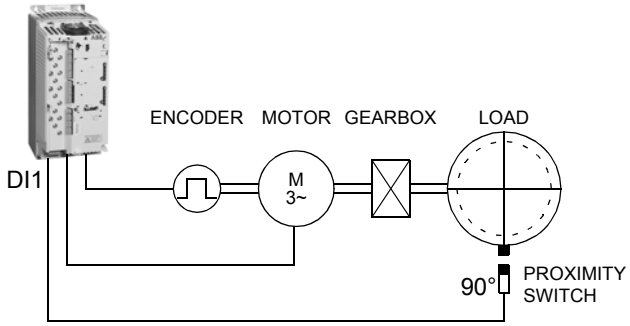
t_2: Error has been corrected and the follower (load) is in line with the master (motor). Cyclic function is ready for a new correction if necessary.

Actual Position Correction function

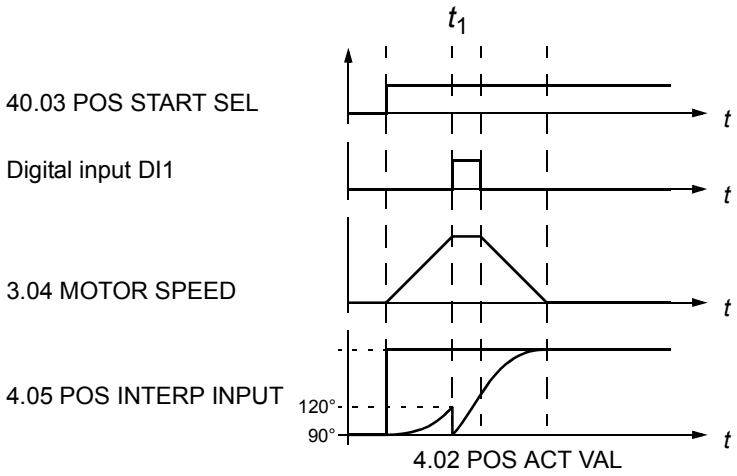
The purpose of actual position correction is to measure a position and compare it with the actual encoder position. If there is a deviation, a corresponding correction is carried out. The required transition is determined by the position interpolator parameters.

Example:

The following figure presents a roll-over application. The motor rotates a round table. There is a mechanical gear between the motor and the load. The gear is prone to produce some drift on the load side. In order to compensate this drift, actual position correction is used. A proximity switch is located on the load side at 90°.



Parameter	Setting	Information
19.13 POS UNIT	DEGREE	All position values are in degrees.
19.12 POSITION FORMAT	ROLLOVER AXIS	Positioning is between 0 and 1 revolutions, i.e. after 360°, the position calculation starts from 0° again.
43.01 HOMING MODE SEL	FALSE	Homing mode according to parameter 43.02 HOMING MODE 1
43.02 HOMING MODE 1	CORR ACT POS	Actual position correction
43.05 LATCH POS ACT SEL	DI1	Source of the actual position latching command (proximity switch signal source)
43.07 POS ACT PROBE	90°	Reference position for the actual position probe



t_1: Rising edge of digital input DI1 signal (proximity switch signal) is detected when the follower (load) position is 90°. The actual position of the encoder is 120° (stored to signal 04.15 LATCHED ACT POS).

Distance between the follower (load) position and the actual position is 90° - 120° = -30° (= CYC POS ACT ERR). Actual position of the encoder 04.02 POSITION ACT VAL is corrected according to CYC POS ACT ERR. Also position control reference 04.12 POS CTRL REF is adjusted with the same value to avoid step change in the position controller reference.

Position error 04.17 CYCLIC POSIT ERR is the inverse of CYC POS ACT ERR, i.e 60°. The error is added to 04.11 SYNCHRON ERROR. The synchron error is corrected using the positioning parameter and the dynamic limiter settings.

Master/Follower Distance correction

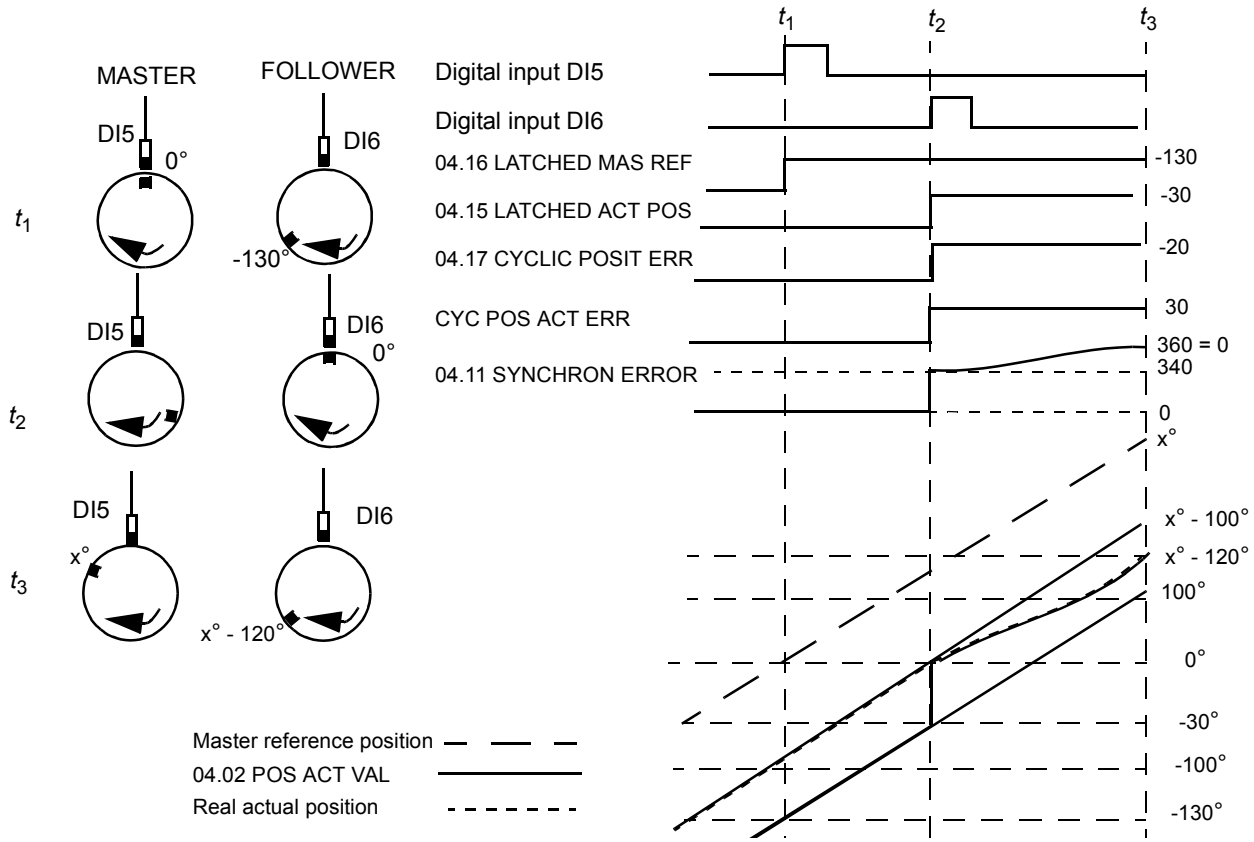
The purpose of Master/Follower Distance correction is to measure the distance between two positions and compare it with the defined reference. If there is a deviation, a correction is carried out. See the following rollover and linear axis examples.

In Master/Follower Distance correction the follower must always be in synchron control mode.

Example1: Rollover axis application

Master and follower proximity switches are located at 0°.

Parameter	Setting	Information
19.13 POS UNIT	DEGREE	All position values are in degrees.
19.12 POSITION FORMAT	ROLLOVER AXIS	Positioning is between 0 and 1 revolutions, i.e. after 360°, the position calculation starts from 0° again.
41.02 SYNC GEAR NUM	Same as for 41.03 SYNC GEAR DEN	Synchron gear ratio is 1.
43.01 HOMING MODE SEL	FALSE	Homing mode according to parameter 43.02 HOMING MODE 1.
43.02 HOMING MODE1	CORR M/F DIST	Cyclic master follower distance correction
43.05 LATCH POS ACT SEL	DI6	Source of the actual position latching command (proximity switch signal source)
43.06 LATCH MAS REF SEL	DI5	Source of the master position reference latching command (proximity switch signal source)
43.07 POS ACT PROBE	0°	Reference position for the actual position probe
43.08 POS MAS PROBE	-120°	Reference position for the master position probe, i.e. follower is 120° [(0°-120°)-(0°-0°)] behind the master.



t_1: Rising edge of digital input DI5 signal (proximity switch signal) is detected when the master position is 0°. The follower position is -130° (stored to signal 04.16 LATCHED MAS REF).

t_2: Rising edge of digital input DI6 signal (proximity switch signal) is detected when the follower position is 0°. The actual position of the encoder is -30° (stored to signal 04.15 LATCHED ACT POS). Distance between the follower position and the actual position is 0° - (-30°) = 30°.

According to parameter 43.07 POS ACT PROBE and 43.08 POS MAS PROBE settings the follower should be 120° behind the master.

The following phase shift between the master and follower is calculated and stored as reference error 04.17 CYCLIC POSIT ERR.

(43.08 POS MAS PROBE - 04.16 LATCHED MAS REF)) - (43.07 POS ACT PROBE - 04.15 LATCHED ACT POS) = [-120° - (130°)] - [0° - (-30°)] = -20°

This error is added to 04.11 SYNCHRON ERROR. The synchron error is corrected using the positioning parameters.

t_3: Error has been corrected and the follower is 120° behind the master. Cyclic function is ready for a new correction if necessary.

Note 1: Only after the active correction is finished, the next position latching is enabled.

Note 2: The cyclic corrections are always performed along the shortest path. This must be taken into account in all rollover applications.

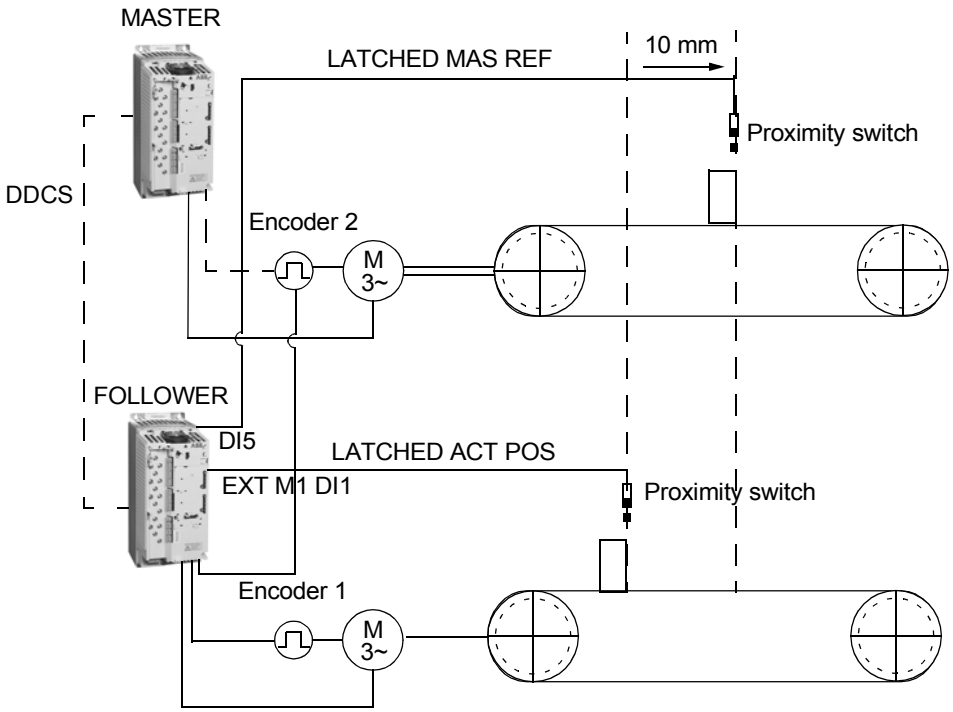
Note 3: In rollover applications, the correction range is limited to ±180°

Example 2: Linear axis application

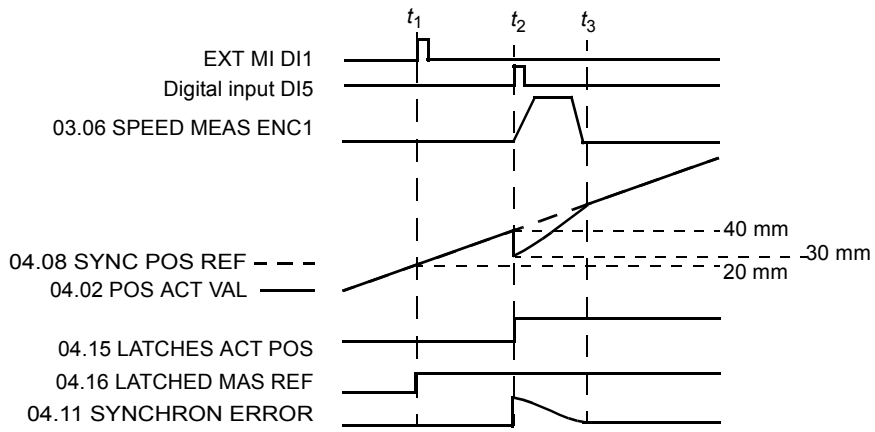
Two conveyer systems are synchronized using two encoders. The follower is in synchron control and follows the master encoder 2 position.

Note: In linear axis applications only the difference between the master and follower positions is corrected.

The dashed line presents a Master/Follower application, i.e. the Follower reference is taken from the Master drive via the Master/Follower link (parameter 41.01 SYNC POS REF SEL is set to M/F REF instead of ENC2).



Parameter	Setting	Information
19.12 POSITION FORMAT	LINEAR	Positioning between minimum position 42.02 POSITION MIN and maximum position 42.01 POSITION MAX
19.13 POS UNIT	MILLIMETER	All position values are in millimetres
41.01 SYNC POS REF SEL	ENC2	Synchron position reference (master position) from encoder 2.
41.04 SYNCHRON FUNC	ABSOLUTE	Absolute synchronisation of the follower. The follower follows the master position after start.
43.01 HOMING MODE SEL	FALSE	Homing mode according to parameter 43.02 HOMING MODE 1.
43.02 HOMING MODE1	CORR M/F DIST	Cyclic master follower distance correction
43.05 LATCH POS ACT SEL	DI5	Source of the actual position latching command (proximity switch signal source)
43.06 LATCH MAS REF SEL	EXT M1 DI1	Source of the master position reference latching command (proximity switch signal source)
43.07 POS ACT PROBE	15 mm	Reference position for the actual position probe
43.08 POS MAS PROBE	25 mm	Reference position for the master position probe.



t_1: Rising edge of digital input DI1 of external module 1 signal (proximity switch signal) is detected. The follower position is 20 mm (stored to signal 04.16 LATCHED MAS REF.)

t_2: Rising edge of digital input DI5 signal (proximity switch signal) is detected when the follower position is 40 mm (stored to signal 04.15 LATCHED ACT POS).

According to parameter 43.07 POS ACT PROBE and 43.08 POS MAS PROBE settings the follower should be 10 mm behind the master.

The following correction is calculated and stored as reference error 04.17 CYCLIC POSIT ERR:

(43.07 POS ACT PROBE - 43.08 POS MAS PROBE) - (04.16 LATCHED MAS REF) - 04.15 LATCHED ACT POS)] = (15 mm - 25 mm) - (20 mm - 40 mm)] = 10 mm

This error is added to 04.11 SYNCHRON ERROR. The synchron error is corrected using the positioning parameters.

t_3: Error has been corrected and the follower is 10 mm behind the master. Cyclic function is ready for a new correction if necessary.

Encoder

Encoder Gear functions

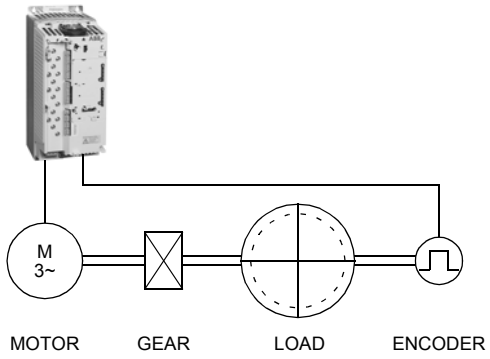
The drive provides two Encoder Gear functions (the Motor Encoder Gear function and the Load Encoder Gear function) for compensating of mechanical gears between the motor shaft, the encoder and the load. The appropriate gear function is used automatically after the user has set the related parameters.

Speed control uses the motor speed. The Motor Encoder Gear function calculates the motor speed on the basis of feedback of encoder mounted on the load side.

Positioning uses the measured speed and position of the load. The Load Encoder Gear function calculates the actual load position on the basis of the measured motor shaft position.

Motor Encoder Gear application example

Speed control uses the motor speed. If no encoder is mounted on the motor shaft, the Motor Encoder Gear function must be applied in order to calculate the actual motor speed on the basis of the measured load speed.



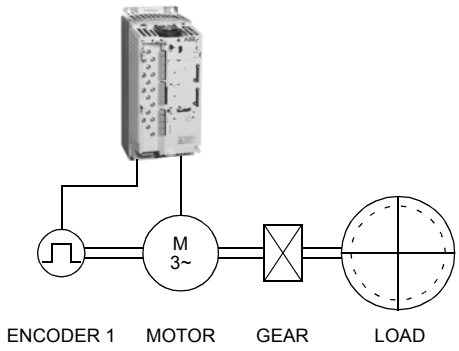
The Motor Encoder Gear parameters 19.07 MOTOR GEAR NUM and 19.08 MOTOR GEAR DEN are set as follows:

$$\frac{\text{(19.07 MOTOR GEAR NUM)}}{\text{(19.08 MOTOR GEAR DEN)}} = \frac{\text{Motor speed}}{\text{Encoder speed}}$$

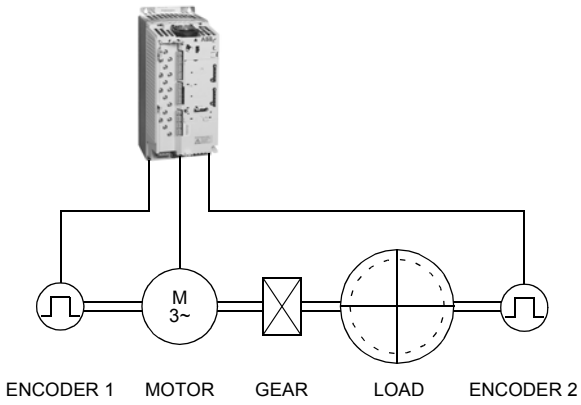
Note: Since the measured speed is also used for the DTC control motor model, incorrect gear parameters will cause unexpected behaviour of the drive.

Load Encoder Gear application examples

Positioning uses the measured speed and position of the load. If no encoder is mounted on the load side, the Load Encoder Gear function must be applied in order to calculate the actual load position on the basis of the measured motor shaft position.



A second encoder (Encoder 2) mounted on the load side is used as the source for the actual position value. (Note: Inverted gear ratio is considered when the position control output (speed reference) is produced).



The Load Encoder Gear parameters 19.09 LOAD GEAR NUM and 19.10 LOAD GEAR DEN are set as follows:

$$\frac{\text{(19.09 LOAD GEAR NUM)}}{\text{(19.10 LOAD GEAR DEN)}} = \frac{\text{Load speed}}{\text{Encoder 1 speed}}$$

Note: The sign of the programmed gear ratio has to match the sign of the mechanical gear ratio.

Because the speed control uses the motor speed, an inverted gear ratio is applied to the position control output (speed reference) as follows:

$$\frac{\text{(19.07 MOTOR GEAR NUM)} \times \text{(19.10 LOAD GEAR DEN)}}{\text{(19.09 LOAD GEAR NUM)} \times \text{(19.08 MOTOR GEAR DEN)}}$$

Note: It is emphasised that all position relevant parameters are load side related, e.g. the setting of parameter 42.04 POS SPEED MAX (dynamic limiter speed limitation) of 300 rpm denotes that, with a load gear ratio of 1:10, the motor can run at up to 3000 rpm.

Application macros

What this chapter contains

This chapter describes the intended use, operation and the default control connections of the factory application macro. It also describes how to save a user macro, and how to recall it.

Overview of macros

Application macros are preprogrammed parameter sets. While starting up the drive, the user typically makes the essential changes and saves the result as a user macro.

The table below contains a summary of the macros and describes suitable applications.

Macro	Suitable applications
Factory	For simple speed control
User	The user can save the customised standard macro i.e. the parameter settings including group 99, and the results of the motor identification into the permanent memory, and recall the data at a later time. Two user macros are essential when switching between two different motors is required.

Factory macro

All drive commands and reference settings can be given from the control panel or from an external control location. The active control location is selected with the ***LOC/REM*** key of the panel. The drive is speed-controlled.

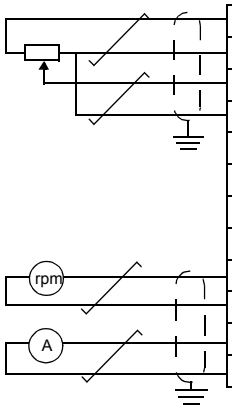
In external control, the control location is EXT1 (see par. 11.01 CNTROL PLACE SEL). The reference signal is connected to analogue input AI1 and Start/Stop signal is connected to digital input DI1.

Acceleration and deceleration ramps are defined by parameters 22.02 ACCEL TIME1 and 22.03 DECEL TIME1. Two analogue signals (speed and current) and three relay output signals (ready, running and inverted fault) are available.

The default signals on the display of the control panel are SPEED, TORQUE and CTRL MODE ACK.

Default control connections

The figure below shows the external control connections for the Factory macro. The markings of the standard I/O terminals on the RMIO board are shown.



X20		
1	VREF	Reference voltage -10 VDC 1 kohm ≤ R_L ≤ 10 kohm
2	GND	
X21		
1	VREF	Reference voltage 10 VDC 1 kohm ≤ R_L ≤ 10 kohm
2	GND	
3	AI1+	Speed reference 0(2) … 10 V, R_{in} > 200 kohm
4	AI1-	
5	AI2+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
6	AI2-	
7	AI3+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
8	AI3-	
9	AO1+	Motor speed 0(4) … 20 mA ≙ 0 … motor nom. speed, R_L ≤ 700 ohm
10	AO1-	
11	AO2+	Output current 0(4) … 20 mA ≙ 0 … motor nom. current, R_L ≤ 700 ohm
12	AO2-	
X22		
1	DI1	Stop/Start
2	DI2	EXT1/EXT2 control place selection
3	DI3	By default, not in use.
4	DI4	By default, not in use.
5	DI5	By default, not in use.
6	DI6	By default, not in use.
7	+24 V	+24 VDC, max. 100 mA
8	+24 V	
9	DGND1	Digital ground
10	DGND2	Digital ground
11	DI IL	Start interlock (0 = stop) [1]
X23		
1	+24 V	Auxiliary voltage output, non-isolated, 24 VDC, 250 mA
2	GND	
X25		
1	RO11	Relay output 1 **Ready**
2	RO12	
3	RO13	
X26		
1	RO21	Relay output 2 **Running**
2	RO22	
3	RO23	
X27		
1	R031	Relay output 3 **Inverted fault**
2	R032	
3	R033	

Fault

[1] See parameter 10.09 START INTERL FUNC.

User macros

In addition to the Factory macro, it is possible to create two user macros. The user macro allows the user to save the parameter settings including group 99, and the results of the motor identification into the permanent memory, and recall the data at a later time. The panel reference is also saved, if the macro is saved and loaded in Local control mode. Remote control location setting is saved into the user macro, but Local control location setting is not.

To create User Macro 1:

- Adjust the parameters. Perform the motor identification if not performed yet.
- Save the parameter settings and the results of the motor identification by changing parameter 99.02 APPLICATION MACRO to USER 1 SAVE (press ENTER). The storing takes 20 s to 1 min.

To recall the User Macro:

- Change parameter 99.02 APPLICATION MACRO to USER 1 LOAD.
- Press ***ENTER*** to load.

The user macro can also be switched via digital inputs (see parameter 16.03 USER MACRO IO CHG).

Note: User macro load restores also the motor settings in parameter group 99 START UP and the results of the motor identification. Check that the settings correspond to the used motor.

Example: The user can switch the drive between two motors without having to adjust the motor parameters and to repeat the motor identification every time the motor is changed. The user needs only to adjust the settings and perform the motor identification once for both motors and then to save the data as two user macros. When the motor is changed, only the corresponding User macro needs to be loaded, and the drive is ready to operate.

Actual signals and parameters

What this chapter contains

The chapter describes the actual signals and parameters and gives the fieldbus equivalent values for each signal/parameter.

Terms and abbreviations

Term	Definition
Actual signal	Signal measured or calculated by the drive. Can be monitored by the user. No user setting possible.
Def	Default value
FbEq	Fieldbus equivalent: The scaling between the value shown on the panel and the integer used in serial communication.
Parameter	A user-adjustable operation instruction of the drive.

Fieldbus addresses

Rxxx adapter modules (such as RPBA-01, RDNA-01, etc.)

See the appropriate fieldbus adapter module User's Manual.

Nxxx adapter modules (such as NPBA-12, NDNA-02, etc.)

NPBA-12 Profibus Adapter:

Signal/Parameter group	Fieldbus address
01	yy
02...03	(25 · xx) + yy
10...41	25 · (xx - 6) + yy
50...51	25 · (xx - 10) + yy
52...97	18 · (xx + 6) + yy + 6
98...99	25 · (xx - 22) + yy

xxyy = drive parameter number

Note: The following signals/parameters are not supported: 02.26, 02.27, groups 04...07, 13.26...13.29, 15.26...15.28 and groups 42...49.

NIBA-01 InterBus-S Adapter:

- xxyy · 100 + 12288 converted into hexadecimal, where xxyy = drive parameter number
- Example: The index number for drive parameter 13.09 is 1309 + 12288 = 13597 (dec) = 351D (hex)

NMBP-01 ModbusPlus Adapter and NMBA-01 Modbus Adapter:

4xxyy, where xxyy = drive parameter number

No.	Name/Value	Description	FbEq
01 ACTUAL SIGNALS		Basic signals for monitoring of the drive	
01.01	CTRL LOCATION	Active control location. (1) LOCAL; (2) EXT1; (3) EXT2. See chapter *Basic program features*.	
01.02	CTRL MODE ACK	Active control mode. 0 = stopped, 1 = torque, 2 = speed, 3 = position, 4 = synchron	1 = 1
01.03	SPEED	Calculated motor speed in rpm. Speed scaling is defined by parameter 19.01 SPEED SCALING. Filter time constant is defined by parameter 19.16 MOTOR SP FILT TIM.	20000 = par. 19.01
01.04	FREQUENCY	Calculated drive output frequency	-100 = -1 Hz 100 = 1 Hz
01.05	CURRENT	Measured motor current	10 = 1 A
01.06	TORQUE	Calculated motor torque. 100 is the motor nominal torque. Filter time constant is defined by parameter 19.17 TORQ ACT FILT TIM.	-10000 = -100% 10000 = 100% of motor nom. torque
01.07	MOTOR ACCELERATIO	Calculated motor acceleration rate from signal 01.03 SPEED	1 = 1 rpm/s
01.08	INVERTER POWER	Inverter power	10 = 1 kW
01.09	MOTOR POWER	Motor power. 100 is the nominal power.	-1000 = -100% 1000 = 100% of motor nom. power
01.10	DC BUS VOLTAGE V	Measured intermediate circuit voltage	1 = 1 V
01.11	ACS 800 TEMP	Calculated IGBT temperature in percent. Fault trip limit is 100%.	10 = 1%
01.12	PP1 TEMP	Measured heatsink temperature of inverter no. 1	1 = 1 °C
01.13	CTRL BOARD TEMP	Control board temperature	1 = 1 °C
01.14	OP HOUR COUNTER	Elapsed time counter. Runs when the control board is powered.	1 = 1h
01.15	KILOWATT HOURS	kWh counter. Counts inverter output kilowatt hours during drive operation (motoring power - generator power).	1 = 100 kWh
01.16	FAN ON-TIME	Running time of the drive cooling fan. **Note:** Resetting of the counter is recommended when the fan is replaced. For more information, contact your local ABB representative.	1 = 10h (600min)
01.17	MOTOR RUN TIME	Motor run time counter. The counter runs when the inverter modulates.	1 = 10 h
01.18	MOTOR 1 TEMP	Measured temperature of motor 1. See parameter 35.01 MOT 1 TEMP AI1 SEL.	1 = 1°C
01.19	MOTOR 2 TEMP	Measured temperature of motor 2. See parameter 35.04 MOT 2 TEMP AI2 SEL.	1 = 1°C
01.20	MOTOR TEMP EST	Estimated motor temperature	1 = 1°C
01.21	ACTIVE APPL MACRO	Active application macro	
02 I/O VALUES		I/O signal monitoring	
02.01	AI1 [V]	Value of analogue input AI1	1 = 0.001 V
02.02	AI1 SCALED	Value of analogue input AI1 scaled in percent. See parameter 13.03 AI1 MIN SCALE.	100 = 1%
02.03	AI2 [mA]	Value of analogue input AI2	1 = 0.001 mA
02.04	AI2 SCALED	Value of analogue input AI2 scaled in percent. See parameter 13.03 AI1 MIN SCALE.	100 = 1%

No.	Name/Value	Description	FbEq
02.05	AI3 [mA]	Value of analogue input AI3	1 = 0.001 mA
02.06	AI3 SCALED	Value of analogue input AI3 scaled in percent. See parameter 13.03 AI1 MIN SCALE.	100 = 1%
02.07	EXT AI1 [mA]	Value of analogue input AI1 of analogue I/O extension module (optional)	1 = 0.001 mA
02.08	EXT AI1 SCALED	Value of analogue input EXT AI1 scaled in percent. See parameter 13.03 AI1 MIN SCALE.	100 = 1%
02.09	EXT AI2 [mA]	Value of analogue input AI2 of analogue I/O extension module (optional)	1 = 0.001 mA
02.10	EXT AI2 SCALED	Value of analogue input EXT AI2 scaled in percent. See parameter 13.03 AI1 MIN SCALE.	100 = 1%
02.11	AO1 [mA]	Value of analogue output AO1	1 =0.001 mA
02.12	AO2 [mA]	Value of analogue output AO2	1 = 0.001 mA
02.13	EXT AO1 [mA]	Value of analogue output AO1 of analogue I/O extension module (optional)	1 = 0.001 mA
02.14	EXT AO2 [mA]	Value of analogue output AO2 of analogue I/O extension module (optional)	1 = 0.001 mA
02.15	MAIN DS REF1	Reference 1 (REF1) of the Main Reference dataset DS1 received from the master station through the fieldbus interface	-32768 … 32767
02.16	MAIN DS REF2	Reference 2 (REF2) of the Main Reference dataset DS1 received from the master station through the fieldbus interface	-32768 … 32767
02.17	AUX DS REF1	Reference 3 of the Auxiliary Reference dataset DS3	-32768 … 32767
02.18	AUX DS REF2	Reference 4 of the Auxiliary Reference dataset DS3	-32768 … 32767
02.19	AUX DS REF3	Reference 5 of the Auxiliary Reference dataset DS3	-32768 … 32767
02.20	MAIN DS REF12	32-bit reference 12 (REF1 + REF2) of the Main Reference dataset DS1	$-2^{31}…2^{31}$
02.21	M/F REF1	Master/Follower link reference 1	-32768 … 32767
02.22	M/F REF2	Master/Follower link reference 2	-32768 … 32767
02.23	MAIN DS ACT1	Actual value 1 of the Main Actual Signal dataset DS2	-32768 … 32767
02.24	MAIN DS ACT2	Actual value 2 of the Main Actual Signal dataset DS2	-32768 … 32767
02.25	AUX DS ACT1	Actual value 3 of the Auxiliary Actual Signal dataset DS4 which the drive sends to the fieldbus master station.	-32768 … 32767
02.26	AUX DS ACT2	Actual value 4 of the Auxiliary Actual Signal dataset DS4 which the drive sends to the fieldbus master station.	-32768 … 32767
02.27	AUX DS ACT3	Actual value 5 of the Auxiliary Actual Signal dataset DS4 which the drive sends to the fieldbus master station.	-32768 … 32767
03 CONTROL VALUES		Speed and torque reference monitoring signals. See *Control block diagrams* for more information on the use of the signal in the control chain.	
03.01	SPEED REF INPUT	Speed reference after reference selection and scaling in rpm	20000 = par. 19.01
03.02	SPEED REF 2	Speed reference ramp input in rpm	20000 = par. 19.01

No.	Name/Value	Description	FbEq
03.03	SPEED REF 4	Speed reference used in speed error calculation in rpm.	20000 = par. 19.01
03.04	MOTOR SPEED	Actual motor speed (defined by parameters 19.02 SPEED FB SEL and 19.03 SPEED ACT FILT TIM) for the speed controller in rpm	20000 = par. 19.01
03.05	SPEED ESTIMATED	Estimated motor speed in rpm	20000 = par. 19.01
03.06	SPEED MEAS ENC1	Measured encoder 1 speed in rpm	20000 = par. 19.01
03.07	SPEED MEAS ENC2	Measured encoder 2 speed in rpm	20000 = par. 19.01
03.08	SPEED ERROR	Speed error for the speed controller in rpm	20000 = par. 19.01
03.09	TORQ REF 1	Torque reference from the torque selection chain in percent of the nominal torque	10000 = 100%
03.10	TORQ REF 2	Torque reference from speed controller chain in percent of the nominal torque	10000 = 100%
03.11	TORQ REF 3	Torque reference after control location selection chain in percent of the nominal torque	10000 = 100%
03.12	TORQ REF USED	Torque reference after frequency, voltage and torque limiters. 100% corresponds to the motor nominal torque.	10000 = 100%
03.13	MOTOR TORQUE FILT	Filtered motor torque. 100% corresponds to the motor nominal torque.	10000 = 100%
03.14	FLUX REF	Flux reference in percent	10000 = 100%
03.15	SYNCR VELOC REF	Synchronous speed reference in rpm. Source for the signal is selected with parameter 41.01 SYNC POS REF SEL.	20000 = par. 19.01
04 POS CTRL VALUES		Positioning monitoring signals. See *Control block diagrams* for more information on the use of the signal in the control chain.	
04.01	POS ACT ENC	Actual position of the encoder in degrees (-180°...180°). Encoder is selected with parameter 19.11 POS ACT SEL.	32768 = 180°
04.02	POS ACT VAL	Actual position of the encoder. Unit for the position value is selected with parameter 19.13 POS UNIT. Encoder is selected with parameter 19.11 POS ACT SEL.	See par. 19.13
04.03	POS ENC2	Actual encoder 2 position. Encoder is selected with parameter 19.11 POS ACT SEL.	See par. 19.13
04.04	SEL POS REF SET	Reference set for position control. Selected with parameters 40.06...40.09.	1 = 1
04.05	POS INTERP INPUT	Position target reference for the position interpolator	See par. 19.13
04.06	POS INTERP OUTPUT	Position reference from the position interpolator	See par. 19.13
04.07	DISTANCE TO TARGET	Distance to the target	See par. 19.13
04.08	SYNC POS REF	Position reference in Synchron Control mode (output of the synchron gear). See *Control block diagrams.*	See par. 19.13
04.09	SYNC GEAR INPUT	Position reference in Synchron Control for the synchron gear (input of synchron gear). See *Control block diagrams.*	See par.19.13
04.10	SYNC GEAR OUTPUT	Synchron control reference from the synchron gear. See *Control block diagrams.*	See par. 19.13
04.11	SYNCHRON ERROR	Synchronising error caused by the dynamic limitations of the position correction, fed to the position interpolator.	See par. 19.13
04.12	POS CTRL REF	Position reference for the position controller	See par. 19.13

No.	Name/Value	Description	FbEq
04.13	SPEED FEED FORW	Position speed reference from the dynamic limiter for the speed controller. To improve speed control, this speed reference is added to the position error (difference between position reference and actual position).	1 = 1 rpm
04.14	POSITION ERROR	Position error	See par. 19.13
04.15	LATCHED ACT POS	Measured actual position. Triggered according to parameter 43.05 LATCH POS ACT SEL setting.	See par. 19.13
04.16	LATCHED MAS REF	Measured master reference position. Triggered according to parameter 43.06 LATCH MAS REF SEL setting.	See par. 19.13
04.17	CYCLIC POSIT ERR	Calculated cyclic position error for the cyclic correction function. See *Motion control features*, *Cyclic correction function*. error = reference latch position - measured latch position The error is added to synchron error (04.11 SYNCHRON ERROR).	See par. 19.13
05 CONTROL WORDS		Control words for monitoring of fieldbus communication (each signal is a 16-bit data word).	
05.01	MAIN CONTROL WORD	A 16-bit data word. See chapter *Fieldbus control, Control word for ABB Drives communication profile (05.01 MAIN CONTROL WORD).*	0...65535
05.02	DATASET MCW	A 16-bit data word. Control Word (CW) of the Main Reference dataset DS2 received from the master station through the fieldbus interface.	0...65535
05.03	FOLLOWER MCW	A 16-bit data word. For the contents, see *Master/Follower Application Guide* [3AFE64590430 (English)].	0...65535
06 STATUS WORDS		Status words for monitoring of fieldbus communication (each signal is a 16-bit data word).	
06.01	MAIN STATUS WORD	A 16-bit data word. See chapter *Fieldbus control, Status word for ABB Drives communication profile (06.01 MAIN STATUS WORD).*	0 … 65535
06.02	AUX STATUS WORD	A 16-bit data word. See 06.02 AUXILIARY STATUS WORD.	0 … 65535
06.04	RMIO DI STATUS	Status of digital inputs. Example: 0000001 = DI1 is on, DI2 to DI6 are off.	0 … 65535
06.05	EXT DI STATUS	Status of extension module digital inputs. External control is enabled with parameters 12.01...12.03.	0 … 65535
06.06	PROG DI STATUS	Status of programmable binary inputs enabled with parameters 12.04...12.11.	0 … 65535
06.07	AI SUP STATUS	A 16-bit data word of analogue input supervision enabled with parameter 13.29 AI MIN ACTIVATION. Bit = 0: Supervision is not enabled or supervision value is within limit. Bit = 1: Supervision is enabled and the supervision value is out of limit(s). See parameter 13.29 AI MIN ACTIVATION for a list of available supervisions.	0 … 65535
06.08	SUPERVIS STATUS	Status of supervision functions 1...3 activated with parameters 32.01...32.09.	0 … 65535
06.09	RMIO RO STATUS	Status of relay outputs. Example: 001 = RO1 is energised, RO2 and RO3 are de-energised.	0 … 65535
06.10	EXT RO STATUS	Status of the relay outputs on the digital I/O extension modules (optional). E.g. value 0000001: RO1 of module 1 is on. Other relay outputs are off.	0 … 65535
06.11	POS STATUS WORD 1	A 16-bit data word. See chapter *Fieldbus control*, 06.11 POS STATUS WORD 1.	0 … 65535
06.12	POS STATUS WORD 2	A 16-bit data word. See chapter *Fieldbus control*, 06.12 POS STATUS WORD 2.	0 … 65535

No.	Name/Value	Description	FbEq
06.13	LIMIT WORD 1	A 16-bit data word. See chapter *Fieldbus control*, 06.13 LIMIT WORD 1.	0 … 65535
06.14	LIMIT WORD 2	A 16-bit data word. See chapter *Fieldbus control*, 06.14 LIMIT WORD 2.	0 … 65535
06.15	LIMIT WORD INV	A 16-bit data word. See chapter *Fieldbus control,* 06.15 LIMIT WORD INV.	0 … 65535
06.16	AUX STAUS WORD3	A 16-bit data word. See chapter *Fieldbus control,* 06.16 AUX STATUS WORD3.	0 … 65535
07 ALARMS AND FAULTS		Fault and alarm words	
07.01	LATEST FAULT	Fieldbus code of the latest fault. See chapter *Fault tracing* for the codes.	0 … 65535
07.02	2. LATEST FAULT	Fieldbus code of the 2nd latest fault.	0 … 65535
07.03	3. LATEST FAULT	Fieldbus code of the 3rd latest fault.	0 … 65535
07.04	4. LATEST FAULT	Fieldbus code of the 4th latest fault.	0 … 65535
07.05	5. LATEST FAULT	Fieldbus code of the 5th latest fault.	0 … 65535
07.06	LATEST WARNING	Fieldbus code of the latest warning.	0 … 65535
07.07	2. LATEST WARNING	Fieldbus code of the 2nd latest warning.	0 … 65535
07.08	3. LATEST WARNING	Fieldbus code of the 3rd latest warning.	0 … 65535
07.09	4. LATEST WARNING	Fieldbus code of the 4th latest warning.	0 … 65535
07.10	5. LATEST WARNING	Fieldbus code of the 5th latest warning.	0 … 65535
07.11	FAULT WORD 1	A 16-bit data word. See chapter *Fieldbus control,* 07.11 FAULT WORD 1.	0 … 65535
07.12	FAULT WORD 2	A 16-bit data word. See chapter *Fieldbus control,* 07.12 FAULT WORD 2.	0 … 65535
07.13	FAULT WORD POS	A 16-bit data word. See chapter *Fieldbus control*, 07.13 FAULT WORD POS.	0 … 65535
07.14	FAULT WORD 4	A 16-bit data word. See chapter *Fieldbus control*, 07.14 FAULT WORD 4.	0 … 65535
07.15	FAULT WORD 5	A 16-bit data word. See chapter *Fieldbus control*, 07.15 FAULT WORD 5.	0 … 65535
07.16	SYSTEM FAULT	A 16-bit data word. See chapter *Fieldbus control*, 07.16 SYSTEM FAULT WORD.	0 … 65535
07.17	INT INIT FAULT	A 16-bit data word. See chapter *Fieldbus control*, 07.17 INT board INIT FAUL.	0 … 65535
07.18	FAULTED INT INFO	A 16-bit data word. See chapter *Fieldbus control,* 07.18 INT FAULT INFO WORD.	0 … 65535
07.19	INT SC INFO	A 16-bit data word. See chapter *Fieldbus control*, 07.19 INT SC INFO.	0 … 65535
07.20	ALARM WORD 1	A 16-bit data word. See chapter *Fieldbus control*, 07.20 ALARM WORD 1.	0 … 65535
07.21	ALARM WORD 2	A 16-bit data word. See chapter *Fieldbus control*, 07.21 ALARM WORD 2.	0 … 65535
07.22	ALARM WORD POS	A 16-bit data word. Bit 0 TGT POS LIM = Target position limit. Position reference is over the limit defined by parameter 42.01 POSITION MAX or 42.02 POSITION MIN. Bits 1...15 = not defined.	0 … 65535
07.23	ALARM WORD 4	A 16-bit data word. See chapter *Fieldbus control*, 07.23 ALARM WORD 4.	0 … 65535

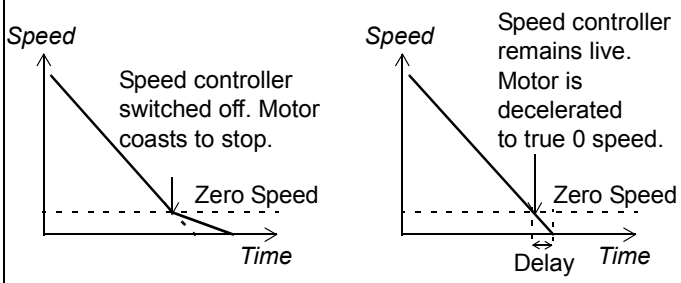
No.	Name/Value	Description	FbEq
07.24	ALARM WORD 5	A 16-bit data word. See chapter *Fieldbus control*, 07.21 ALARM WORD 2.	0 … 65535

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>Def
FbEq</th></tr>
<tr><td colspan="2">10 START/STOP</td><td>Start and stop control</td><td></td></tr>
<tr><td>10.01</td><td>EXT1 START FUNC</td><td>Selects the start and stop function and the input signal sources for external control location 1 (EXT1). Control place is selected with group 11 CONTROL PLACES parameters.</td><td>IN1</td></tr>
<tr><td></td><td>IN1</td><td>Source of the start and stop commands are selected by parameter 10.02 EXT1 START IN1. The start/stop is controlled as follows:
<table><tr><th>Par. 10.02</th><th>Command</th></tr><tr><td>0 -> 1</td><td>Start</td></tr><tr><td>1 -> 0</td><td>Stop</td></tr></table></td><td>1</td></tr>
<tr><td></td><td>3-WIRE</td><td>Source of the start and stop commands are selected by parameters 10.02 EXT1 START IN1 and 10.03 EXT1 START IN2. The start/stop is controlled as follows:
<table><tr><th>Par. 10.02</th><th>Par.10.03</th><th>Command</th></tr><tr><td>0 -> 1</td><td>1</td><td>Start</td></tr><tr><td>any</td><td>1 -> 0</td><td>Stop</td></tr><tr><td>any</td><td>0</td><td>Stop</td></tr></table></td><td>2</td></tr>
<tr><td></td><td>MAIN DS WORD1</td><td>Fieldbus control word</td><td>3</td></tr>
<tr><td></td><td>M/F LINK</td><td>Master/Follower link control word</td><td>4</td></tr>
<tr><td>10.02</td><td>EXT1 START IN1</td><td>Selects the source of input signal 1 for the start and stop commands of external control location EXt1. See parameter 10.01 EXT1 START FUNC selections IN1 and 3-WIRE.</td><td>DI1</td></tr>
<tr><td></td><td>FALSE</td><td>False (0)</td><td>1</td></tr>
<tr><td></td><td>TRUE</td><td>True (1)</td><td>2</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1</td><td>3</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2</td><td>4</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3</td><td>5</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4</td><td>6</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5</td><td>7</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6</td><td>8</td></tr>
<tr><td></td><td>EXT M1 DI1</td><td>Digital input DI1 of extension module 1</td><td>9</td></tr>
<tr><td></td><td>EXT M1 DI2</td><td>Digital input DI2 of extension module 1</td><td>10</td></tr>
<tr><td></td><td>EXT M1 DI3</td><td>Digital input DI3 of extension module 1</td><td>11</td></tr>
<tr><td></td><td>EXT M2 DI1</td><td>Digital input DI1 of extension module 2</td><td>12</td></tr>
<tr><td></td><td>EXT M2 DI2</td><td>Digital input DI2 of extension module 2</td><td>13</td></tr>
<tr><td></td><td>EXT M2 DI3</td><td>Digital input DI3 of extension module 2</td><td>14</td></tr>
<tr><td></td><td>EXT M3 DI1</td><td>Digital input DI1 of extension module 3</td><td>15</td></tr>
<tr><td></td><td>EXT M3 DI2</td><td>Digital input DI2 of extension module 3</td><td>16</td></tr>
<tr><td></td><td>EXT M3 DI3</td><td>Digital input DI3 of extension module 3</td><td>17</td></tr>
<tr><td></td><td>PROG DI1</td><td>Source selected by parameter 12.04 PROGRAMMABLE DI1</td><td>18</td></tr>
<tr><td></td><td>PROG DI2</td><td>Source selected by parameter 12.05 PROGRAMMABLE DI2</td><td>19</td></tr>
<tr><td></td><td>PROG DI3</td><td>Source selected by parameter 12.06 PROGRAMMABLE DI3</td><td>20</td></tr>
</table>

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>Def
FbEq</th></tr>
<tr><td></td><td>PROG DI4</td><td>Source selected by parameter 12.07 PROGRAMMABLE DI4</td><td>21</td></tr>
<tr><td></td><td>PROG DI5</td><td>Source selected by parameter 12.08 PROGRAMMABLE DI5</td><td>22</td></tr>
<tr><td></td><td>PROG DI6</td><td>Source selected by parameter 12.09 PROGRAMMABLE DI6</td><td>23</td></tr>
<tr><td></td><td>PROG DI7</td><td>Source selected by parameter 12.10 PROGRAMMABLE DI7</td><td>24</td></tr>
<tr><td></td><td>PROG DI8</td><td>Source selected by parameter 12.11 PROGRAMMABLE DI8</td><td>25</td></tr>
<tr><td>10.03</td><td>EXT1 START IN2</td><td>Selects the source of input signal 2 for the start and stop commands of external control location EXt1. See parameter 10.01 EXT1 START FUNC selection 3-WIRE.</td><td>FALSE</td></tr>
<tr><td></td><td></td><td>See parameter 10.02 EXT1 START IN1.</td><td></td></tr>
<tr><td>10.04</td><td>EXT2 START FUNC</td><td>Selects the start and stop function and the input signal sources for external control location 2 (EXT2). Control place is selected with group 11 CONTROL PLACES parameters.</td><td>IN1</td></tr>
<tr><td></td><td>IN1</td><td>Source of the start and stop commands are selected by parameter 10.05 EXT2 START IN1. The start/stop is controlled as follows:
<table><tr><th>Par. 10.05</th><th>Command</th></tr><tr><td>0 -> 1</td><td>Start</td></tr><tr><td>1 -> 0</td><td>Stop</td></tr></table></td><td></td></tr>
<tr><td></td><td>3-WIRE</td><td>Source of the start and stop commands are selected by parameters 10.05 EXT2 START IN1 and 10.06 EXT2 START IN2. The start/stop is controlled as follows:
<table><tr><th>Par. 10.05</th><th>Par.10.06</th><th>Command</th></tr><tr><td>0 -> 1</td><td>1</td><td>Start</td></tr><tr><td>any</td><td>1 -> 0</td><td>Stop</td></tr><tr><td>any</td><td>0</td><td>Stop</td></tr></table></td><td></td></tr>
<tr><td></td><td>MAIN DS WORD1</td><td>Fieldbus control word</td><td></td></tr>
<tr><td></td><td>M/F LINK</td><td>Master/Follower link reference</td><td></td></tr>
<tr><td>10.05</td><td>EXT2 START IN1</td><td>Selects the source of input signal 1 for the start and stop commands of external control location EXt1. See parameter 10.04 EXT2 START FUNC selections IN1 and 3-WIRE.</td><td>FALSE</td></tr>
<tr><td></td><td></td><td>See parameter 10.02 EXT1 START IN1.</td><td></td></tr>
<tr><td>10.06</td><td>EXT2 START IN2</td><td>Selects the source of input signal 1 for the start and stop commands of external control location EXT2. See parameter 10.04 EXT1 START FUNC selection 3-WIRE.</td><td>FALSE</td></tr>
<tr><td></td><td></td><td>See parameter 10.02 EXT1 START IN1.</td><td></td></tr>
<tr><td>10.07</td><td>RUN ENABLE</td><td>Activates the run enable signal or selects the source for external Run Enable signal. If Run Enable signal is switched off, the drive will not start or stops if the drive is running. The stop mode is set by parameter 10.08 RUN ENABLE FUNC.
1 = Run enable</td><td>TRUE</td></tr>
<tr><td></td><td>FALSE</td><td>Run enable signal is inactive.</td><td>1</td></tr>
<tr><td></td><td>TRUE</td><td>Run enable signal is active.</td><td>2</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1</td><td>3</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2</td><td>4</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3</td><td>5</td></tr>
</table>

Index	Name/Selection	Description	Def FbEq
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
10.08	RUN ENABLE FUNC	Selects the stop mode applied when the Run Enable signal is switched off. The Run Enable signal is enabled by parameter 10.07 RUN ENABLE. **Note:** The setting overrides the normal stop mode setting (parameter 10.13 STOP FUNCTION) when the Run Enable signal is switched off. **WARNING!** The drive will restart after the Run Enable signal restores (if the start signal is on).	COAST
	RAMP	The application program stops the drive along the deceleration ramp defined in group 22 ACCEL/DECEL.	1
	COAST	The application program stops the drive by cutting off the motor power supply (the inverter IGBTs are blocked). The motor rotates freely to zero speed. **WARNING!** If the brake control function is on, the application program uses ramp stop in spite of the selection COAST STOP (see parameter group 28 BRAKE CTRL).	2
	OFF2 STOP	The application program stops the drive by cutting off the motor power supply (the inverter IGBTs are blocked). The motor rotates freely to zero speed. The drive will restart only when the Run Enable signal is on and the start signal is switched on (the program receives the rising edge of the start signal).	3
	OFF3 STOP	The application program stops the drive along the ramp defined by parameter 22.07 OFF3 RAMP TIME. The drive will restart only when the Run Enable is on and the start signal is switched on (the program receives the rising edge of the start signal).	4

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>Def
FbEq</th></tr>
<tr><td>10.09</td><td>START INTERL FUNC</td><td>Defines how the Start Interlock input on RMIO board affects the drive operation.</td><td>OFF2 STOP</td></tr>
<tr><td></td><td>OFF2 STOP</td><td>Drive running: 1 = Normal operation. 0 = Stop by coasting.
Drive stopped: 1 = Start allowed. 0 = No start allowed.
Restart after OFF2 STOP: Start Interlock input = 1 and the drive receives rising edge of the Start signal.</td><td>1</td></tr>
<tr><td></td><td>OFF3 STOP</td><td>Drive running: 1 = Normal operation. 0 = Stop by ramp. The ramp time is defined by parameter 22.07 OFF3 RAMP TIME.
Drive stopped: 1 = Normal start. 0 = No start allowed.
Restart after OFF3 STOP: Start Interlock input = 1 and the drive receives rising edge of the Start signal.</td><td>2</td></tr>
<tr><td>10.11</td><td>START FUNCTION</td><td>Selects the motor starting method.</td><td>AUTO</td></tr>
<tr><td></td><td>AUTO</td><td>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 (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.</td><td>1</td></tr>
<tr><td></td><td>DC MAGN</td><td>DC magnetising should be selected if a high break-away torque is required. The drive pre-magnetises the motor before the start. The pre-magnetising time is determined automatically, being typically 200 ms to 2 s depending on the motor size. DC MAGN guarantees the highest possible break-away torque.
Note: Starting to a rotating machine is not possible when DC magnetising is selected.</td><td>2</td></tr>
<tr><td></td><td>CONST DC MAGN</td><td>Constant DC magnetising should be selected instead of DC magnetising if constant pre-magnetising time is required (e.g. if the motor start must be simultaneous with a mechanical brake release). This selection also guarantees the highest possible break-away torque when the pre-magnetising time is set long enough. The pre-magnetising time is defined by parameter 10.12 CONST DC MAGN TIME.
Note: Starting to a rotating machine is not possible when DC magnetising is selected.
WARNING! The drive will start after the set magnetising time has passed although the motor magnetisation is not completed. Ensure always in applications where a full break-away torque is essential, that the constant magnetising time is long enough to allow generation of full magnetisation and torque.</td><td>3</td></tr>
<tr><td>10.12</td><td>CONST DC MAGN TIME</td><td>Defines the magnetising time in the constant magnetising mode. See parameter 10.11 START FUNCTION. After the start command, the drive automatically premagnetises the motor the set time.</td><td>500 ms</td></tr>
<tr><td></td><td>30.0...10000.0 ms</td><td>Magnetising time. To ensure full magnetising, 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 Magnetising Time</th></tr><tr><td>< 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></td><td>30…10000</td></tr>
</table>

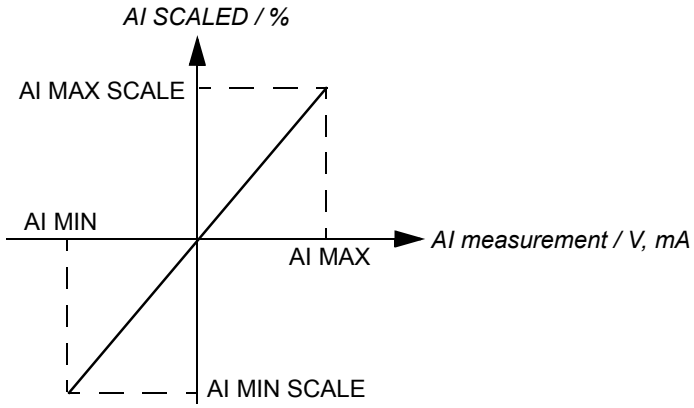
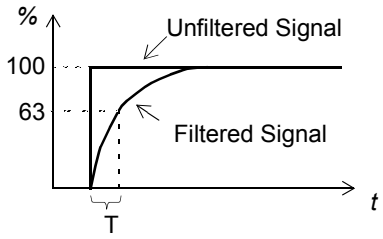
Index	Name/Selection	Description	Def FbEq
10.13	STOP FUNCTION	Selects the motor stop function.	COAST
	COAST	Stop by cutting of the motor power supply. The motor coasts to a stop. **WARNING!** If the mechanical brake control function is on, the application program uses ramp stop in spite of the selection COAST (see parameter group 28 BRAKE CTRL).	1
	RAMP	Stop along a ramp. See parameter group 22 ACCEL/DECEL.	2
10.14	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 accurately the rotor position. **No Zero Speed Delay** **With Zero Speed Delay**  **No Zero Speed Delay** The drive receives a stop command and decelerates along a ramp. When the motor actual speed falls below an internal limit (called Zero Speed), the speed controller is switched off. The inverter modulation is stopped and the motor coasts to standstill. **With Zero Speed Delay** The drive receives a stop command and decelerates along a ramp. When the actual motor speed falls below an internal limit (called Zero Speed), the zero speed delay function activates. During the delay the function keeps the speed controller live: the inverter modulates, motor is magnetised and the drive is ready for a quick restart.	0.5 s
	0.0…60.0 s	Delay time	
10.15	RESET	Activates the fault reset or selects the source for external fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists. 1 = Fault reset	FALSE
	FALSE	Fault reset is inactive.	1
	TRUE	Fault reset is active.	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11

Index	Name/Selection	Description	Def FbEq
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
10.16	NET CONTROL	Activates the net control, i.e. fieldbus control overrides the selection of parameter 10.01 EXT1 START FUNC. EXT1 must be selected as the active control location by parameter 11.01CNTROL PLACE SEL and the drive control mode has to be set to SPEED by parameter 11.02 EXT1 CONTROL MODE. Fieldbus Control Word (except bit 11) is enabled when EXT1 is selected as the active control location. **Note:** The setting is not saved in the permanent memory (will reset to zero when power is switched off).	0
	0	Inactive	0
	1	Active	1
10.17	NET REFERENCE	Activates the net reference, i.e. fieldbus reference REF1 overrides the speed reference defined by parameter group 21 SPEED REFERENCE. EXT1 must be selected as the active control location with parameter 11.01 CNTROL PLACE SEL and the drive control mode must be set to SPEED by parameter 11.02 EXT1 CONTROL MODE. **Note:** The setting is not saved in the permanent memory (will reset to zero when power is switched off).	0
	0	Inactive	0
	1	Active	1
11 CONTROL PLACES		Control mode selection	
11.01	CNTROL PLACE SEL	Selects the external control location or the source from which the drive reads the signal that selects between the two external control locations, EXT1 or EXT2. 0 = EXT1 1 = EXT2	DI2
	FALSE	EXT1 is active.	1
	TRUE	EXT2 is active.	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5

Index	Name/Selection	Description	Def FbEq
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
11.02	EXT1 CONTROL MODE	Selects the control mode for external control location 1 (EXT1) and selects the reference source for the torque control chain (torque selector) when EXT1 is in use. See chapter *Control block diagrams.*	SPEED
	SPEED	Control mode: Speed control. Torque reference source: From speed controller output	1
	TORQUE	Control mode: Torque control Torque reference source: Torque reference	2
	MIN	Control mode: Torque control Torque reference source: Torque selector compares the direct torque reference and the speed controller output, and the smaller of them is used as the reference for motor torque control.	3
	MAX	Control mode: Torque control Torque reference source: Torque selector compares the direct torque reference and the speed controller output and the greater of them is used as the reference for motor torque control.	4
	ADD	Control mode: Torque control Torque reference source: Torque selector adds the speed controller output to the direct torque reference.	5
	POSITION	Control mode: Position control Torque reference source: From speed controller output	6
	SYNCHRON	Control mode: Synchron control Torque reference source: From speed controller output	7
11.03	EXT2 CONTROL MODE	Selects the control mode for external control location 2 (EXT2) and selects the reference source for the torque control chain (torque selector) when EXT2 is in use. See chapter *Control block diagrams.*	SPEED

Index	Name/Selection	Description	Def FbEq
	SPEED	Control mode: Speed control. Torque reference source: From speed controller output	1
	TORQUE	Control mode: Torque control Torque reference source: Torque reference	2
	MIN	Control mode: Torque control Torque reference source: Torque selector compares the direct torque reference and the speed controller output, and the smaller of them is used as the reference for motor torque control.	3
	MAX	Control mode: Torque control Torque reference source: Torque selector compares the direct torque reference and the speed controller output and the greater of them is used as the reference for motor torque control.	4
	ADD	Control mode: Torque control Torque reference source: Torque selector adds the speed controller output to the direct torque reference.	5
	POSITION	Control mode: Position control Torque reference source: From speed controller output	6
	SYNCHRON	Control mode: Synchron control Torque reference source: From speed controller output	7
12 DIGITAL INPUTS		Digital I/O extension module activation and programmable digital input processing	
12.01	DI/O EXT MODULE1	Activates the communication to the digital I/O extension module 1 (optional) and defines the type and connection interface of the module.	NO
	NDIO	Communication active. Module type: NDIO module. Connection interface: Fibre optic DDCS link. **Note:** Module node number must be set to 2. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* [3AFY58919730 (English)].	1
	NO	Inactive	2
	RDIO-SLOT1	Communication active. Module type: RDIO. Connection interface: Option slot 1 of the drive.	3
	RDIO-SLOT2	Communication active. Module type: RDIO. Connection interface: Option slot 2 of the drive.	4
	RDIO-DDCS	Communication active. Module type: RDIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 2. For directions, see *User's Manual for RDIO Module* [3AFE64485733 (English)].	5
12.02	DI/O EXT MODULE2	Activates the communication to the digital I/O extension module 2 (optional) and defines the type and connection interface of the module.	NO
	NDIO	Communication active. Module type: NDIO module. Connection interface: Fibre optic DDCS link. **Note:** Module node number must be set to 3. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* [3AFY58919730 (English)].	1
	NO	Inactive	2
	RDIO-SLOT1	Communication active. Module type: RDIO. Connection interface: Option slot 1 of the drive.	3

Index	Name/Selection	Description	Def FbEq
	RDIO-SLOT2	Communication active. Module type: RDIO. Connection interface: Option slot 2 of the drive.	4
	RDIO-DDCS	Communication active. Module type: RDIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 3. For directions, see *User's Manual for RDIO Module* [3AFE64485733 (English)].	5
12.03	DI/O EXT MODULE3	Activates the communication to the digital I/O extension module 3 (optional) and defines the type and connection interface of the module.	NO
	NDIO	Communication active. Module type: NDIO module. Connection interface: Fibre optic DDCS link. **Note:** Module node number must be set to 4. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* [3AFY58919730 (English)].	1
	NO	Inactive	2
	RDIO-SLOT1	Communication active. Module type: RDIO. Connection interface: Option slot 1 of the drive.	3
	RDIO-SLOT2	Communication active. Module type: RDIO. Connection interface: Option slot 2 of the drive.	4
	RDIO-DDCS	Communication active. Module type: RDIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 4. For directions, see User's Manual for RDIO Module [3AFE64485733 (English)].	5
12.04	PROGRAMMABLE DI1	Defines the source for freely programmable boolean information, i.e. when selection PROG DI1 has been selected.	5.02 bit 11
	-255.255.31…+255.255.31	Parameter index and bit number (0…23) Example: Parameter is set to value +06.04.01, i.e. the application program stores the state of digital input DI2 to bit 1 of actual signal 06.04.	
12.05	PROGRAMMABLE DI2	See parameter 12.04 PROGRAMMABLE DI1.	5.02 bit 7
	-255.255.31…+255.255.31	See parameter 12.04 PROGRAMMABLE DI1.	
12.06	PROGRAMMABLE DI3	See parameter 12.04 PROGRAMMABLE DI1.	6.16 bit 9
	-255.255.31…+255.255.31	See parameter 12.04 PROGRAMMABLE DI1.	
12.07	PROGRAMMABLE DI4	See parameter 12.04 PROGRAMMABLE DI1.	6.12 bit 14
	-255.255.31…+255.255.31	See parameter 12.04 PROGRAMMABLE DI1.	
12.08	PROGRAMMABLE DI5	See parameter 12.04 PROGRAMMABLE DI1.	5.02 bit 12
	-255.255.31…+255.255.31	See parameter 12.04 PROGRAMMABLE DI1.	
12.09	PROGRAMMABLE DI6	See parameter 12.04 PROGRAMMABLE DI1.	5.02 bit 13
	-255.255.31…+255.255.31	See parameter 12.04 PROGRAMMABLE DI1.	
12.10	PROGRAMMABLE DI7	See parameter 12.04 PROGRAMMABLE DI1.	5.02 bit 14
	-255.255.31…+255.255.31	See parameter 12.04 PROGRAMMABLE DI1.	
12.11	PROGRAMMABLE DI8	See parameter 12.04 PROGRAMMABLE DI1.	5.02 bit 15
	-255.255.31…+255.255.31	See parameter 12.04 PROGRAMMABLE DI1.	

Index	Name/Selection	Description	Def FbEq
13 ANALOGUE INPUTS		Analogue input signal processing	
13.01	AI1 MIN	Defines the minimum value for analogue input AI1.	-10 V
	-10.205...10.205 V	Voltage	-10205…10205
13.02	AI1 MAX	Defines the maximum value for analogue input AI1.	10 V
	-10.205...10.205 V	Voltage	-10205…10205
13.03	AI1 MIN SCALE	Defines the %-value that corresponds to the minimum value of analogue input AI1. See *Basic program features*, *Analogue input signal conversion to a speed value in rpm*. The figure below illustrate the converting:  	-100%
	-400…400%	Value in percent	-40000…40000
13.04	AI1 MAX SCALE	Defines the %-value that corresponds to the maximum value of analogue input AI1. See parameter 13.03 AI1 MIN SCALE.	100%
	-400...400%	Value in percent	-40000…40000
13.05	AI1 FILT TIME	Defines the filter time constant for analogue input AI1.  $O = I \cdot (1 - e^{-t/T})$ 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 (1 ms time constant). This cannot be changed by any parameter.	0.1 s
	0.00…10.00 s	Filter time constant	0...1000
13.06	AI2 MIN	Defines the minimum value for analogue input AI2.	0 mA
	0…20.41 mA	Current	0…20410
13.07	AI2 MAX	Defines the maximum value for analogue input AI2.	20 mA
	0…20.41 mA	Current	0…20410
13.08	AI2 MIN SCALE	Defines the %-value that corresponds to the minimum value of analogue input AI2. See parameter 13.03 AI1 MIN SCALE.	-100%
	-400...400%	Value in percent	-40000…40000
13.09	AI2 MAX SCALE	Defines the %-value that corresponds to the maximum value of analogue input AI2. See parameter 13.03 AI1 MIN SCALE.	100%

Index	Name/Selection	Description	Def FbEq
	-400...400%	Value in percent	-40000…40000
13.10	AI2 FILT TIME	Defines the filter time constant for analogue input AI2. See parameter 13.05 AI1 FILT TIME.	0.1 s
	0.00…10.00 s	Filter time constant	0...1000
13.11	AI3 MIN	Defines the minimum value for analogue input AI3.	0 mA
	0…20.41 mA	Current	0…20410
13.12	AI3 MAX	Defines the maximum value for analogue input AI3.	20 mA
	0…20.41 mA	Current	0…20410
13.13	AI3 MIN SCALE	Defines the %-value that corresponds to the minimum value of analogue input AI3. See parameter 13.03 AI1 MIN SCALE.	-100%
	-400...400%	Value in percent	-40000…40000
13.14	AI3 MAX SCALE	Defines the %-value that corresponds to the maximum value of analogue input AI3. See parameter 13.03 AI1 MIN SCALE.	100%
	-400...400%	Value in percent	-40000…40000
13.15	AI3 FILT TIME	Defines the filter time constant for analogue input AI3. See parameter 13.05 AI1 FILT TIME.	0.1 s
	0.00…10.00 s	Filter time constant	0...1000
13.16	AI/O EXT MODULE	Activates the communication to the analogue I/O extension module (optional), and defines the type and connection interface of the module.	NO
	NAIO	Communication active. Module type: NAIO. Connection interface: Fibre optic DDCS link. **Note:** Module node number must be set to 5. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* [3AFY58919730 (English)].	1
	NO	Communication inactive	2
	RAIO-SLOT1	Communication active. Module type: RAIO. Connection interface: Option slot 1 of the drive.	3
	RAIO-SLOT2	Communication active. Module type: RAIO. Connection interface: Option slot 2 of the drive.	4
	RAIO-DDCS	Communication active. Module type: RAIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 5. For directions, see *RAIO Module User's Manual* [3AFE64484567 (English)].	5
13.17	EXT AI1 MIN	Defines the minimum value for analogue input AI1 of analogue I/O extension module.	-20 mA
	-20.41...20.41 mA	Current	-20410…20410
13.18	EXT AI1 MAX	Defines the maximum value for analogue input AI1 of analogue I/O extension module.	20 mA
	-20.41...20.41 mA	Current	-20410…20410
13.19	EXT AI1 MIN SCALE	Defines the %-value that corresponds to the minimum value of analogue input AI1 of analogue I/O extension module. See parameter 13.03 AI1 MIN SCALE.	-100%
	-400...400%	Value in percent	-40000…40000

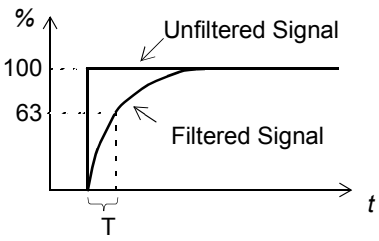
Index	Name/Selection	Description	Def FbEq
13.20	EXT AI1 MAX SCALE	Defines the %-value that corresponds to the maximum value of analogue input AI1 of analogue I/O extension module. See parameter 13.03 AI1 MIN SCALE.	100%
	-400...400%	Value in percent	-40000…40000
13.21	EXT AI1 FILT TIME	Defines the filter time constant for analogue input AI1 of analogue I/O extension module. See parameter 13.05 AI1 FILT TIME.	0.1 s
	0.00…10.00 s	Filter time constant	0...1000
13.22	EXT AI2 MIN	Defines the minimum value for analogue input AI2 of analogue I/O extension module.	-20 mA
	-20.41...20.41 mA	Current	-20410…20410
13.23	EXT AI2 MAX	Defines the maximum value for analogue input AI2 of analogue I/O extension module.	20 mA
	-20.41...20.41 mA	Current	-20410…20410
13.24	EXT AI2 MIN SCALE	Defines the %-value that corresponds to the minimum value of analogue input AI2 of analogue I/O extension module. See parameter 13.03 AI1 MIN SCALE.	-100%
	-400...400%	Value in percent	-40000…40000
13.25	EXT AI1 MAX SCALE	Defines the %-value that corresponds to the maximum value of analogue input AI2 of analogue I/O extension module. See parameter 13.03 AI1 MIN SCALE.	100%
	-400...400%	Value in percent	-40000…40000
13.26	EXT AI2 FILT TIME	Defines the filter time constant for analogue input AI2 of analogue I/O extension module. See parameter 13.10 AI2 FILT TIME.	0.1 s
	0.00…10.00 s	Filter time constant	0...1000
13.27	AI TUNE	Triggers the AI tuning function. Connect the signal to the input and select the appropriate TUNE function.	NO ACTION
	NO ACTION	AI tune is not activated.	1
	AI1 MIN TUNE	Current analogue input AI1 signal value is set as minimum value for AI1, parameter 13.01 AI1 MIN. The value reverts back to NO ACTION automatically.	2
	AI1 MAX TUNE	Current analogue input AI1 signal value is set as maximum value for AI1, parameter 13.02 AI1 MAX. The value reverts back to NO ACTION automatically.	3
	AI2 MIN TUNE	Current analogue input AI1 signal value is set as minimum value for AI2, parameter 13.06 AI2 MIN. The value reverts back to NO ACTION automatically.	4
	AI2 MAX TUNE	Current analogue input AI1 signal value is set as maximum value for AI2, parameter 13.07 AI2 MAX. The value reverts back to NO ACTION automatically.	5
	AI3 MIN TUNE	Current analogue input AI1 signal value is set as minimum value for AI3, parameter 13.11 AI3 MIN. The value reverts back to NO ACTION automatically.	6
	AI3 MAX TUNE	Current analogue input AI1 signal value is set as maximum value for AI3, parameter 13.12. The value reverts back to NO ACTION automatically.	7

Index	Name/Selection	Description	Def FbEq
	EXT AI1 MIN TUNE	Current analogue input AI1 signal value is set as minimum value for EXT AI1, parameter 13.17 AI3 MAX. The value reverts back to NO ACTION automatically.	8
	EXT AI1 MAX TUNE	Current analogue input AI1 signal value is set as maximum value for EXT AI1, parameter 13.18 EXT AI1 MAX. The value reverts back to NO ACTION automatically.	9
	EXT AI2 MIN TUNE	Current analogue input AI2 signal value is set as minimum value for EXT AI2, parameter 13.22 EXT AI2 MIN. The value reverts back to NO ACTION automatically.	10
	EXT AI2 MAX TUNE	Current analogue input AI2 signal value is set as maximum value for EXT AI2, parameter 13.23 EXT AI2 MAX. The value reverts back to NO ACTION automatically.	11
13.28	AI MIN FUNCTION	Selects how the drive reacts when an analogue input signal falls below the set minimum limit. **Note:** The analogue input minimum setting must be set to 0.5 V (1 mA) or above.	NO
	FAULT	The drive trips on a fault and the motor coasts to stop.	1
	NO	Inactive	2
	CONST SPD1	The drive generates a warning AI < MIN FUNC and sets the speed to the value defined by parameter 21.07 CONST SPEED1. **WARNING!** Make sure that it is safe to continue operation in case the analogue input signal is lost.	3
	LAST SPEED	The drive generates a warning AI < MIN FUNC and freezes the speed to the level the drive was operating at (i.e. activates Main Control Word bit 5 RAMP_HOLD). **WARNING!** Make sure that it is safe to continue operation in case the analogue input signal is lost.	4

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>Def
FbEq</th></tr>
<tr><td>13.29</td><td>AI MIN ACTIVATION</td><td>Enables and selects the analogue input signal supervision function.</td><td>0</td></tr>
<tr><td></td><td>0…3FFh (hex)</td><td>Status of analogue input supervision can be monitored with signal 06.07 AI SUP STATUS. The given value is decoded into supervision as follows:
<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>AI1<MIN</td><td>If AI1 value is below par. 13.01 AI1 MIN value, signal 06.07 bit 0 is set to one.</td></tr>
<tr><td>1</td><td>AI2<MIN</td><td>If AI2 value is below par. 13.06 AI1 MIN value, signal 06.07 bit 1 is set to one.</td></tr>
<tr><td>2</td><td>AI3<MIN</td><td>If AI3 value is below par. 13.11 AI1 MIN value, signal 06.07 bit 2 is set to one.</td></tr>
<tr><td>3</td><td>EXT AI1<MIN</td><td>If EXT AI1 value is below par. 13.17 AI1 MIN value, signal 06.07 bit 3 is set to one.</td></tr>
<tr><td>4</td><td>EXT AI2<MIN</td><td>If EXT AI2 value is below par. 13.22 AI1 MIN value, signal 06.07 bit 4 is set to one.</td></tr>
<tr><td>5</td><td>AI1< MAX</td><td>If AI1 value is below par. 13.02 AI1 MAX value, signal 06.07 bit 5 is set to 1.</td></tr>
<tr><td>6</td><td>AI2< MAX</td><td>If AI2 value is below par. 13.07 AI1 MIN value, signal 06.07 bit 6 is set to one.</td></tr>
<tr><td>7</td><td>AI3< MAX</td><td>If AI3 value is below par. 13.12 AI1 MIN value, signal 06.07 bit 7 is set to one.</td></tr>
<tr><td>8</td><td>EXT AI1< MAX</td><td>If EXT AI1 value is below par. 13.18 AI1 MIN value, signal 06.07 bit 8 is set to one.</td></tr>
<tr><td>9</td><td>EXT AI2<MAX</td><td>If EXT AI2 value is below par. 13.23 AI1 MIN value, signal 06.07 bit 9 is set to one.</td></tr>
</table>
Example: value 32 (20h) enables analogue input AI1 maximum value monitoring. Decoding:
bit number 5 0
binary value 0010 0000
decimal value $2^5 = 32$
hex value 20H

Function: AI1 < MAX</td><td>0…1023</td></tr>
<tr><td colspan="2">14 RELAY OUTPUTS</td><td>Status information indicated through relay outputs</td><td></td></tr>
<tr><td>14.01</td><td>RMIO RO1 SEL</td><td>Selects the source for status information indicated through relay output RO1.</td><td>6.16 bit 9</td></tr>
<tr><td></td><td>-255.255.31…+255.255.31</td><td>Parameter index and bit number (1…24), e.g. +01.15.01 = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).</td><td></td></tr>
<tr><td>14.02</td><td>RMIO RO2 SEL</td><td>Selects the source for status information indicated through relay output RO2.</td><td>6.16 bit 10</td></tr>
<tr><td></td><td>-255.255.31…+255.255.31</td><td>Parameter index and bit number (1…24), e.g. +01.15.01 = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).</td><td></td></tr>
<tr><td>14.03</td><td>RMIO RO3 SEL</td><td>Selects the source for status information indicated through relay output RO3.</td><td>inverted 6.01 bit 3</td></tr>
<tr><td></td><td>-255.255.31…+255.255.31</td><td>Parameter index and bit number (1…24), e.g. +01.15.01. = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).</td><td></td></tr>
<tr><td>14.04</td><td>EXT1 RO1 SEL</td><td>Selects the source for status information indicated through relay output EXT1 RO1.</td><td>0</td></tr>
</table>

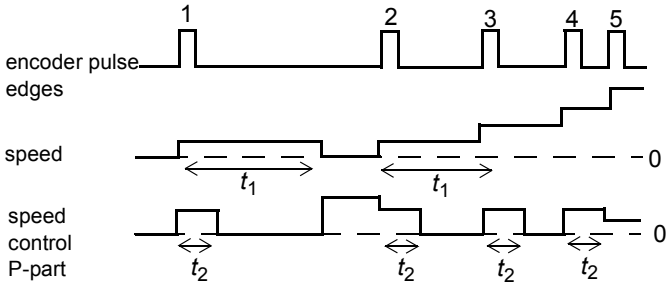
Index	Name/Selection	Description	Def FbEq
	-255.255.31…+255.255.31	Parameter index and bit number (1…24), e.g. +01.15.01. = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).	
14.05	EXT1 RO2 SEL	Selects the source for status information indicated through relay output EXT1 RO2.	0
	-255.255.31…+255.255.31	Parameter index and bit number (1…24), e.g. +01.15.01. = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).	
14.06	EXT2 RO1 SEL	Selects the source for status information indicated through relay output EXT2 RO1.	0
	-255.255.31…+255.255.31	Parameter index and bit number (1…24), e.g. +01.15.01. = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).	
14.07	EXT2 RO2 SEL	Selects the source for status information indicated through relay output EXT2 RO2.	0
	-255.255.31…+255.255.31	Parameter index and bit number (1…24), e.g. +01.15.01. = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).	
14.08	EXT3 RO1 SEL	Selects the source for status information indicated through relay output EXT3 RO1.	0
	-255.255.31…+255.255.31	Parameter index and bit number (1…24), e.g. +01.15.01. = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).	
14.09	EXT3 RO2 SEL	Selects the source for status information indicated through relay output EXT3 RO2.	0
	-255.255.31…+255.255.31	Parameter index and bit number (1…24), e.g. +01.15.01. = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).	
15 ANALOGUE OUTPUTS		Analogue output signal processing	
15.01	RMIO AO1 FUNC	Selects the analogue output AO1 signal current scaling method.	NORMAL
	NORMAL	Input signal defined by par. 15.05 RMIO AO1 MIN SCALE corresponds to output signal defined by par. 15.03 RMIO AO1 MIN.	1
	ABS	Absolute value is taken from the input signal value. Zero input signal corresponds to output signal defined by par. 15.03 RMIO AO1 MIN.	2
15.02	RMIO AO1 SEL	Selects the source or constant value for analogue output AO1.	1.03
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or constant value.	
15.03	RMIO AO1 MIN	Defines the minimum value of the analogue output signal AO1.	0 mA
	0...20 mA	Current	0…2000
15.04	RMIO AO1 MAX	Defines the maximum value of the analogue output signal AO1.	20 mA
	0...20 mA	Current	0…000
15.05	RMIO AO1 MIN SCALE	Defines the corresponding integer value of the input signal connected to analogue output AO1. The value corresponds to output signal defined by par. 15.03 RMIO AO1 MIN, if par. 15.01 RMIO AO1 FUNC value is set to NORMAL.	0
	-32768...32767	Signal value	-32768…32767

Index	Name/Selection	Description	Def FbEq
15.06	RMIO AO1 MAX SCALE	Defines the corresponding integer value of the input signal connected to analogue output AO1. The value corresponds to output signal defined by par. 15.04 RMIO AO1 MAX	20000
	-32768...32767	Signal value	-32768…32767
15.07	RMIO AO1 FILTER TIME	Defines the filter time constant for analogue output AO1.	0.1 s
	0.00…10.00 s	Filter time constant  $O = I \cdot (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant **Note:** Even if 0 s is selected as the minimum value, the signal is still filtered with a time constant of 1 ms due to the signal interface hardware. This cannot be changed by any parameters.	0…1000
15.08	RMIO AO2 FUNC	Selects the analogue output AO2 signal current scaling method.	NORMAL
	NORMAL	Input signal defined by par. 15.12 RMIO AO2 MIN SCALE corresponds to output signal defined by par. 15.10 RMIO AO2 MIN.	1
	ABS	Absolute value is taken from the input signal value. Zero input signal corresponds to output signal defined by par. 15.10 RMIO AO2 MIN.	2
15.09	RMIO AO2 SEL	Selects the source or constant value for analogue output AO2.	01.05
	-255.255.31…+255.255.31 / C.-32768…C.32767	See parameter 15.02 RMIO AO1 SEL.	
15.10	RMIO AO2 MIN	Defines the minimum value of the analogue output signal AO2.	0 mA
	0...20 mA	Current	0…2000
15.11	RMIO AO2 MAX	Defines the maximum value of the analogue output signal AO2.	20 mA
	0...20 mA	Current	0…2000
15.12	RMIO AO2 MIN SCALE	Defines the value of the input signal connected to analogue output AO2. The value corresponds to output signal defined by par. 15.10 RMIO AO2 MIN if par. 15.08 RMIO AO2 FUNC value is set to NORMAL.	0
	-32768...32767	Signal value	-32768…32767
15.13	RMIO AO2 MAX SCALE	Defines the corresponding integer value of the input signal connected to analogue output AO2. The value corresponds to output signal defined by par. 15.11 RMIO AO2 MAX.	10000
	-32768...32767	Signal value	-32768…32767
15.14	RMIO AO2 FILTER TIME	Defines the filter time constant for analogue output AO2.	0.1 s
		See parameter 15.07 RMIO AO1 FILTER TIME.	
15.15	EXT AO1 FUNC	Selects the analogue output EXT AO1 signal current scaling method.	NORMAL
	NORMAL	Input signal defined by par. 15.19 EXT AO1 MIN SCALE corresponds to output signal defined by par. 15.17 EXT AO1 MIN.	1
	ABS	Absolute value is taken from the input signal value. Zero input signal corresponds to output signal defined by par. 15.17 EXT AO1 MIN.	2
15.16	EXT AO1 SEL	Selects the source or constant value for analogue output EXT AO1.	0

Index	Name/Selection	Description	Def FbEq
	-255.255.31…+255.255.31 / C.-32768…C.32767	See parameter 15.02 RMIO AO1 SEL.	
15.17	EXT AO1 MIN	Defines the minimum value of the analogue output signal EXT AO1.	0 mA
	0...20 mA	Current	0…2000
15.18	EXT AO1 MAX	Defines the maximum value of the analogue output signal EXT AO1.	20 mA
	0...20 mA	Current	0…2000
15.19	EXT AO1 MIN SCALE	Defines the corresponding integer value of the input signal connected to analogue output EXT AO1. The value corresponds to output signal defined by par. 15.17 EXT AO1 MIN if par. 15.15 EXT AO1 FUNC value is set to NORMAL.	0
	-32768...32767	Signal value	-32768…32767
15.20	EXT AO1 MAX SCALE	Defines the corresponding integer value of the input signal connected to analogue output EXT AO1. The value corresponds to output signal defined by par. 15.18 EXT AO1 MAX.	10000
	-32768...32767	Signal value	-32768…32767
15.21	EXT AO1 FILTER TIME	Defines the filter time constant for analogue output EXT AO1.	0.1 s
		See parameter 15.07 RMIO AO1 FILTER TIME.	
15.22	EXT AO2 FUNC	Selects the analogue output EXT AO2 signal current scaling method.	NORMAL
	NORMAL	Input signal defined by par. 15.26 EXT AO2 MIN SCALE corresponds to output signal defined by par. 15.24 EXT AO2 MIN.	1
	ABS	Absolute value is taken from the input signal value. Zero input signal corresponds to output signal defined by par. 15.24 EXT AO2 MIN.	2
15.23	EXT AO2 SEL	Selects the source or constant value for analogue output EXT AO2.	0
	-255.255.31…+255.255.31 / C.-32768…C.32767	See parameter 15.02 RMIO AO1 SEL.	
15.24	EXT AO2 MIN	Defines the minimum value of the analogue output signal EXT AO2.	0 mA
	0...20 mA	Current	0…2000
15.25	EXT AO2 MAX	Defines the maximum value of the analogue output signal EXT AO2.	20 mA
	0...20 mA	Current	0…2000
15.26	EXT AO2 MIN SCALE	Defines the corresponding integer value of the input signal connected to analogue output EXT AO2. The value corresponds to output signal defined by par. 15.24 EXT AO2 MIN if par. 15.22 EXT AO2 FUNC value is set to NORMAL.	0
	-32768...32767	Signal value	-32768…32767
15.27	EXT AO2 MAX SCALE	Defines the corresponding integer value of the input signal connected to analogue output EXT AO2. The value corresponds to output signal defined by par. 15.25 EXT AO2 MAX.	10000
	-32768...32767	Signal value	-32768…32767
15.28	EXT AO2 FILTER TIME	Defines the filter time constant for analogue output EXT AO2.	0.1 s
		See parameter 15.07 RMIO AO1 FILTER TIME.	
16 SYSTEM CONTROL INPUTS		Run Enable, parameter lock etc.	
16.01	PARAMETER LOCK	Selects the state of the parameter lock. The lock prevents parameter changing.	OPEN
	OPEN	The lock is open. Parameter values can be changed.	0

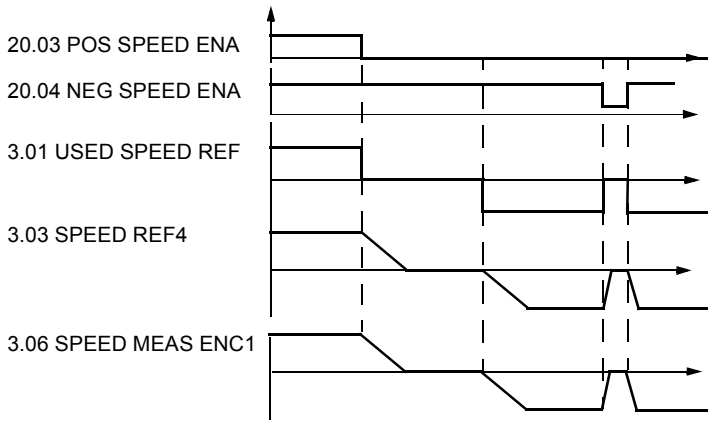
Index	Name/Selection	Description	Def FbEq
	LOCKED	Locked. Parameter values cannot be changed from the control panel. The lock can be opened by entering the valid code to parameter 16.02 PASS CODE.	65535
16.02	PASS CODE	Selects the pass code for the parameter lock (see parameter 16.01 PARAMETER LOCK).	0
	0…30000	Setting 358 opens the lock. The value reverts back to 0 automatically.	0…30000
16.03	USER MACRO IO CHG	Selects the User Macro or enables the change of the User Macro through a digital input. See parameter 99.02 APPLICATION MACRO. The change is only allowed when the drive is stopped. During the change, the drive will not start. 0 = User Macro 1 1 = User Macro 2 **Note:** Always save the User Macro by parameter 99.02 after changing any parameter settings, or re-performing the motor identification. The last settings saved by the user are loaded into use whenever the power is switched off and on again or the macro is changed. Any unsaved changes will be lost. **Note:** The value of this parameter is not included in the User Macro. A setting once made remains despite the User Macro change.	FALSE
	FALSE	User Macro 1 (USER1)	1
	TRUE	User Macro 2 (USER2)	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25

Index	Name/Selection	Description	Def FbEq
16.04	LOCAL LOCK	Disables entering local control mode (***LOC/REM*** key of the panel). **WARNING!** Before activating, ensure that the control panel is not needed for stopping the drive!	FALSE
	OFF	Local control allowed.	0
	ON	Local control disabled.	65535
16.05	PARAM SAVE	Saves the valid parameter values to the permanent memory. **Note:** A new parameter value of a standard macro is saved automatically when changed from the panel but not when altered through a fieldbus connection.	DONE
	DONE	Saving completed	0
	SAVE	Saving in progress	1
16.06	CONTRL BOARD SUPPLY	Defines the source of the control board power supply. **Note:** If an external supply is used but this parameter has value INTERNAL, the drive trips to a fault at power switch off.	INTERNAL 24 V
	INTERNAL 24V	Internal (default)	1
	EXTERNAL 24V	External. The control board is powered from an external supply.	2
19 SIGNAL CALC		Speed and encoder functions. For more information, see chapter *Motion control features*, *Encoder*.	
19.01	SPEED SCALING	Defines the speed reference and actual signal values that correspond to integer value 20000 in the control program. See chapter *Basic program features*, *Analogue input signal conversion to a speed value in rpm*. -20000...20000 $\hat{=}$ -SPEED SCALE...SPEED SCALE	1500 rpm
	0...100000 rpm	Speed scaling value	0…1000000
19.02	SPEED FB SEL	Defines the speed feedback value used in control.	ENCODER
	INTERNAL	Calculated speed estimate	65535
	ENCODER	Actual speed measured with encoder module. The encoder module is selected with parameter 50.01 ENCODER MODULE1.	0
19.03	SPEED ACT FILT TIM	Defines the time constant of the actual speed filter, i.e. time within the actual speed has reached 63% of the nominal speed. (Filtered speed = 03.04 MOTOR SPEED)	8 ms
	0...1000000 ms	Time constant	1 = 1ms
19.04	SLIP GAIN	Defines the slip gain for the motor slip compensation control. 100% means full slip compensation; 0% means no slip compensation. The default value is 100%. Other values can be used if a static speed error is detected despite of the full slip compensation. Example: 1000 rpm constant speed reference is given to the drive. Despite of the full slip compensation (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 106% gain value, no static speed error exists.	100%
	0.0...400.0%	Slip gain	0...400

Index	Name/Selection	Description	Def FbEq
19.05	ZERO DETECT DELAY	Defines the time the speed controller saves the last reference value. This parameter can be adjusted for the best possible performance at low speeds when a pulse encoder is used. The definition of low speed depends on the type of the encoder in use. If the encoder pulse number is 2048 and both edges of both of the channels (A and B) are counted, the number of pulses per revolution is 8192. This means that at least one pulse per millisecond is received at 7.3 rpm (1 pulse / ms => 1000 pulses/s => 1000/8192 rev/s = 7.3 rpm) Thus 4 ms between pulses corresponds to 1.8 rpm and 80 ms to 0.09 rpm. Example: Pulse 1: After receiving a pulse, speed is calculated and proportional part of the speed controller (P-part) is set to a value related to the speed error. When no new pulses are received within 1 ms, the measured speed and P-part due to the constant speed reference stay unchanged. After the 19.06 SPEED HOLD TIME, the P-part is forced to zero so that speed control will not be based on absolute speed measurement value. After ZERO DETECT DELAY, it is assumed that speed is zero: measured speed is cleared and the use of P-part is allowed. Pulse 2: After the next pulse, speed is calculated again and the P-part is set accordingly. P-part is forced to zero after SPEED HOLD TIME. Speed is not set to zero any more, because a new pulse comes before time defined by ZERO DETECT DELAY has elapsed. Pulse 3: The time between pulses 3 and 4 is longer than SPEED HOLD TIME and P-part is forced to zero. Pulse 4: The time between pulses 4 and 5 is so short that neither P-part nor the measured speed is forced to zero.  t_1 = ZERO DETECT DELAY = 250 ms t_2 = SPEED HOLD TIME = 4 ms A long ZERO DETECT DELAY time gives accurate speed measurement. Short SPEED HOLD TIME keeps the speed control stable, because speed control output is not influenced by the earlier speed measurement sample. If the value of the P-part is very large, forcing it to zero causes undesirable torque steps. The tuning values depend on the mechanics. Therefore after increasing these parameter values, check that the actual torque value is still smooth.	250 ms
	1...2000 ms	Zero detect delay time	1…2000

Index	Name/Selection	Description	Def FbEq
19.06	SPEED HOLD TIME	Defines the time delay for the proportional part of the speed controller. After the time has elapsed and no encoder pulses have been received, the P-part is forced to zero. When Speed Hold Time is increased, the effect of the P-part at low frequencies is amplified due to the longer effect time of the P-part. Oscillation can occur, if the time set is too long. See 19.05 ZERO DETECT DELAY. **Note:** The value of SPEED HOLD TIME ≤ ZERO DETECT DELAY.	4 ms
	1…par. 19.05 ms	Speed hold time	1…par. 19.05 ms
19.07	MOTOR GEAR NUM	Defines the motor gear numerator for the Motor Encoder Gear function $\frac{\text{19.07 MOTOR GEAR NUM}}{\text{19.08 MOTOR GEAR DEN}} = \frac{\text{MOTOR SPEED}}{\text{ENCODER 1 SPEED}}$	1
	-32 768...32767	Numerator **Note:** A setting of 0 is changed internally to 1.	1 = 1
19.08	MOTOR GEAR DEN	Defines the motor gear denominator for the motor encoder gear function. See parameter 19.07 MOTOR GEAR NUM.	1
	1...32767	Denominator	1 = 1
19.09	LOAD GEAR NUM	Defines the load gear numerator for the Load Encoder Gear function $\frac{\text{19.09 LOAD GEAR NUM}}{\text{19.10 LOAD GEAR DEN}} = \frac{\text{LOAD SPEED}}{\text{ENCODER 1 SPEED}}$	1
	-32 768...32767	Numerator	1 = 1
19.10	LOAD GEAR DEN	Defines the load gear denominator for the Load Encoder Gear function. See parameter 19.09 LOAD GEAR DEN.	1
	1...32767	Denominator	1 = 1
19.11	POS ACT SEL	Selects the source for the actual position value.	ENCODER 1
	ENC1	Encoder 1. Load Encoder Gear function is applied.	0
	ENC2	Encoder 2. Load Encoder Gear function is not applied. Inverted gear ratio is considered when the position control output (speed reference) is produced).	1
19.12	POSITION FORMAT	Selects the positioning.	LINEAR AXIS
	LINEAR AXIS	Linear motion. Positioning is between the minimum position 42.02 POSITION MIN and the maximum position 42.01 POSITION MAX.	0
	ROLLOVER AXIS	Rotating motion. Positioning is between 0 and 1 revolutions, i.e. after 360°, the position calculation starts from 0° again.	65535
19.13	POS UNIT	Defines the unit and scaling for the position parameters. (The scaling factor is equal to one revolution.) **Note:** If translatory (mm, inch) unit is selected, the range also depends on parameter 19.14 FEED CONSTANT selection.	REVOLUTION
	REVOLUTION	Unit: revolution. Scaling factor: 1	0
	DEGREE	Unit: degree. Scaling factor: 360	1
	INCREMENTAL	Scaling factor: 65536, i.e. unscaled position information	2
	MILLIMETER	Unit: millimeter. Scaling factor: according to parameter 19.14 FEED CONSTANT	3
	INCH	Unit: inch. Scaling factor: according to parameter 19.14 FEED CONSTANT	4

Index	Name/Selection	Description	Def FbEq
19.14	FEED CONSTANT	Defines the feed constant which converts rotational motion into translatory motion. The feed constant is the distance the load moves during one turn of the motor shaft (2πr), when linear positioning has been selected with 19.13 POS UNIT (i.e. parameter is set to MILLIMETER or INCH). **Note:** Parameters 19.13 POS UNIT and 19.14 FEED CONSTANT also affect the positioning parameters. If the feed constant is changed, positioning references are re-calculated and the limits are changed. However, the internal motor shaft references remain unchanged.	1 rev
	0...1000000 mm or inch / rev	Feed constant	
19.15	POSITION SCALING	Scales a position value to an integer value. Integer values are used in the control program and Fieldbus communication.	1000
	0...16777216	Example: If 19.15 POSITION SCALING is set to 100 and 19.13 POS UNIT is set to MILLIMETER, integer value of 30000 corresponds to position value of 300 mm.	0...16777216
19.16	MOTOR SP FILT TIM	Defines the filter time constant for the actual speed (01.03 SPEED).	500 ms
	2...20000 ms	Filter time constant	2...20000
19.17	TORQ ACT FILT TIM	Defines the filter time constant for the actual torque (01.06 TORQUE).	100 ms
	2...20000 ms	Filter time constant	2...20000
19.18	ACT POS OFFSET	Defines the offset for the actual position.	0
	See par. 19.13.	Offset	See par. 19.15.
20 LIMITS		Drive operation limits	
20.01	MIN SPEED	Defines the allowed minimum speed. **Note:** The limit is linked to the motor nominal speed setting i.e. parameter 99.05 MOTOR NOM FREQ. If 99.05 is changed, the default speed limit will also change.	
	-18000 / (no. of pole pairs) … par. 20.02 rpm	Minimum speed limit **Note:** If the value is positive, the motor cannot be run in the reverse direction.	1 = 1 rpm
20.02	MAX SPEED	Defines the allowed maximum speed. **Note:** The limit is linked to the motor nominal speed setting i.e. parameter 99.05 MOTOR NOM FREQ. If 99.05 is changed, the default speed limit will also change.	
	par. 20.01…18000 / (no. of pole pairs) rpm	Maximum speed limit	1 = 1 rpm

Index	Name/Selection	Description	Def FbEq
20.03	POS SPEED ENA	Enables the positive speed reference or selects the source of the positive speed reference enable command. 1 = Positive speed reference is enabled. 0 = Positive speed reference is interpreted as zero speed reference (In the figure below SPEED REF 4 is ramped 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 according to 22.03 DECEL TIME 1 Torque Control: Torque limit is set to zero. Position and synchron control: Dynamic limiter sets the positioning speed reference to zero and the motor is stopped according to 42.07 POS DEC MAX.  	TRUE
	FALSE	Positive speed reference disabled, interpreted as zero speed reference	1
	TRUE	Positive speed reference enabled	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21

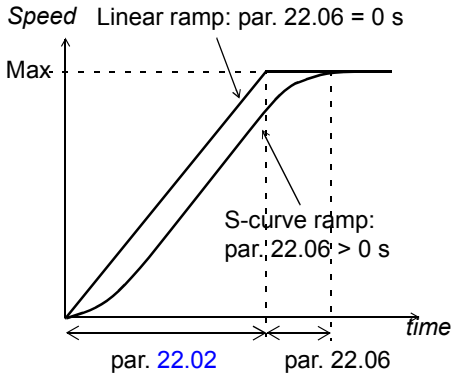
Index	Name/Selection	Description	Def FbEq
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
20.04	NEG SPEED ENA	Enables the negative speed reference or selects the source of the negative speed reference enable command. See parameter 20.03 POS SPEED ENA.	TRUE
		See parameter 20.03 POS SPEED ENA.	
20.05	MAX CURRENT	Defines the allowed maximum motor current.	
	0.0…I_{max} A	Current limit	0…100·I_{max}
20.06	TORQ LIM SEL	Selects the minimum and maximum torque limits. 0 = Torque limits according to parameter 20.07 TORQ MAX LIM1 and 20.08 TORQ MIN LIM1 values 1 = Torque limits are according to parameter 20.09 TORQ MAX LIM2 and 20.10 TORQ MIN LIM2 values	FALSE
	FALSE	Torque limit 1 (T LIM1) according to parameters 20.07 and 20.08	1
	TRUE	Torque limit 2 (T LIM2) according to parameters 20.09 and 20.10	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
20.07	TORQ MAX LIM1	Defines the maximum torque limit 1 for the drive.	300%
	0.0…600.0%	Value of limit in percent of the motor nominal torque.	0…60000

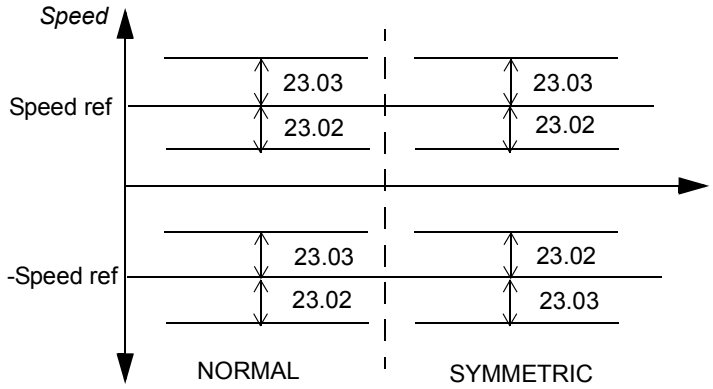
Index	Name/Selection	Description	Def FbEq
20.08	TORQ MIN LIM1	Defines the minimum torque limit 1 for the drive.	-300%
	-600.0…0.0%	Value of limit in percent of the motor nominal torque.	-60000…0
20.09	TORQ MAX LIM2	Selects the source or constant value for maximum torque limit 2.	0
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or constant value	
20.10	TORQ MIN LIM2	Selects the source or constant value for minimum torque limit 2.	0
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or constant value	
20.11	P MOTORING LIM	Defines the allowed maximum power fed by the inverter to the motor.	300%
	0 … 600%	Power limit in percent of the motor nominal power.	0…60000
20.12	P GENER LIM	Defines the allowed maximum power fed by the motor to the inverter.	-300%
	-600…0%	Power limit in percent of the motor nominal power	-60000…0
20.13	OVERVOLTAGE CTRL	Activates or deactivates 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 a brake chopper and resistor are connected to the drive, the controller must be off (selection NO) to allow chopper operation.	ON
	OFF	Overvoltage control deactivated	0
	ON	Overvoltage control activated	65535
20.14	UNDERVOLTAGE CTRL	Activates or deactivates 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 speed in order to keep the voltage above the lower limit. By decreasing the motor speed, the inertia of the load will cause regeneration back into the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to stop. This will act as a power-loss ride-through functionality in systems with a high inertia, such as a centrifuge or a fan.	ON
	OFF	Undervoltage control deactivated	0
	ON	Undervoltage control activated	65535
21 SPEED REFERENCE		Speed reference selection. For the selection logic, see chapter *Motion control features*, *Speed control mode - reference selection*.	
21.01	SPEED FUNC	Selects the speed reference.	REF1
	REF1	Speed reference 1. See parameter 21.02. SPEED REF1	0
	REF2	Speed reference 2. See parameter 21.03. SPEED REF2	1
	REF1 + REF2	Sum of speed references 1 and 2	2
21.02	SPEED REF1	Selects the source for speed reference 1. See parameter 21.01 SPEED FUNC.	AI1
	NOT SEL	Not selected	0
	AI1	Analogue input 1	1
	AI2	Analogue input 2	2
	AI3	Analogue input 3	3
	EXT AI1	Analogue input 1 of AI/O extension module 1	4

Index	Name/Selection	Description	Def FbEq
	EXT AI 2	Analogue input 2 of AI/O extension module 1	5
	MAIN DS REF1	Main dataset reference 1	6
	MAIN DS REF2	Main dataset reference 2	7
	AUX DS REF1	Auxiliary dataset reference 1	8
	AUX DS REF2	Auxiliary dataset reference 2	9
	AUX DS REF3	Auxiliary dataset reference 3	10
	M/F REF1	Master/Follower link reference 1	11
	M/F REF2	Master/Follower link reference 2	12
	MEASURED SPEED	03.06 SPEED MEAS ENC1	13
	ENC2	03.07 SPEED MEAS ENC2	14
	ENC2 SYNC GEAR	03.15 SYNCRON VELOC REF	15
21.03	SPEED REF2	Selects the source for speed reference 2. See parameter 21.01 SPEED FUNC.	NOT SEL
		See 21.02 SPEED REF1.	
21.04	SPEED REF3	Selects the source for speed reference 3. See chapter *Motion control features, Speed control mode - reference selection*.	NOT SEL
		See 21.02 SPEED REF1.	
21.05	SPEED REF SEL1	Selects with parameter 21.06 SPEED REF SEL2 the speed reference or the source from which the drive reads the signal that selects between speed reference 1, 2 or 3. See *Motion control features*, *Speed control mode - reference selection*.	NOT SEL
	FALSE	See *Motion control features*, *Speed control mode - reference selection*.	1
	TRUE	See *Motion control features*, *Speed control mode - reference selection*.	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21

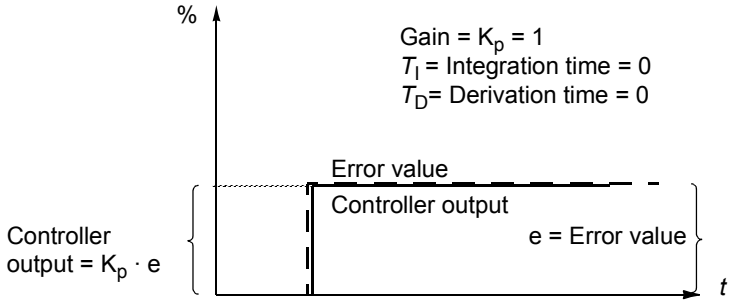
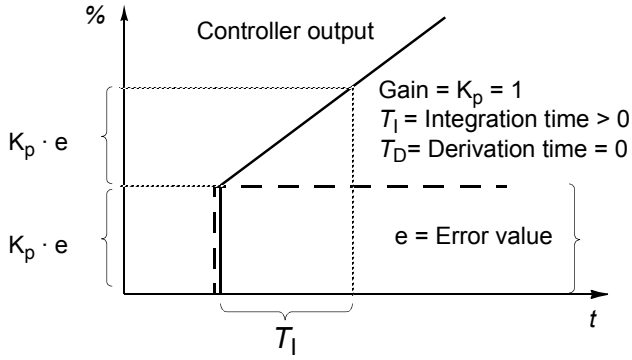
Index	Name/Selection	Description	Def FbEq
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
21.06	SPEED REF SEL2	Selects with parameter 21.05 SPEED REF SEL1 the source from which the drive reads the signal that selects between speed reference, 1, 2 or 3. See parameter 21.05.	FALSE
		See parameter 21.05.	
21.07	CONST SPEED1	Defines the constant speed reference 1. See *Speed control mode - reference selection.*	0 rpm
	-18000 / (no. of polepairs)... 18000 rpm / (no. of polepairs)	Setting range	20000 = par. 19.01
21.08	CONST SPEED2	Defines the constant speed reference 2. See *Speed control mode - reference selection.*	0 rpm
	-18000 / (no. of polepairs)... 18000 rpm / (no. of polepairs)	Setting range	20000 = par. 19.01
21.09	SPEED REF NEG SEL	Activates/inactivates the speed reference inversion or selects the source for the speed reference inversion. 1 = Sign of the speed reference is changed (inversion active)	FALSE
	FALSE	Speed reference inversion is inactive.	1
	TRUE	Speed reference inversion is active. Sign of the external speed reference is changed.	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22

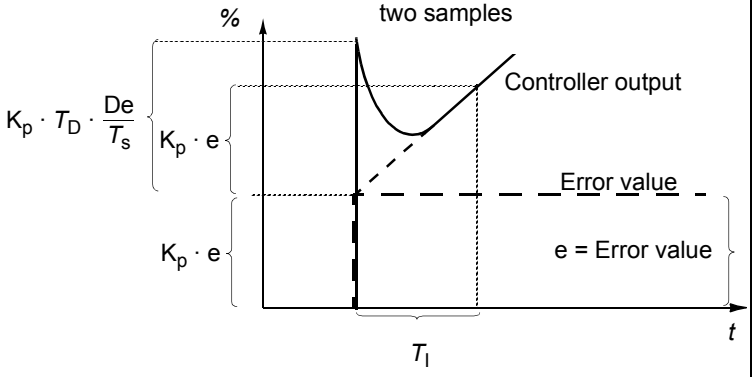
Index	Name/Selection	Description	Def FbEq
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
22 ACCEL/DECEL		Acceleration and deceleration times	
22.01	ACC/DEC SEL	Selects the source for acceleration/deceleration times. 0 = Acceleration time 1 and deceleration time 1 according to parameters 22.02 ACCEL TIME1 and 22.03 DECEL TIME1 1 = Acceleration time 2 and deceleration time 2 according to parameters 22.04 ACCEL TIME2 and 22.05 DECEL TIME2	FALSE
	FALSE	Acceleration time 1 and deceleration time 1 according to parameters 22.02 and 22.03	1
	TRUE	Acceleration time 2 and deceleration time 2 according to parameters 22.04 and 22.05	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
22.02	ACCEL TIME1	Defines the acceleration time 1 i.e. the time required for the speed to change from zero to the maximum speed. - If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. - If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference signal. - If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive operating limits.	3 s

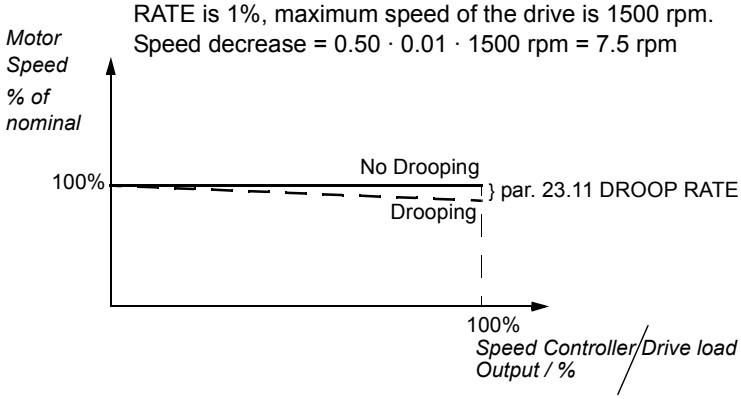
Index	Name/Selection	Description	Def FbEq
	0.00…1800.00 s	Acceleration time	0…18000
22.03	DECEL TIME1	Defines the deceleration time 1 i.e. the time required for the speed to change from the maximum (see parameter 22.02 ACCEL TIME1) to zero. - If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference signal. - If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. - If the deceleration time is set too short, the drive will automatically prolong the deceleration in order not to exceed drive operating limits. If there is any doubt about the deceleration time being too short, ensure that the DC overvoltage control is on (parameter 22.05 DECEL TIME2). **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with an electric braking option e.g. with a brake chopper and a brake resistor.	3 s
	0.00…1800.00 s	Deceleration time	0…18000
22.04	ACCEL TIME2	Defines the source or constant for acceleration time 2.	0
	-255.255.31…+255.255.31 / C.-32768 … C.32767	Parameter index or a constant value	
22.05	DECEL TIME2	Defines the source or constant for deceleration time 2.	0
	-255.255.31…+255.255.31 / C.-32768 … C.32767	Parameter index or a constant value	
22.06	RAMP SHAPE TIME	Selects the shape of the acceleration/deceleration ramp.	0 s
	0.00…1000.00 s	0.00 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.01…1000.00 s: S-curve ramp. S-curve ramps are ideal for conveyors carrying fragile loads, or other applications where a smooth transition is required when changing from one speed to another. The S curve consists of symmetrical curves at both ends of the ramp and a linear part in between. **A rule of thumb** A suitable relation between the ramp shape time and the acceleration ramp time is 1/5. 	0…100000

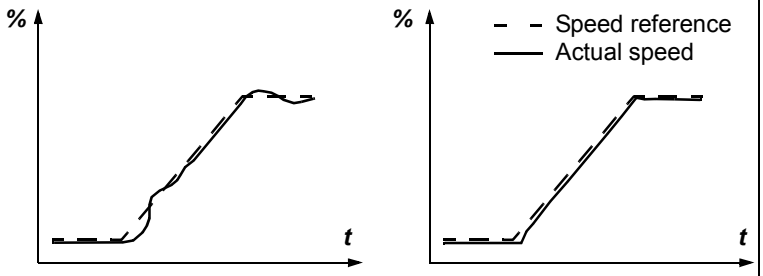
Index	Name/Selection	Description	Def FbEq
22.07	OFF3 RAMP TIME	Defines the OFF3 RAMP TIME i.e. the time required for the speed to change from the maximum to zero. OFF3 RAMP TIME is used if - the drive receives an emergency stop command or - the Run Enable signal is switched off and the Run Enable function has value OFF3 (see parameter 10.08 RUN ENABLE FUNC). The emergency stop command can be given through a fieldbus. Consult the local ABB representative for more information on the optional module and the related settings of the Motion Control Application Program.	3 s
	0.00…2000.00 s	Deceleration time	0…200000
23 SPEED CTRL		Window control and speed controller variables	
23.01	WINDOW CTRL FUNC	Defines and selects the window control function. The Window control, together with selection ADD at parameter 11.02 EXT1 CONTROL MODE / 11.03 EXT2 CONTROL MODE, forms a speed supervision function for a torque controlled drive. Window control 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 exceeds the value of parameter 23.02 WINDOW WIDTH POS or - the absolute value of the negative speed error exceeds the value of parameter 23.03 WINDOW WIDTH NEG. 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 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 inactivate, the motor speed would rise until a speed limit of the drive is reached.  	NO
	NO	Inactive	0
	NORMAL	Active. Speed error is calculated using the signed speed values.	1

Index	Name/Selection	Description	Def FbEq
	SYMMETRIC	Symmetric window control. Speed error is calculated from the absolute value of the speed instead of the signed value. Thus window width functions are symmetric for both directions of rotation. Parameter 23.03 WINDOW WIDTH NEG functions as WINDOW WIDTH OVERSPEED and 23.02 WINDOW WIDTH POS as WINDOW WIDTH UNDERSPEED.	2
23.02	WINDOW WIDTH POS	Defines the supervision window width above the speed reference. See parameter 23.01 WINDOW CTRL FUNC.	0 rpm
	0...par. 99.06	Window width	See par. 19.01
23.03	WINDOW WIDTH NEG	Defines the supervision window width below the speed reference. See parameter 23.01 WINDOW CTRL FUNC.	0 rpm
	0...par. 99.06	Window width	See par. 19.01
23.04	PI PAR 1/2 SEL	Selects the PI control parameters or the source from which the drive reads the signal that selects between PI controller parameter sets. 0 = PI control according to parameters 23.05...23.07 1 = PI control according to parameters 23.08...23.10	FALSE
	FALSE	PI control according to parameters 23.05...23.07	1
	TRUE	PI control according to parameters 23.08...23.10	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25

Index	Name/Selection	Description	Def FbEq
23.05	GAIN1	Defines a relative gain for the speed controller. Great gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant. 	10
	0.0…250.0	Gain	0…25000
23.06	INTEGRATION TIME1	Defines an integration time for the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant. The shorter the integration time, the faster the continuous error value is corrected. Too short an integration time makes the control unstable. The figure below shows the speed controller output after an error step when the error remains constant. 	2.5 s
	0.01…999.97 s	Integration time	10…999970

Index	Name/Selection	Description	Def FbEq
23.07	DERIVATION TIME1	Defines the derivation time for 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. **Note:** Changing this parameter is recommended only if a pulse encoder is used. 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 = 1 ms Δe = Error value change between two samples 	0 ms
	0.0…9999.8 ms	Derivation time	1 = 1 ms
23.08	GAIN2	See parameter 23.05 GAIN1.	10
		See parameter 23.05 GAIN1.	
23.09	INTEGRATION TIME2	See parameter 23.06 NTEGRATION TIME1.	2.5 s
		See parameter 23.06 NTEGRATION TIME1.	
23.10	DERIVATION TIME2	See parameter 23.07 DERIVATION TIME1.	0 ms
		See parameter 23.07 DERIVATION TIME1.	

Index	Name/Selection	Description	Def FbEq
23.11	DROOP RATE	Defines the droop rate. The parameter value needs to be changed only if both the master and the follower are speed-controlled: - External control location 1 (EXT1) is selected (see par. group 11 CONTROL PLACES or - External control location 2 (EXT2) is selected (see par. group 11 CONTROL PLACES. The droop rate needs to be set both for the master and the follower. The correct droop rate for a process must be found out case by case in practice. The drooping prevents a conflict between the master and the follower by allowing a slight speed difference between them. The drooping slightly decreases the drive speed 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 the DROOP RATE. The drooping effect decreases linearly to zero along with the decreasing load. **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  	0%
	0...100%	Droop rate in percent of the motor nominal speed	

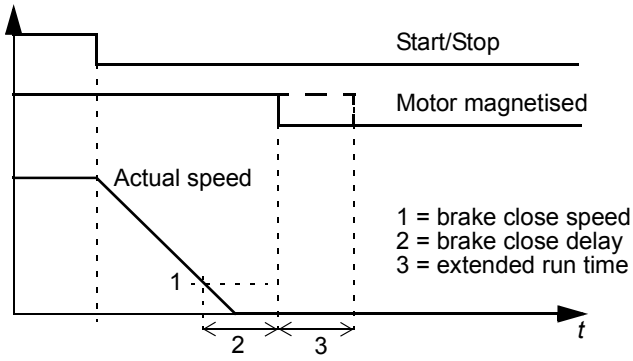
Index	Name/Selection	Description	Def FbEq
23.12	ACC COMPENSATION	Defines the derivation time for acceleration/(deceleration) compensation. In order to compensate inertia during acceleration a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described for parameter 23.07 DERIVATION TIME1. **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 speed controller PI tune does this automatically, see parameter 23.13.) The figure below shows the speed responses when a high inertia load is accelerated along a ramp. **No Acceleration Compensation** **Acceleration Compensation** 	0 s
	0.00…999.98 s	Derivation time	0...9999
23.13	PI TUNE	Start automatic tuning of the speed controller. Instructions: - Run the motor at a constant speed of 20 to 40% of the rated speed. - Change the autotuning parameter 23.13 to YES. **Note:** The motor load must be connected to the motor.	NO
	NO	No PI tune	0
	YES	Activates the speed controller PI tuning. Automatically reverts to NO.	65535
24 TORQUE CONTROL			
24.01	TORQ REF FUNC	Selects the torque reference.	REF1
	REF1	Torque reference 1. See parameter 24.02 TORQ REF1.	
	REF2	Torque reference 2. See parameter 24.03 TORQ REF2.	
	REF1 + REF2	Sum of torque reference 1 and 2.	
24.02	TORQ REF1	Defines the source for torque reference 1. Dataset integer value 100 corresponds to 1% motor nominal torque.	AI2
	NOT SEL	Not selected	0
	AI1	Analogue input 1	1
	AI2	Analogue input 2	2
	AI3	Analogue input 3	3
	EXT AI1	Analogue input 1 of AI/O extension module 1	4
	EXT AI 2	Analogue input 2 of AI/O extension module 1	5
	MAIN DS REF1	Main dataset reference 1	6
	MAIN DS REF 2	Main dataset reference 2	7
	AUX DS REF1	Auxiliary dataset reference 1	8
	AUX DS REF2	Auxiliary dataset reference 2	9

Index	Name/Selection	Description	Def FbEq
	AUX DS REF3	Auxiliary dataset reference 3	10
	M/F REF1	Master/Follower link reference 1	11
	M/F REF2	Master/Follower link reference 2	12
24.03	TORQ REF2	Defines the source for torque reference 2.	NOT SEL
		See 24.02 TORQ REF1.	
24.04	TORQ REF NEG SEL	Activates the torque reference inversion or selects the source for torque reference inversion. 1 = Sign of the torque reference is changed.	FALSE
	FALSE	Torque reference inversion is inactive.	1
	TRUE	Sign of the torque reference is changed.	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
24.05	TORQ RAMP UP	Defines the torque reference ramp up time.	0.002 s
	0.00…120.00 s	Time for the reference to increase from zero to the nominal motor torque.	0…12000
24.06	TORQ RAMP DOWN	Defines the torque reference ramp down time.	0.002 s
	0.00…120.00 s	Time for the reference to decrease from the nominal motor torque to zero.	0…12000

Index	Name/Selection	Description	Def FbEq
26 MOTOR CONTROL			
26.01	FLUX OPTIMIZATION	Activates/deactivates the flux optimisation function. This function can be used to minimise motor losses and torque ripple with partial load. The disadvantage of this function is that the dynamic performance of the drive is weakened.	NO
	NO	Inactive	0
	YES	Active	65535
26.02	FLUX BRAKING	Activates/deactivates the flux braking function.	YES
	NO	Inactive	0
	YES	Active	65535
26.03	HEX FIELDWEAKENING	Selects whether motor flux is controlled along a circular or a hexagonal pattern in the field weakening area of the frequency range (above 50/60 Hz).	OFF
	OFF	The rotating flux vector follows a circular pattern. Optimal selection in most applications: Minimal losses at constant load. Maximal instantaneous torque is not available in the field weakening range of the speed.	0
	ON	Motor flux follows a circular pattern below the field weakening point (typically 50 or 60 Hz) and a hexagonal pattern in the field weakening range. Optimal selection in the applications that require maximal instantaneous torque in the field weakening range of the speed. The losses at constant operation are higher than with the selection OFF.	65535
26.04	FLUX REF PTR	Selects the source for the flux reference, or sets the flux reference value.	C.10000
	-255.255.31…+255.255.31 / C.- 32768 … C.32767	Parameter index or a constant value. See parameter 10.04 EXT2 START FUNC for information on the difference. The range of the flux is 25…140%. With constant value settings 100% = C.10000. Typically there is no need to change this value.	100 = 1%
26.05	TR TUNE	Affects the calculated rotor time constant. This parameter is used if the nominal speed of the motor rating plate does not correspond the real speed. For example, if the real slip speed is 10% higher than the calculated slip speed stated on the motor rating plate, a coefficient value of 10% is set into this parameter. **Note:** This parameter is effective only when a pulse encoder is used.	0%
	-60…200%	Rotor time constant	-60…200
27 BRAKE CHOPPER		Control of the brake chopper	
27.01	BRAKE CHOPPER CTL	Activates the brake chopper control.	OFF
	OFF	Inactive	0
	ON	Active. **Note:** Ensure the brake chopper and resistor are installed and the overvoltage control is switched off (parameter 20.13 OVERVOLTAGE CTRL).	65535
27.02	BR OVERLOAD FUNC	Activates the overload protection of the brake resistor. The user-adjustable variables are parameters 27.04 BR THERM TCONST and 27.05 MAX CONT BR POWER.	NO
	NO	Inactive	0
	WARNING	Active. If the drive detects an overload, it generates a warning.	1
	FAULT	Active. If the drive detects an overload, it trips on a fault.	2

Index	Name/Selection	Description	Def FbEq
27.03	BR RESISTANCE	Defines the resistance value of the brake resistor. The value is used for brake chopper protection.	100 ohm
	0.00…100.00 ohm	Resistance value	0…100
27.04	BR THERM TCONST	Defines the thermal time constant of the brake resistor. The value is used in the overload protection. See parameter 27.02 BR OVERLOAD FUNC.	0 s
	0.000…10000.000 s	Time constant	1 = 1
27.05		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. See parameter 27.02 BR OVERLOAD FUNC.	0 kW
	0.00…10000 kW	Power	1 = 1
27.06	BC CTRL MODE	Selects the control mode of the braking chopper.	COMMON DC
	AS GENERATOR	Chopper operation is allowed when the DC voltage exceeds the braking limit, the inverter bridge modulates and the motor generates power to the drive. The selection prevents the operation in case the intermediate circuit DC voltage rises due to abnormally high supply voltage level. Long time supply voltage rise would damage the chopper.	0
	COMMON DC	Chopper operation is allowed always when the DC voltage exceeds the braking limit. The selection is to be used in applications where several inverters are connected to the same intermediate circuit (DC bus). **WARNING!** Excessive supply voltage will raise the intermediate circuit voltage above the operation limit of the chopper. If the voltage remains abnormally high for a long period, the braking chopper will be overloaded and damaged.	65535
28 BRAKE CTRL		Control of a mechanical brake. The function operates on a 100 ms time level. For the function description, see chapter *Basic program features*, *Control of a mechanical brake.*	
28.01	BRAKE CTRL	Activates the brake control function.	OFF
	OFF	Inactive	1
	ON	Active	2
28.02	BRAKE ACKNOWLEDGE	Activates the external brake on/off supervision and selects the source for the signal. The use of the external on/off supervision signal is optional.	OFF
	OFF	Inactive	1
	DI5	Active. Digital input DI5 is the signal source. DI5 = 1: The brake is open. DI5 = 0: the brake is closed.	2
	DI6	See selection DI5.	3
	EXT M3 DI1	See selection DI5.	4
	EXT M3 DI2	See selection DI5.	5
28.03	BRAKE OPEN DELAY	Defines the brake open delay (= the delay between the internal open brake command and the release of the motor speed control). The delay counter starts when the drive has magnetised the motor and risen the motor torque to the level required at the brake release (parameters 28.07 START TORQ REF SEL and 28.08 START TORQ REF). Simultaneously with the counter start, the brake function energises the relay output controlling the brake and the brake starts opening.	0 s

Index	Name/Selection	Description	Def FbEq
	0.0…5.0 s	Delay time. Set the delay the same as the mechanical opening delay of the brake specified the brake manufacturer.	0…500
28.04	BRAKE CLOSE DELAY	Defines the brake close delay. The delay counter starts when the motor actual speed has fallen below the set level (parameter 28.05 ABS BRAKE CLS SPD) after the drive has received the stop command. Simultaneously with the counter start, the brake control function de-energises the relay output controlling the brake and the brake starts closing. During the delay, the brake function keeps the motor live preventing the motor speed from falling below zero.	0 s
	0.0…60.0 s	Delay time. Set the delay time to the same value as the mechanical make-up time of the brake (= operating delay when closing) specified by the brake manufacturer.	0…6000
28.05	ABS BRAKE CLS SPD	Defines the brake close speed. See parameter 28.04 BRAKE CLOSE DELAY.	10 rpm
	0…1000 rpm	Speed (an absolute value)	0…100000
28.06	BRAKE FAULT FUNC	Defines how the drive reacts in case the status of the optional external brake acknowledgement signal does not meet the status presumed by the brake control function.	FAULT
	FAULT	The drive trips on a fault: fault indication and drive stops the motor.	1
	WARNING	The drive generates a warning.	2
28.07	START TORQ REF SEL	Selects the source for the motor starting torque reference applied at the brake release. The value is read in percent of the motor nominal torque.	NO
	NO	No source selected	1
	AI1	Analogue input AI1	2
	AI2	Analogue input AI2	3
	AI3	Analogue input AI3	4
	AI5	Analogue input AI5	5
	AI6	Analogue input AI6	6
	PAR 28.08	Defined by parameter 28.08 START TORQ REF	7
	MEMORY	The motor torque stored at the previous brake close command	8
28.08	START TORQ REF	Defines the motor starting torque at brake release if parameter 28.07 START TORQ REF SEL is set to PAR 40.28.	0%
	-300…300%	Torque value in percent of the motor nominal torque	-30000…30000
28.09	EXTEND RUN T	Defines an extended run time for the brake control function at stop. During the delay, the motor is kept magnetised and ready for an immediate restart.	0 s

Index	Name/Selection	Description	Def FbEq
	0.0…60.0 s	0.0 s = Normal stop routine of the brake control function: The motor magnetisation is switched off after the brake close delay has passed. 0.1 … 60.0 s = Extended stop routine of the brake control function: The motor magnetisation is switched off after the brake close delay and the extended run time have passed. During the extended run time, a zero torque reference is applied, and the motor is ready for a immediate restart. 	
28.10	LOW REF BRK HOLD	Activates a brake hold function and defines the hold delay for it. The function stabilises the operation of the brake control application when the motor operates near zero speed and there is no measured speed feedback available (pulse encoder).	0 s
	0.0…60.0 s	0.0 s = inactive. 0.1 s … 60.0 s = active. When the absolute value of the motor speed reference falls below the brake close speed: - The brake hold delay counter starts. - The brake is closed according to normal stop routine of the brake control function. During the delay, the function keeps the brake closed despite of the speed reference value and the value of start command. When the set delay has passed, the normal operation resumes.	
30 FAULT FUNCTIONS		Programmable protection functions	
30.01	PANEL LOSS	Selects how the drive reacts to a control panel communication break.	FAULT
	FAULT	Drive trips on a fault and the motor stops as defined by parameter 10.13 STOP FUNCTION.	1
	CONST SP 1	The drive generates a warning and sets the speed to the speed defined by parameter 21.07 CONST SPEED1. **WARNING!** Make sure that it is safe to continue operation in case of a panel communication break.	2
	LAST SPEED	The drive generates a warning and freezes the speed to the level the drive was operating at (i.e. activates Main control Word bit 5 RAMP_HOLD). **WARNING!** Make sure that it is safe to continue operation in case of a panel communication break.	3

Index	Name/Selection	Description	Def FbEq
30.02	EXTERNAL FAULT	Activates the external fault or selects the source for an external fault signal. 0 = Fault trip. Motor coasts to stop. 1 = No external fault	TRUE
	FALSE	inactive	
	TRUE	Fault active	
	DI1	Digital input DI1	
	DI2	Digital input DI2	
	DI3	Digital input DI3	
	DI4	Digital input DI4	
	DI5	Digital input DI5	
	DI6	Digital input DI6	
	EXT M1 DI1	Digital input DI1 of extension module 1	
	EXT M1 DI2	Digital input DI2 of extension module 1	
	EXT M1 DI3	Digital input DI3 of extension module 1	
	EXT M2 DI1	Digital input DI1 of extension module 2	
	EXT M2 DI2	Digital input DI2 of extension module 2	
	EXT M2 DI3	Digital input DI3 of extension module 2	
	EXT M3 DI1	Digital input DI1 of extension module 3	
	EXT M3 DI2	Digital input DI2 of extension module 3	
	EXT M3 DI3	Digital input DI3 of extension module 3	
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	
30.03	MOTOR THERM PROT	Selects how the drive reacts when the motor overtemperature is detected by the function defined by parameter 30.04 MOT THERM P MODE.	NO
	FAULT	The drive generates a warning when the temperature exceeds the warning level (95% of the allowed maximum value). The drive trips on a fault when the temperature exceeds the fault level (100% of the allowed maximum value).	1
	WARNING	The drive generates a warning when the temperature exceeds the warning level (95% of the allowed maximum value).	2
	NO	Inactive	3
30.04	MOT THERM P MODE	Selects the thermal protection mode of the motor. When overtemperature is detected, the drive reacts as defined by parameter 30.03 MOTOR THERM PROT.	DTC

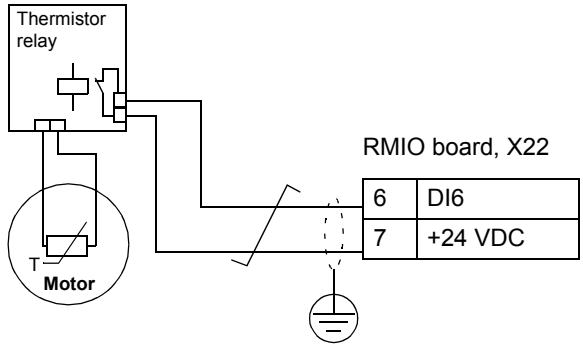
Index	Name/Selection	Description	Def FbEq
	DTC	The protection is based on the calculated motor thermal model. The following assumptions are used in the calculation: - The motor is at ambient temperature (30°C) when the power is switched on. - The motor temperature increases if it operates in the region above the load curve and decreases if it operates below the curve. - The motor thermal time constant is an approximate value for a standard self-ventilated squirrel-cage motor. It is possible to finetune the model by parameter 30.05 MOTOR THERM TIME. **Note:** The model cannot be used with high power motors (parameter 99.04 MOTOR NOM CURR is higher than 800 A). **WARNING!** The model does not protect the motor if it does not cool properly due to dust and dirt.	1
	USER MODE	The protection is based on the user-defined motor thermal model and the following basic assumptions: - The motor is at ambient temperature (30°C) when power is switched on. - The motor temperature increases if it operates in the region above the motor load curve and decreases if it operates below the curve. The user-defined thermal model uses the motor thermal time constant (parameter 30.05 MOTOR THERM TIME) and the motor load curve (parameters 30.06...30.08). User tuning is typically needed only if the ambient temperature differs from the normal operating temperature specified for the motor. **WARNING!** The model does not protect the motor if it does not cool properly due to dust and dirt.	2

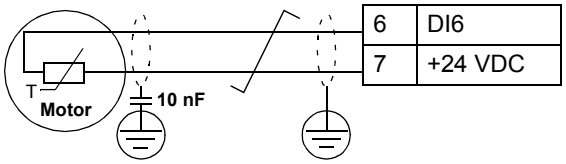
<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>Def
FbEq</th></tr>
<tr><td></td><td>THERMISTOR</td><td>Motor thermal protection is activated through digital input DI6. A motor thermistor, or a break contact of a thermistor relay, must be connected to digital input DI6. The drive reads the DI6 states as follows:

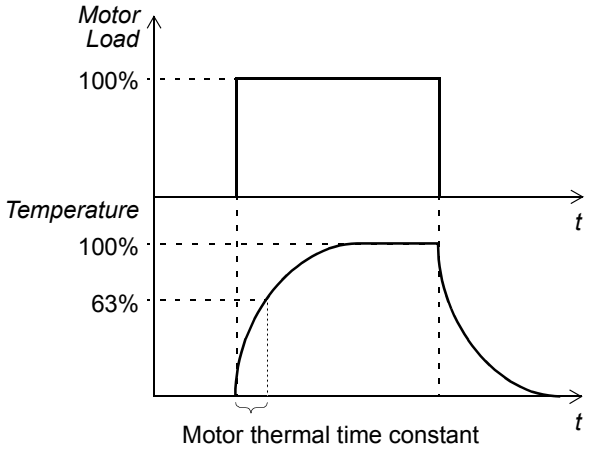
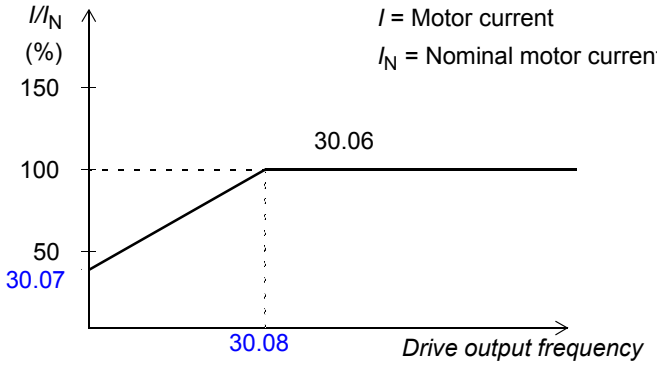
<table><tr><th>DI6 status (thermistor resistance)</th><th>Temperature</th></tr><tr><td>1 (0…1.5 kohm)</td><td>Normal</td></tr><tr><td>0 (4 kohm or higher)</td><td>Overtemperature</td></tr></table>
WARNING! According to IEC 664, the connection of the motor thermistor to the digital input requires double or reinforced insulation between motor live parts and the thermistor. Reinforced insulation entails a clearance and creeping distance of 8 mm (400 / 500 VAC equipment). If the thermistor assembly does not fulfil the requirement, the other I/O terminals of the drive must be protected against contact, or a thermistor relay must be used to isolate the thermistor from the digital input.

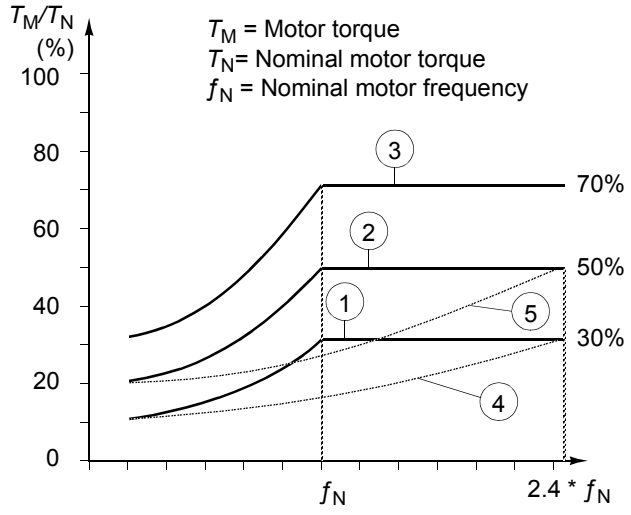
WARNING! Digital input DI6 may be selected for another use. Change these settings before selecting THERMISTOR. In other words, ensure that digital input DI6 is not selected by any other parameter.

The figure below shows the alternative thermistor connections. At the motor end the cable shield should be earthed through a 10 nF capacitor. If this is not possible, the shield is to be left unconnected.

Alternative 1
 

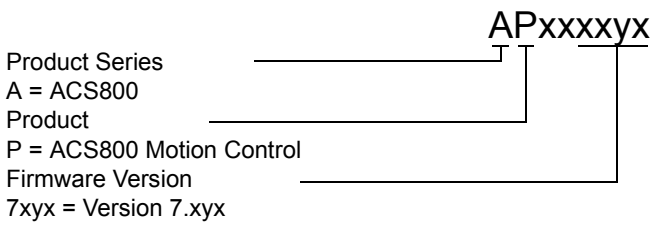
Alternative 2
 
</td><td>3</td></tr>
</table>

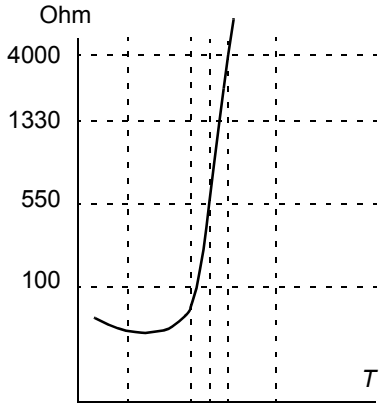
Index	Name/Selection	Description	Def FbEq
30.05	MOTOR THERM TIME	Defines the thermal time constant for the user-defined thermal model (see the selection USER MODE of parameter 30.04 MOT THERM P MODE). 	
	256.0…9999.8 s	Time constant	256…9999
30.06	MOTOR LOAD CURVE	Defines the load curve together with parameters 30.07 ZERO SPEED LOAD and 30.08 BREAK POINT. The load curve is used in the user-defined thermal model (see the selection USER MODE of parameter 30.04 MOT THERM P MODE). 	100%
	50.0…150.0%	Allowed continuous motor load in percent of the nominal motor current	50…150
30.07	ZERO SPEED LOAD	Defines the load curve together with parameters 30.06 MOTOR LOAD CURVE and 30.08 BREAK POINT.	74%
	25.0…150.0%	Allowed continuous motor load at zero speed in percent of the nominal motor current	25…150
30.08	BREAK POINT	Defines the load curve together with parameters 30.06 MOTOR LOAD CURVE and 30.08 BREAK POINT.	45 Hz
	1.0…300.0 Hz	Drive output frequency at 100% load	100…30000
30.09	STALL FUNCTION	Selects how the drive reacts to a motor stall condition. The protection wakes up if: - the motor torque is at the internal stall torque limit (not user-adjustable) - the output frequency is below the level set by parameter 30.10 STALL FREQ HI and - the conditions above have been valid longer than the time set by parameter 30.11 STALL TIME.	FAULT

Index	Name/Selection	Description	Def FbEq
	FAULT	The drive trips on a fault.	1
	WARNING	The drive generates a warning. The indication disappears in half of the time set by parameter 30.11 STALL TIME.	2
	NO	Protection is inactive.	3
30.10	STALL FREQ HI	Defines the frequency limit for the stall function. See parameter 30.09 STALL FUNCTION.	20 Hz
	0.5…50.0 Hz	Stall frequency	50…5000
30.11	STALL TIME	Defines the time for the stall function. See parameter 30.09 STALL FUNCTION.	20 s
	10.00…400.00 s	Stall time	10…400
30.12	UNDERLOAD FUNC	Selects how the drive reacts to underload. The protection wakes up if: - the motor torque falls below the curve selected by parameter 30.14 UNDERLOAD CURVE, - output frequency is higher than 10% of the nominal motor frequency and - the above conditions have been valid longer than the time set by parameter 30.13 UNDERLOAD TIME.	NO
	NO	Protection is inactive.	1
	WARNING	The drive generates a warning.	2
	FAULT	The drive trips on a fault.	3
30.13	UNDERLOAD TIME	Time limit for the underload function. See parameter 30.12 UNDERLOAD FUNC.	600 s
	0…600 s	Underload time	0…600
30.14	UNDERLOAD CURVE	Selects the load curve for the underload function. See parameter 30.12 UNDERLOAD FUNC. 	1
	1…5	Number of the load curve	1…5
30.15	MOTOR PHASE LOSS	Activates the motor phase loss supervision function.	NO
	NO	Inactive	0
	FAULT	Active. The drive trips on a fault.	65535

Index	Name/Selection	Description	Def FbEq
30.16	EARTH FAULT	Selects how the drive reacts when an earth fault is detected in the motor or the motor cable.	FAULT
	WARNING	The drive generates a warning.	0
	FAULT	The drive trips on a fault.	65535
32 SUPERVISION		Supervision function 1...3. Example: If speed (01.03 SPEED) supervision above certain speed is needed - parameter 32.01 is set to HIGH LIMIT - parameter 32.02 is set to +001.003.00 - parameter 32.03 is set to the integer value of the speed limit (see 19.01 SPEED SCALING). If the supervision limit is exceeded, parameter 06.08 SUPERVIS STATUS bit 0 is set to 1. **Note:** Supervision functions are not valid for position signals.	
32.01	SUPERVISION FUNC1	Activates and selects the supervision function 1. See also parameters 32.02 SUP FUNC1 VALUE and 32.03 SUP FUNC1 LIMIT.	NO
	NO	Inactive	1
	LOW LIMIT	Supervision is activated, if parameter 32.02 SUP FUNC1 VALUE value is below the limit defined by 32.03 SUP FUNC1 LIMIT.	2
	HIGH LIMIT	Supervision is activated, if parameter 32.02 SUP FUNC1 VALUE value is above the limit defined by 32.03.	3
	ABS LOW LIMIT	Supervision is activated, if the absolute value of parameter 32.02 SUP FUNC1 VALUE is below the limit defined by 32.03 SUP FUNC1 LIMIT.	4
32.02	SUP FUNC1 VALUE	Selects the source or constant value for supervision function 1.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or constant value	1.03
32.03	SUP FUNC1 LIMIT	Defines the supervision limit for supervision function 1.	0
	-32768...32767	Supervision limit	-32768...32767
32.04	SUPERVISION FUNC2	Activates the supervision function 2. See also parameters 32.05 SUP FUNC2 VALUE and 32.06 SUP FUNC2 LIMIT.	NO
	NO	Inactive	1
	LOW LIMIT	Supervision is activated if parameter 32.05 SUP FUNC2 VALUE value is below the limit defined by 32.06 SUP FUNC2 LIMIT.	2
	HIGH LIMIT	Supervision is activated if parameter 32.05 SUP FUNC2 VALUE value is above the limit defined by 32.06 SUP FUNC2 LIMIT.	3
	ABS LOW LIMIT	Supervision is activated if the absolute value of parameter 32.05 SUP FUNC2 VALUE is below the limit defined by 32.06 SUP FUNC2 LIMIT.	4
32.05	SUP FUNC2 VALUE	Selects the source or constant value for supervision function 2.	1.05
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or constant value	
32.06	SUP FUNC2 LIMIT	Defines the supervision limit for supervision function 2.	0
	-32768...32767	Supervision limit	-32768...32767
32.07	SUPERVISION FUNC3	Activates the supervision function 3. See also parameters 32.08 SUP FUNC3 VALUE and 32.09 SUP FUNC3 LIMIT.	NO
	NO	Inactive	1

Index	Name/Selection	Description	Def FbEq
	LOW LIMIT	Supervision is activated if parameter 32.08 SUP FUNC3 VALUE value is below the limit defined by 32.09 SUP FUNC3 LIMIT.	2
	HIGH LIMIT	Supervision is activated if parameter 32.08 SUP FUNC3 VALUE value is above the limit defined by 32.09 SUP FUNC3 LIMIT.	3
	ABS LOW LIMIT	Supervision is activated if the absolute value of parameter 32.08 SUP FUNC3 VALUE is below the limit defined by 32.09 SUP FUNC3 LIMIT.	4
32.08	SUP FUNC3 VALUE	Selects the source or constant value for supervision function 3.	1.06
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or constant value	
32.09	SUP FUNC3 LIMIT	Defines the supervision limit for supervision function 2.	0
	-32768...32767	Supervision limit	-32768...32767
32.10	POS ERROR WINDOW	Defines the absolute value for the position error supervision. The drive is tripped on fault POSITION ERROR if the position error is exceeded. The supervision is active in position and synchron modes.	0 rev
	See par. 19.13	Position error window. If this parameter is set to zero, the supervision is disabled.	See par. 19.15
32.11	POSITION WINDOW	Defines the absolute value for the positioning window supervision. When the final position is within the limits defined by this parameter, the positioning is completed. Parameter value must be smaller than value set by parameter 32.10 POS ERROR WINDOW. Signal 06.12 bit 4 IN_POS_WIN_PSW2 is set to 1 if 04.07 DISTANCE TO TARGET is smaller than the position window. Signal 06.12 bit 6 IN_POS_OK_PSW2 is set to 1 if interpolator has reached the target and 04.14 POSITION ERROR is smaller than the position window.	0 rev
	See par. 19.13	Position window	See par. 19.15
32.12	POS THRESHOLD 1	Defines the position threshold supervision limit. Signal 06.12 bit 0 POS_SW1_PSW2 is set to 1 if 04.02 POS ACT VAL is greater than the threshold supervision limit.	0 rev
	See par. 19.13	Position threshold	See par. 19.15
32.13	POS THRESHOLD 2	Defines the position threshold supervision limit. Signal 06.12 bit 1 POS_SW2_PSW2 is set to 1 if 04.02 POS ACT VAL is greater than the threshold supervision limit.	0 rev
	See par. 19.13	Position threshold	See par. 19.15
32.14	POS THRESHOLD 3	Defines the position threshold supervision limit. Signal 06.12 bit 2 POS_SW3_PSW2 is set to 1 if 04.02 POS ACT VAL is greater than the threshold supervision limit.	0 rev
	See par. 19.13	Position threshold	See par. 19.15
32.15	SYNC ERR WINDOW	Defines the absolute value for the synchron error supervision window. Signal 06.11 bit 4 POS_SYN_CYC_OK_PSW1 is set to 1 if 04.11 SYNCHRON ERROR is smaller than the defined window. Signal 06.11 bit 5 POS_SYN_ERR_OK_PSW1 is set to 1 if also the cyclic correction is performed at least once (signal 6.12 bit 13 is set to 1).	0 rev
	See par. 19.13	Synchron error window	See par. 19.15

Index	Name/Selection	Description	Def FbEq
33 INFORMATION		Program versions, test date	
33.01	SOFTWARE VERSION	Displays the type and the version of the firmware package in the drive.	-
		Decoding key:  	
33.02	TEST DATE	Displays the test date.	-
		Date value in format DDMMYY (day, month, year)	
33.03	DEVICE NAME	Defines the name for the drive or application. The name is visible on the control panel display in the Drive Selection Mode. **Note:** The name can be typed only by using a drive PC tool.	
35 MOT TEMP MEAS		Motor temperature measurement. For the function description see chapter *Basic program features*.	
35.01	MOT 1 TEMP AI1 SEL	Activates the motor 1 temperature measurement function and selects the sensor type.	NOT IN USE
	NOT IN USE	The function is inactive.	1
	1xPT100	The function is active. The temperature is measured with one Pt 100 sensor. Analogue output AO1 feeds constant current through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through analogue input AI1 and converts it to degrees centigrade.	2
	2XPT100	The function is active. Temperature is measured using two Pt 100 sensors. See selection 1xPT100.	3
	3XPT100	The function is active. Temperature is measured using three Pt 100 sensors. See selection 1xPT100.	4

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>Def
FbEq</th></tr>
<tr><td></td><td>1...3 PTC</td><td>The function is active. The temperature is supervised using one to three PTC sensors. Analogue output AO1 feeds constant current through the sensor(s). The resistance of the sensor increases sharply as the motor temperature rises over the PTC reference temperature (T_{ref}), as does the voltage over the resistor. The temperature measurement function reads the voltage through analogue input AI1 and converts it into ohms. The figure below shows typical PTC sensor resistance values as a function of the motor operating temperature.
<table><tr><th>Temperature</th><th>Resistance</th></tr><tr><td>Normal</td><td>0 … 1.5 kohm</td></tr><tr><td>Excessive</td><td>≥ 4 kohm</td></tr></table> 
</td><td>5</td></tr>
<tr><td>35.02</td><td>MOT 1 TEMP ALM L</td><td>Defines the alarm limit for motor 1 temperature measurement. The alarm indication is given when the limit is exceeded.</td><td>110°C</td></tr>
<tr><td></td><td>-10…5000 ohm/°C (PTC/ Pt100)</td><td>Limit in °C or ohms. °C: parameter 35.01 MOT 1 TEMP AI1 SEL is 1xPT100, 2XPT100, 3XPT100. Ohm: parameter 35.01 is 1...3 PTC.</td><td>-10…5000</td></tr>
<tr><td>35.03</td><td>MOT 1 TEMP FLT L</td><td>Defines the fault trip limit for motor 1 temperature measurement. The fault indication is given when the limit is exceeded.</td><td>130°C</td></tr>
<tr><td></td><td>-10…5000 ohm/°C (PTC/ Pt100)</td><td>Limit in °C or ohms. °C: parameter 35.01 is 1xPT100, 2XPT100, 3XPT100. Ohm: parameter 35.01 is 1...3 PTC.</td><td>-10…5000</td></tr>
<tr><td>35.04</td><td>MOT 2 TEMP AI2 SEL</td><td>Activates the motor 2 temperature measurement function and selects the sensor type. Two motors can be protected only by using an optional analogue extension module. Parameter 35.08 AI/O MOTOR TEMP needs to be activated.
Note: If 35.08 is activated, the analogue I/O extension is also used for motor 1 temperature measurement (the standard I/O terminals are not in use).</td><td>NOT IN USE</td></tr>
<tr><td></td><td></td><td>See parameter 35.01 MOT 1 TEMP AI1 SEL.</td><td></td></tr>
<tr><td>35.05</td><td>MOT 2 TEMP ALM L</td><td>Defines the alarm limit for the motor 2 temperature measurement function. The alarm indication is given when the limit is exceeded.</td><td>110°C</td></tr>
<tr><td></td><td>-10…5000 ohm/°C (PTC/ Pt100)</td><td>See parameter 35.02 MOT 1 TEMP ALM L.</td><td>-10…5000</td></tr>
<tr><td>35.06</td><td>MOT 2 TEMP FLT L</td><td>Defines the fault trip limit for the motor 2 temperature measurement function. The fault indication is given when the limit is exceeded.</td><td>130°C</td></tr>
<tr><td></td><td>-10…5000 ohm/°C (PTC/ Pt100)</td><td>See parameter 35.03 MOT 1 TEMP FLT L.</td><td>-10…5000</td></tr>
<tr><td>35.07</td><td>MOT MOD COMPENSAT</td><td>Selects whether measured motor 1 temperature is used in the motor model compensation.</td><td>YES</td></tr>
<tr><td></td><td>NO</td><td>The function is inactive.</td><td>1</td></tr>
</table>

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>Def
FbEq</th></tr>
<tr><td></td><td>YES</td><td>The temperature is used in the motor model compensation.
Note: Selection is possible only when Pt 100 sensor(s) is used.</td><td>2</td></tr>
<tr><td>35.08</td><td>AI/O MOTOR TEMP</td><td>Activates the communication to the analogue I/O extension module and reserves the module for the use of the motor temperature measurement function. The parameter also defines the type and connection interface of the module.
The use of the analogue inputs (AI) and outputs (AO) of the module is shown in the table below.
<table>
<tr><td colspan="2">Motor 1 temperature measurement</td></tr>
<tr><td>AO1</td><td>Feeds a constant current to motor 1 temperature sensor. The current value depends on the setting of parameter 35.01:
- AO1 is 9.1 mA with selection 1xPT100
- AO1 is 1.6 mA with selection 1...3 PTC</td></tr>
<tr><td>AI1</td><td>Measures voltage over motor 1 temperature sensor.</td></tr>
<tr><td colspan="2">Motor 2 temperature measurement</td></tr>
<tr><td>AO2</td><td>Feeds a constant current to motor 2 temperature sensor. The current value depends on the setting of parameter 35.04:
- AO2 is 9.1 mA with selection 1xPT100,
- AO2 is 1.6 mA with selection 1...3 PTC</td></tr>
<tr><td>AI2</td><td>Measures voltage over motor 2 temperature sensor.</td></tr>
</table>
Before setting the drive parameters, ensure the module hardware settings are appropriate for the motor temperature measurement:
1. The module node number is 9.
2. The input signal type selections are the following:
- for one Pt 100 sensor measurement, set the range to 0…2 V.
- for two to three Pt 100 sensors or one to three PTC sensors, set the range to 0…10 V.
3. The operation mode selection is unipolar.</td><td>NO</td></tr>
<tr><td></td><td>NAIO</td><td>Communication active. Module type: NAIO. Connection interface: Fibre optic DDCS link.
Note: Make the module hardware settings described above. For instructions, see Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules [3AFY58919730 (English)].</td><td>1</td></tr>
<tr><td></td><td>NO</td><td>Inactive</td><td>2</td></tr>
<tr><td></td><td>RAIO-SLOT1</td><td>Communication active. Module type: RAIO. Connection interface: Option slot 1 of the drive.
Note: Make the module hardware settings described above. The node number is not required. For directions, see RAIO Module User’s Manual [3AFE64484567 (English)].</td><td>3</td></tr>
<tr><td></td><td>RAIO-SLOT2</td><td>Communication active. Module type: RAIO. Connection interface: Option slot 2 of the drive.
Note: Make the module hardware settings described above. The node number is not required. For directions, see RAIO Module User’s Manual [3AFE64484567 (English)].</td><td>4</td></tr>
</table>

Index	Name/Selection	Description	Def FbEq
	RAIO-DDCS	Communication active. Module type: RAIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Set the module node number to 9. For directions, see *RAIO Module User's Manual* [3AFE64484567 (English)].	5
40 POS REFERENCE			
40.01	POS ENABLE SEL	Activates the position interpolator or selects the source of the position interpolator enable command. 0 = Drive is stopped according to current position deceleration (42.07 POS DEC MAX). 1 = Active positioning task is performed. If the target position is not reached, the position interpolator is suspended (POS ENABLE SEL is 0). When the positioning is re-enabled, the task continues according to current positioning parameters defined by parameter group 49 POS PAR TABLE. See chapters *Motion control features* and *Control block diagrams*.	TRUE
	FALSE	Drive is stopped according to current position deceleration (group 48 POS DEC TABLE).	1
	TRUE	Active positioning task is performed	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
40.02	POS START FUNC	Selects the positioning start function. This function is active in position and synchron modes.	NORMAL

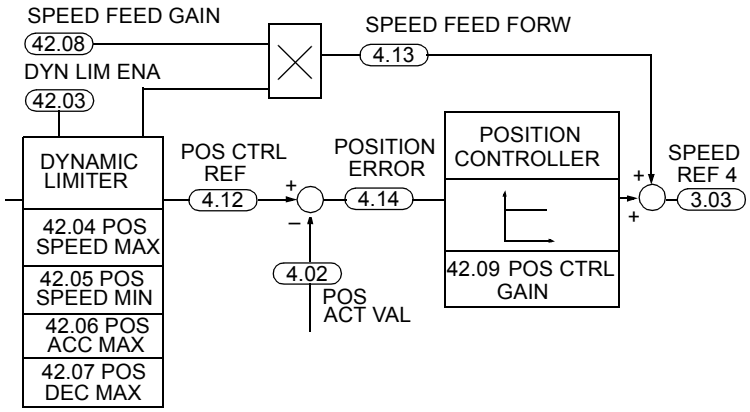
Index	Name/Selection	Description	Def FbEq
	NORMAL	Rising edge of a signal from the source defined by 40.03 POS START SEL activates the positioning. The input signal has to stay TRUE during the positioning task.	0
	PULSE	Rising edge of a pulse from the source defined by 40.03 POS START SEL activates the positioning. If a new pulse is received during the positioning, the new task is started as soon as the previous task has been completed. The status of the positioning task can be monitored with signal 06.12 bit 4 IN_POS_WIN_PSW2. **Note:** Only one task at the time can be pretriggered.	1
40.03	POS START SEL	Activates the positioning start function or selects the source of the positioning start command. Functionality of the input is defined by parameter 40.02 POS START FUNC. 0 -> 1 = rising edge of the selected signal activates the start function See chapters *Motion control features* and *Control block diagrams*.	FALSE
	FALSE	Positioning start function is inactive.	1
	TRUE	Positioning start function is active.	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
40.04	POS REF SEL	Defines the source of the target position reference. In position mode the target is the absolute position. In synchron mode the target is relative to the synchronous position.	POS REF TABLE
	ZERO	Zero target position reference	0

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>Def
FbEq</th></tr>
<tr><td></td><td>POS REF TABLE</td><td>Reference and other positioning parameters are read from the reference table defined by parameter groups 45 POS REF TABLE to 49 POS PAR TABLE and selected with parameters 40.06...40.09.
Note: Position reference table is read only, if position start function is activated. See parameter 40.03 POS START SEL.</td><td>1</td></tr>
<tr><td></td><td>MAIN DS REF12</td><td>Position reference is read from main dataset words 1 and 2.
Note: First parameter sets in groups 46 POS SPEED TABLE to 49 POS PAR TABLE are used to determine positioning speed, acceleration, deceleration and mode</td><td>2</td></tr>
<tr><td>40.05</td><td>POS REF ADD</td><td>Defines the additional target position reference.</td><td>0 rev</td></tr>
<tr><td></td><td>See par. 19.13</td><td>Position reference</td><td>See par. 19.15</td></tr>
<tr><td>40.06</td><td>POS TABLE SEL1</td><td>Defines the source of the positioning reference used in the reference table:
<table>
<tr><th>Par 40.09</th><th>Par 40.08</th><th>Par 40.07</th><th>Par 40.06</th><th>Function</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>reference set 1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>reference set 2</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>reference set 3</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>reference set 4</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>reference set 5</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>reference set 6</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>reference set 7</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>reference set 8</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>reference set 9</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>reference set 10</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>reference set 11</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>reference set 12</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>0</td><td>reference set 13</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>reference set 14</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>reference set 15</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>reference set 16</td></tr>
</table>
For diagnostics, see 04.04 SEL POS REF SET (= reference set selected with parameters 40.06...40.09)
Example: Reference set is selected by the Main Dataset Reference (signal 2.15 MAIN DS REF1) received from the fieldbus interface:
- par. 40.06 is set to PROG DI1 and 12.04 is set to +002.015.01
- par. 40.07 is set to PROG DI2 and 12.05 is set to +002.015.02
- par. 40.08 is set to PROG DI3 and 12.06 is set to +002.015.03
- par. 40.09 is set to PROG DI4 and 12.07 is set to +002.015.04</td><td>FALSE</td></tr>
<tr><td></td><td>FALSE</td><td>0</td><td>1</td></tr>
<tr><td></td><td>TRUE</td><td>1</td><td>2</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1</td><td>3</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2</td><td>4</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3</td><td>5</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4</td><td>6</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5</td><td>7</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6</td><td>8</td></tr>
<tr><td></td><td>EXT M1 DI1</td><td>Digital input DI1 of extension module 1</td><td>9</td></tr>
</table>

Index	Name/Selection	Description	Def FbEq
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
40.07	POS TABLE SEL2	See parameter 40.06 POS TABLE SEL1.	FALSE
		See parameter 40.06 POS TABLE SEL1.	
40.08	POS TABLE SEL3	See parameter 40.06 POS TABLE SEL1.	FALSE
		See parameter 40.06 POS TABLE SEL1.	
40.09	POS TABLE SEL4	See parameter 40.06 POS TABLE SEL1.	FALSE
		See parameter 40.06 POS TABLE SEL1.	
40.10	POS TEACH-IN SEL	Enables the teach-in function or defines the source of the function. The teach-in function fills the reference table with actual position values. 0 -> 1 = rising edge of the selected signal stores the actual position value to the selected target (= reference table). Example: If parameter 40.10 POS TEACH-IN SEL is set to DI1 and signal 4.04 SEL POS REF SET value is 2 (i.e. reference set 2 has been selected with parameters 40.06...40.09), the rising edge of the digital input DI1 signal writes the actual position value (4.02 POS ACT VAL) into parameter 45.02 POS REF TABLE.	FALSE
	FALSE	Teach-in function disabled	1
	TRUE	Teach-in function enabled	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12

Index	Name/Selection	Description	Def FbEq
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
40.11	POS REF FILT TIME	Defines the first-order shape filter time. The filter reduces jerk caused by the positioning process.	10 ms
	0...1000000 ms	Filter time	1 = 1 ms
40.12	POS SPEED MUL SEL	Defines the source for online positioning speed multiplier. The speed is multiplied with absolute value 0...1 received from the selected source. Dataset integer value 32767 corresponds to 1. 100% analogue input value corresponds to 1.	NOT SEL
	NOT SEL	Multiplier 1 is used.	0
	AI1	Analogue input 1	1
	AI2	Analogue input 2	2
	AI3	Analogue input 3	3
	EXT AI1	Analogue input 1 of AI/O extension module 1	4
	EXT AI 2	Analogue input 2 of AI/O extension module 1	5
	MAIN DS REF1	Main dataset reference 1	6
	MAIN DS REF 2	Main dataset reference 2	7
	AUX DS REF1	Auxiliary dataset reference 1	8
	AUX DS REF2	Auxiliary dataset reference 2	9
	AUX DS REF3	Auxiliary dataset reference 3	10
	M/F REF1	Master/Follower link reference 1	11
	M/F REF2	Master/Follower link reference 2	12
41 SYNCHRON REFERENCE			
41.01	SYNC POS REF SEL	Selects the source of the synchron position reference (master position) used in synchron mode.	ZERO
	ZERO	Synchron position reference is not selected.	0
	ENC2	Value is read from encoder 2.	1
	M/F REF1	Value is read from Master/Follower link. **Note:** Parameter 70.12 MASTER SIGNAL2 must be set to 401 (= signal 04.01 POS ACT ENC).	2

Index	Name/Selection	Description	Def FbEq
41.02	SYNC GEAR NUM	Defines the numerator of the gear ratio used in the gear function. The gear function modifies the position alterations of the synchron position reference value in order to obtain a certain ratio between the master and follower motion. See also parameter 41.03 SYNC GEAR DEN and chapter *Motion control features.* Example: Parameter 41.02 is set to the value of 253 and parameter 41.03 is set to the value of 100. Gear ratio is 2.53, i.e. follower speed is 2.53 times the master speed.	1
	-32768...32767	Gear numerator	-32768…32767
41.03	SYNC GEAR DEN	Defines the denominator of the synchronous gear. See parameter 19.07 MOTOR GEAR NUM.	1
	1...32767	Gear denominator	1…32767
41.04	SYNCRON FUNC	Selects the synchronisation of the follower drive in synchron mode. **Note:** See start and stop examples in chapter *Motion control features, Position control mode - reference selection*.	RELATIVE
	RELATIVE	Relative synchronisation of the follower. Only master position changes which take place after the follower is started are taken into account.	0
	ABSOLUTE	Absolute synchronisation of the follower. The follower follows the master position after start.	65535
42 POS CONTROL			
42.01	POSITION MAX	Defines the maximum position value. If the actual position value exceeds the maximum position limit, fault message POS LIM ERR is generated. The value of this parameter must be higher than 42.02 POSITION MIN.	0 rev
	See par. 19.13	Maximum position	See par. 19.15
42.02	POSITION MIN	Defines the minimum position value. If the actual position value falls below the minimum position limit, fault message POS LIM ERR is generated.	0 rev
	See par. 19.13	Minimum position	See par. 19.15
42.03	DYN LIM ENA	Activates the dynamic limiter or defines the source of the dynamic limiter enable command. 1 = Dynamic limiter is active See chapter *Motion control features, Dynamic limiter.*	TRUE
	FALSE	Dynamic limiter is inactive. Limiter output is forced to zero.	1
	TRUE	Dynamic limiter is active.	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12

Index	Name/Selection	Description	Def FbEq
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
42.04	POS SPEED MAX	Limits the positive positioning speed. See chapter *Motion control features*, *Position control mode - reference selection.*	3000 rpm
	0...15000 rpm	Speed limit	0…15000
42.05	POS SPEED MIN	Limits the negative positioning speed. See chapter *Motion control features, Position control mode - reference selection.*	-3000 rpm
	-15000...0 rpm	Speed limit	-15000…0
42.06	POS ACC MAX	Limits the positioning acceleration rate. Example: Speed change from 0 to 3000 rpm in 4 seconds corresponds to acceleration of 12.5 rev/s2. Speed change from 3000 to 0 rpm in 1 second corresponds to deceleration of –50 rev/s2	12.5 rev/s^2
	0...125000 rev/s^2	Acceleration limit	0…125000
42.07	POS DEC MAX	Limits the positioning deceleration rate.	-12.5 rev/s^2
	-125000...0 rev/s^2	Deceleration limit	-125000…0
42.08	SPEED FEED GAIN	Defines the speed feed forward gain for the speed control. The default gain value is suitable for most applications. In some cases the gain can be used to compensate the difference between the reference position and the actual position caused by external disturbances. The position control loop:  	100%
	0...400%	Value in percent	0…40000

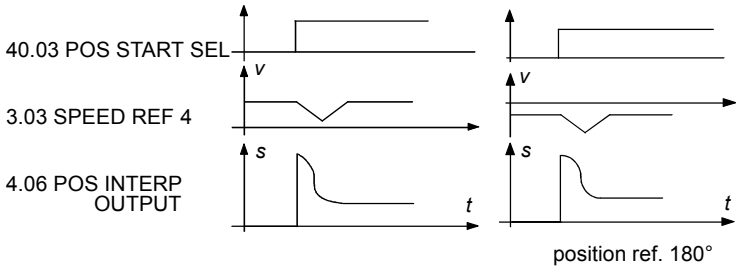
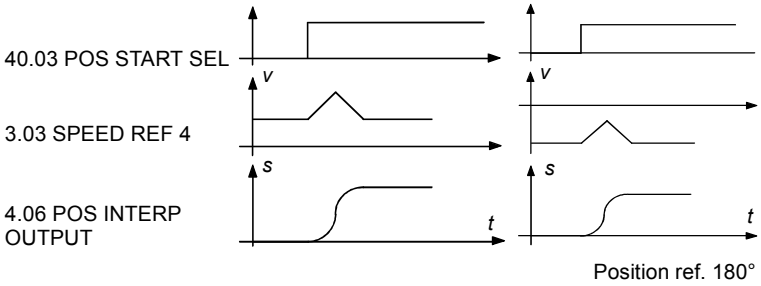
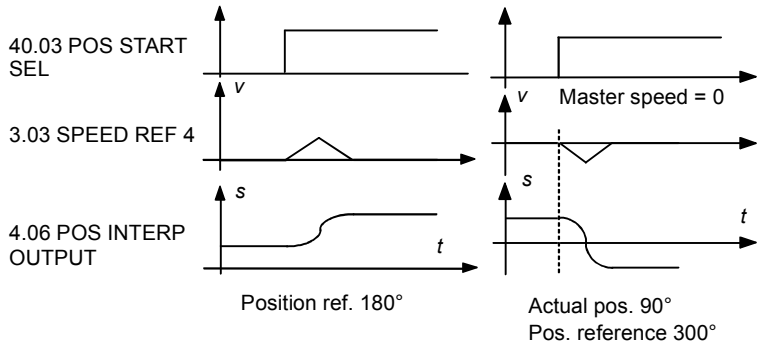
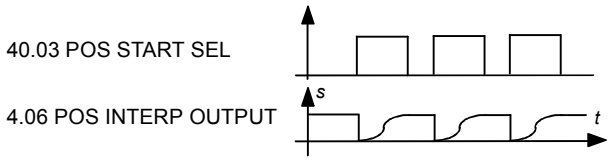
Index	Name/Selection	Description	Def FbEq
42.09	POS CTRL GAIN	Defines the gain for the position control loop. For rotatoric drives, the value of 1 1/min produces a speed reference of 1 rpm (motor shaft related), if the position error is 1 revolution.	1000 1/min
	0...30 000 1/min	**Note:** For translatory motion drives the unit is (1/min)/mm or (1/min)/in, depending on the selected scaling method.	0…30000
43 HOMING		For more information see chapter *Motion control features*, *Homing control.*	
43.01	HOMING MODE SEL	Selects the homing mode or selects the source of the homing mode selection command. 0 = Homing mode according to parameter 43.02 HOMING MODE 1 1 = Homing mode according to parameter 43.03 HOMING MODE 2	FALSE
	FALSE	Homing mode 1 (H MODE1) according to parameter 43.02 HOMING MODE 1	1
	TRUE	Homing mode 2 (H MODE2) according to parameter 43.03 HOMING MODE 2	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
43.02	HOMING MODE1	Selects homing mode 1.	STANDARD
	STANDARD	Standard (sequential) homing logic. Speed reference is selected with parameter 43.10. See chapter *Motion control features*, *Standard homing*.	0

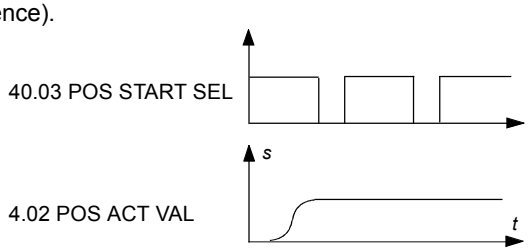
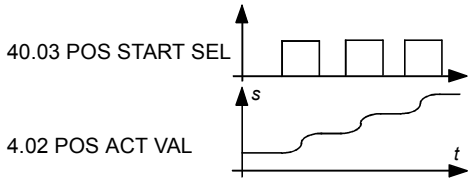
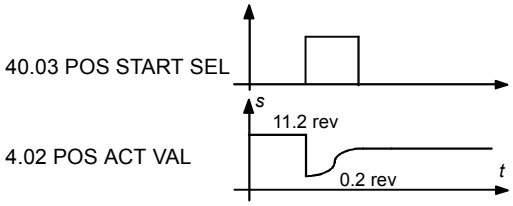
Index	Name/Selection	Description	Def FbEq
	SET HOME POS	Rising edge of the homing start command selected by 43.04 HOMING START SEL sets the position system to the value defined by 43.09 HOME POSITION.	1
	SET POS ACT	Rising edge of the homing start command selected by 43.04 HOMING START SEL sets the position system to the value defined by 04.02 POSITION ACT VAL.	2
	SET SYNC GEAR IN	Rising edge of the homing start command selected by 43.04 HOMING START SEL sets the position system to the value defined by 04.09 GEAR INPUT.	3
	CORR ACT POS	Actual Position Correction. See chapter *Motion control features, Cyclic correction function*.	4
	CORR MAS REF	Master Reference Correction. See chapter *Motion control features, Cyclic correction function*.	5
	CORR M/F DIST	Master/Follower Distance Correction. See chapter *Motion control features*, *Cyclic correction function*.	6
43.03	HOMING MODE2	Selects homing mode 2.	STANDARD
		See parameter 43.02 HOMING MODE1.	
43.04	HOMING START SEL	Activates the start command or selects the source of the start command used in STANDARD and PRESET homing functions. 0 -> 1: Start **Note:** Homing can only be started when the motor is running.	FALSE
	FALSE	No start command	1
	TRUE	Start	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23

Index	Name/Selection	Description	Def FbEq
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
43.05	LATCH POS ACT SEL	Defines the source of the actual position latching command used in STANDARD, CORR ACT POS and CORR M/F DIST homing modes. 0 -> 1 Selected input signal latches the actual position.	FALSE
	FALSE	False	1
	TRUE	True	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
43.06	LATCH MAS REF SEL	Defines the source of the master position reference latching command used in CORR MAS REF and CORR M/F DIST homing modes (selected by parameter 43.02 / 43.03). 0 -> 1: Selected input signal latches the reference position.	FALSE
	FALSE	False	1
	TRUE	True	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8

Index	Name/Selection	Description	Def FbEq
	EXT M1 DI1	Digital input DI1 of extension module 1	9
	EXT M1 DI2	Digital input DI2 of extension module 1	10
	EXT M1 DI3	Digital input DI3 of extension module 1	11
	EXT M2 DI1	Digital input DI1 of extension module 2	12
	EXT M2 DI2	Digital input DI2 of extension module 2	13
	EXT M2 DI3	Digital input DI3 of extension module 2	14
	EXT M3 DI1	Digital input DI1 of extension module 3	15
	EXT M3 DI2	Digital input DI2 of extension module 3	16
	EXT M3 DI3	Digital input DI3 of extension module 3	17
	PROG DI1	Source selected by parameter 12.04 PROGRAMMABLE DI1	18
	PROG DI2	Source selected by parameter 12.05 PROGRAMMABLE DI2	19
	PROG DI3	Source selected by parameter 12.06 PROGRAMMABLE DI3	20
	PROG DI4	Source selected by parameter 12.07 PROGRAMMABLE DI4	21
	PROG DI5	Source selected by parameter 12.08 PROGRAMMABLE DI5	22
	PROG DI6	Source selected by parameter 12.09 PROGRAMMABLE DI6	23
	PROG DI7	Source selected by parameter 12.10 PROGRAMMABLE DI7	24
	PROG DI8	Source selected by parameter 12.11 PROGRAMMABLE DI8	25
43.07	POS ACT PROBE	Defines the reference position for the actual position probe. For more information see *Actual Position Correction function* example.	0 rev
	See par. 19.13	Position reference	See par. 19.15
43.08	POS MAS PROBE	Defines the reference position for the master position reference probe. For more information see *Master Reference Correction function* and *Master/Follower Distance correction* examples.	0 rev
	See par. 19.13	Position reference	See par. 19.15
43.09	HOME POSITION	Defines the motion control home position.	0 rev
	See par. 19.13	Home position	See par. 19.15
43.10	SPEED REFHOMING	Defines the speed reference for standard homing. Normal speed reference scaling, i.e no Encoder Gear functions are applied.	0 rpm
	-18000 / (no. of polepairs)...18000 rpm / (no. of polepairs)	Speed reference	20000 = par. 19.01
43.11	HOMING START FUNC	Selects the homing start function.	NORMAL
	NORMAL	Rising edge of a signal from the source defined by 43.04 HOMING START SEL activates the homing. The input signal has to stay TRUE during the homing task.	0
	PULSE	Rising edge of a pulse from the source defined by 43.04 HOMING START SEL activates the homing.	1
45 POS REF TABLE		See chapter *Motion control features, Reference sets.*	
45.01	POS REF TABLE1	Defines the target position for the position reference set 1.	0 rev
	See par. 19.13	Reference value	See par. 19.15
...	...	...	...
45.08	POS REF TABLE8	Defines the target position for the position reference set 8.	0 rev
	See par. 19.13	Reference value	See par. 19.15

Index	Name/Selection	Description	Def FbEq
46 POS SPEED TABLE			
46.01	POS SPEED TABLE1	Defines the positioning speed for the position reference set 1.	300 rpm
	0...15000 rpm	Positioning speed	1 = 1 rpm
...	...	...	...
46.08	POS SPEED TABLE8	Defines the positioning speed for the position reference set 8.	1 = 1 rpm
	0...15000 rpm	Positioning speed	1 = 1 rpm
47 POS ACC TABLE			
47.01	POS ACC TABLE1	Defines the positioning acceleration for the position reference set 1.	12.5 rev/s^2
	0...125000 rev/s^2	Positioning acceleration	0...125000
...	...	...	...
47.08	POS ACC TABLE8	Defines the positioning acceleration for the position reference set 8.	12.5 rev/s^2
	0...125000 rev/s^2	Positioning acceleration	0...125000
48 POS DEC TABLE			
48.01	POS DEC TABLE1	Defines the positioning deceleration for the position reference set 1.	-12.5 rev/s^2
	-125000...0 rev/s^2	Positioning deceleration	-125000...0
...	...	....	....
48.08	POS DEC TABLE 8	Defines the positioning deceleration for the position reference set 8.	-12.5 rev/s^2
	-125000...0 rev/s^2	Positioning deceleration	-125000...0
49 POS PAR TABLE		See chapter *Motion control features, Position interpolator.*	
49.01	POS PAR TABLE1	Determines the behaviour of the positioning interpolator when position reference set 1 is in use. The figures below display the behaviour of each bit, but different bit combinations are possible. In synchron applications, bits 0...2 determine the positioning to an additional position reference. Only one of the bits 0...2 can be active at a time. The positioning priority order is: 1) bit 2 or according to the linear axis positioning selected by par. 19.12 POSITION FORMAT 2) bit 0 3) bit 1 Conversion form binary to hexadecimal format: 10000 (bin) = 2^5 (dec) = 10 (hex) Bits 3...5 determine the path to the target position.	10 (hex)
	Bit 0	1 = Positioning direction depends on the direction of the synchronous (master) speed. 0 = Positioning direction is independent of the synchronous (master) speed.	

Index	Name/Selection	Description	Def FbEq
	Bit 1	1 = Counter-clockwise positioning to the target position (bit 0 = 0).  or positioning in the opposite direction to the synchronous (master) speed when bit 0 = 1. 0 = Clockwise positioning to the target position (bit 0 = 0).  or positioning in the direction of the synchronous (master) speed when bit 0 = 1.	
	Bit 2	1 = Positioning to the target position along the shortest path, regardless of bit 0 and 1 values.  0 = Positioning to the target position according to bits 0 and 1.	
	Bit 3	1 = Before the positioning is started, the position system is reset.  0 = The position system is not reset.	

Index	Name/Selection	Description	Def FbEq
	Bit 4	1 = Selected target position is absolute. (Always the same position reference).  0 = Selected target position is relative to the previous target position. (Always the same reference set.) 	
	Bit 5	1 = Before the positioning is started, the position system is returned to the rollover axis range, i.e between 0...1 revolutions.  0 = The position system is not returned into the rollover axis range.	
...	...	...	...
49.08	POS PAR TABLE8	Determines the behaviour of the positioning interpolator when position reference set 8 is in use. See parameter 49.01 POS PAR TABLE1.	
		See parameter 49.01 POS PAR TABLE1.	
50 ENCODER MODULES		Encoder connection	
50.01	ENCODER MODULE1	Activates the communication to the optional pulse encoder module 1.	NO
	NTAC	Communication active. Module type: NTAC module. Connection interface: Fibre optic DDCS link. **Note:** Module node number must be set to 16. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* [3AFY58919730 (English)].	0
	NO	Inactive	1
	RTAC-SLOT1	Communication active. Module type: RTAC. Connection interface: Option slot 1 of the drive.	2
	RTAC-SLOT2	Communication active. Module type: RTAC. Connection interface: Option slot 2 of the drive.	3
	RTAC-DDCS	Communication active. Module type: RTAC. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 16. For directions, see *RTAC-01 Pulse Encoder Interface User's Manual* [3AFE64486853 (English)].	4

Index	Name/Selection	Description	Def FbEq
	RRIA-SLOT1	Communication active. Module type: RRIA. Connection interface: Option slot 1 of the drive.	5
	RRIA-SLOT2	Communication active. Module type: RRIA. Connection interface: Option slot 2 of the drive.	6
	RRIA-DDCS	Communication active. Module type: RRIA. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link.	7
50.02	ENC1 PULSE NR	States the number of encoder pulses per one revolution.	2048
	0 … 29999 ppr	Pulse number in pulses per round (ppr)	0 … 29999
50.03	ENC1 MEAS MODE	Defines how the encoder pulses are calculated.	A ‾_ B ‾_
	A ‾ B DIR	Channel A: positive edges calculated for speed. Channel B: direction.	0
	A ‾_	Channel A: positive and negative edges calculated for speed. Channel B: not used.	1
	A ‾_ B DIR	Channel A: positive and negative edges are calculated for speed. Channel B: direction.	2
	A ‾_ B ‾_	All edges of the signals are calculated.	3
50.04	ENC1 FAULT FUNC	Defines the operation of the drive if a failure is detected in communication between the pulse encoder and the pulse encoder interface module, or between the module and the drive. Encoder supervision function activates if either of the following conditions is valid: -The difference between estimated and measured speed is greater than 20% of the motor nominal speed. - No pulses are received from the encoder within 1 second, and the motor torque is at the maximum allowed value.	WARNING
	WARNING	The drive generates a warning indication.	0
	FAULT	The drive trips on a fault: gives a fault indication and stops the motor.	65535
50.11	ENCODER MODULE2	Activates the communication to the optional pulse encoder module 2.	NO
	NTAC	Communication active. Module type: NTAC module. Connection interface: Fibre optic DDCS link. **Note:** Module node number must be set to 17. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* [3AFY58919730 (English)].	0
	NO	Inactive	1
	RTAC-SLOT1	Communication active. Module type: RTAC. Connection interface: Option slot 1 of the drive.	2
	RTAC-SLOT2	Communication active. Module type: RTAC. Connection interface: Option slot 2 of the drive.	3
	RTAC-DDCS	Communication active. Module type: RTAC. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 17. For directions, see *RTAC-01 Pulse Encoder Interface User's Manual* [3AFE64486853 (English)].	4
	RRIA-SLOT1	Communication active. Module type: RRIA. Connection interface: Option slot 1 of the drive.	5
	RRIA-SLOT2	Communication active. Module type: RRIA. Connection interface: Option slot 2 of the drive.	6

Index	Name/Selection	Description	Def FbEq
	RRIA-DDCS	Communication active. Module type: RRIA. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link.	7
50.12	ENC2 PULSE NR	See parameter 50.02 ENC1 PULSE NR.	2048
		See parameter 50.02 ENC1 PULSE NR.	
50.13	ENC2 MEAS MODE	See parameter 50.03 ENC1 MEAS MODE.	A ¯_ B ¯_
		See parameter 50.03 ENC1 MEAS MODE.	
50.14	ENC2 FAULT FUNC	See parameter 50.04 ENC1 FAULT FUNC.	ALARM
		See parameter 50.04 ENC1 FAULT FUNC.	
51 COMM MODULE DATA		The parameters are visible and need to be adjusted, only when a fieldbus adapter module (optional) is installed and activated by parameter 70.01 COMM MODULE LINK. For details on the parameters, refer to the manual of the fieldbus module and chapter *Fieldbus control*. These parameter settings will remain the same even though the macro is changed.	
52 STANDARD MODBUS		Settings for the Standard Modbus Link. See chapter *Fieldbus control*.	
52.01	STATION NUMBER	Defines the address of the device. Two units with the same address are not allowed on-line.	1
	1…247	Address	1 = 1
52.02	BAUDRATE	Defines the transfer rate of the link.	9600
	600	600 bit/s	1
	1200	1200 bit/s	2
	2400	2400 bit/s	3
	4800	4800 bit/s	4
	9600	9600 bit/s	5
	19200	19200 bit/s	6
52.03	PARITY	Defines the use of parity and stop bit(s). The same setting must be used in all on-line stations.	ODD
	NONE1STOPBIT	No parity bit, one stop bit	1
	NONE2STOPBIT	No parity bit, two stop bits	2
	ODD	Odd parity indication bit, one stop bit	3
	EVEN	Even parity indication bit, one stop bit	4
70 COMM INTERFACE			
70.01	COMM MODULE LINK	Activates the external serial communication and selects the interface. See chapter *Fieldbus control*.	NO
	NO	No communication	1
	FIELDBUS	The drive communicates via a fieldbus adapter module in option slot 1 of the drive, or via CH0 on the RDCO board. See also parameter group 51 COMM MODULE DATA.	2
	ADVANT	The drive communicates with an ABB Advant OCS system via CH0 on the RDCO board (optional). See also parameter group 70 COMM INTERFACE.	3
	STD MODBUS	The drive communicates with a Modbus controller via the Modbus Adapter Module (RMBA) in option slot 1 of the drive. See also parameter 52 STANDARD MODBUS.	4

Index	Name/Selection	Description	Def FbEq
	CUSTOMISED	The drive communicates via customer specified link. The control sources are defined by parameters 90.04 MAIN DS SOURCE and 90.05 AUX DS SOURCE.	5
70.02	COMM PROFILE	Defines the profile on which the communication with the fieldbus or another drive is based. Visible only when fieldbus communication is activated by parameter 70.01 COMM MODULE LINK.	ABB DRIVES
	ABB DRIVES	ABB Drives profile	1
	GENERIC	Generic drive profile. Typically used with the fieldbus modules that have the type designation of form Rxxx (installed in the option slot of the drive).	2
70.03	COMM MOD FLT FUNC	Selects how the drive reacts in a fieldbus communication break, i.e. when the drive fails to receive the Main Reference Data Set or the Auxiliary Reference Data Set.	FAULT
	FAULT	Protection is active. The drive trips on a fault and stops the motor as defined by parameter 10.13 STOP FUNCTION.	1
	NO	Protection is inactive.	2
	CONST SPEED1	Protection is active. The drive generates a warning and sets the speed to the value defined by parameter 21.07 CONST SPEED1. **WARNING**! Make sure that it is safe to continue operation in case of a communication break.	3
	LAST SPEED	Protection is active. The drive generates a warning and freezes the speed to the level the drive was operating at (i.e activates Main Control Word bit 5 RAMP_HOLD). **WARNING**! Make sure that it is safe to continue operation in case of a communication break.	4
70.04	CH0 NODE ADDR	Defines the node address for channel CH0. No two nodes on-line may have the same address. The setting needs to be changed when a master station is connected to channel CH0 and it does not automatically change the address of the follower. Examples of such masters are an ABB Advant Controller or another drive.	1
	1...254	Address	1...254
70.05	CH0 HW CONNECTION	Selects the topology of the DDCS channel CH3 link.	RING
	RING	Devices are connected in a ring.	0
	STAR	Devices are connected in a star.	65535
70.06	CH0 BAUD RATE	Selects the communication speed of channel 1. Typically the setting needs to be changed only if the pulse encoder interface module is connected to channel 1 instead of channel 2. Then the speed must be changed to 4 Mbit/s.	1 Mbit/s
	8 Mbit/s	8 megabits per second	0
	4 Mbit/s	4 megabits per second	1
	2 Mbit/s	2 megabits per second	2
	1 Mbit/s	1 megabit per second	3
70.07	MAIN DS TIMEOUT	Defines the time delay before a communication break fault is activated. Time count starts when the link fails to update the message.	100 ms
	0...60000 ms	Time	1 = 1 ms

Index	Name/Selection	Description	Def FbEq
70.08	CH2 M/F FUNC	Defines the role of the drive in the Master/Follower link. See *Master/ Follower use of several drives*.	NOT IN USE
	NOT IN USE	The Master/Follower link is inactive.	1
	MASTER	Master drive	2
	FOLLOWER	Follower drive	3
	STANDBY	Follower drive which reads the control signals through a fieldbus interface, not from the Master/Follower link as usual.	4
70.09	CH2 NODE ADDR	Defines the node address for channel CH2. No two nodes on-line may have the same address.	1
	1...125	Address	1...125
70.10	CH2 COMM FLT FUNC	Selects how the drive reacts when a communication break is detected on channel CH2.	FAULT
		See parameter 70.03 COMM MOD FLT FUNC.	
70.11	CH2 TIME OUT DELAY	Selects the communication speed of channel CH2.	100 ms
	0...60000 ms	Time	1 = 1 ms
70.12	MASTER SIGNAL2	Selects the signal which is sent by the Master to the Follower drive(s) as reference 1 (to dataset 41 index 2).	401
	0...30000	Parameter index 401 denotes par. 4.01 POS ACT ENC. **Note:** If the Follower drive is in synchron control, this parameter must be set to 401.	0...30000
70.13	MASTER SIGNAL3	Selects the signal which is sent by the Master to the Follower drive(s) as reference 2 (to dataset 41 index 3).	303
	0...30000	Parameter index 210 denotes par. 2.10 TORQ REF3.	0...30000
70.14	CH3 NODE ADDR	Node address for channel CH3. No two nodes on-line may have the same address. Typically the setting needs to be changed when the drive is connected in a ring which consists of several drives and a PC with the DriveWindow program running.	1
	1...254	Address	1...254
70.15	CH3 HW CONNECTION	Selects the topology of the DDCS channel CH3 link.	RING
	RING	Devices are connected in a ring.	0
	STAR	Devices are connected in a star.	65535
90 DSET REC ADDR		- Addresses into which the received fieldbus data sets are written. - Numbers of the main and auxiliary data sets. The parameters are visible only when a fieldbus communication is activated by parameter 70.01 COMM MODULE LINK. For more information, see chapter *Fieldbus control*.	
90.01	AUX DS REF3	Selects the address into which the value of fieldbus reference REF3 is written.	0
	0…30000	Parameter index	0…30000
90.02	AUX DS REF4	Selects the address into which the value of fieldbus reference REF4 is written.	0
	0…30000	Parameter index	0…30000
90.03	AUX DS REF5	Selects the address into which the value of fieldbus reference REF5 is written.	0
	0…30000	Parameter index	0…30000

Index	Name/Selection	Description	Def FbEq
90.04	MAIN DS SOURCE	Defines the data set from which the drive reads the references REF1 and REF2.	1
	1...255	Data set number	1...255
90.05	AUX DS SOURCE	Defines the data set from which the drive reads references REF3, REF4 and REF5.	3
	1…255	Data set number	1...255
92 DSET TR ADDR		Main and Auxiliary Data Sets which the drive sends to the fieldbus master station. The parameters are visible only when a fieldbus communication is activated by parameter 70.01 COMM MODULE LINK. For more information, see chapter *Fieldbus control*. **Note:** Position parameter selections with group 92 DSET TR ADDR is not supported by the application program.	
92.01	MAIN DS STATUS WORD	Stores the address from which the Main Status Word is read from. Fixed value, not visible.	
	6.01 (fixed)	Parameter index	
92.02	MAIN DS ACT1	Selects the address from which Actual Signal 1 is read to the Main Data Set.	103
	0…30000	Parameter index	0…30000
92.03	MAIN DS ACT2	Selects the address from which Actual Signal 2 is read to the Main Data Set.	106
	0…30000	Parameter index	0…30000
92.04	AUX DS ACT3	Selects the address from which Actual Signal 3 is read to the Auxiliary Data Set.	711
	0…30000	Parameter index	0…30000
92.05	AUX DS ACT4	Selects the address from which Actual Signal 4 is read to the Auxiliary Data Set.	720
	0…30000	Parameter index	0…30000
92.06	AUX DS ACT5	Selects the address from which Actual Signal 5 is read to the Auxiliary Data Set.	712
	0…30000	Parameter index	0…30000
92.07	MSW BIT13 SEL	Selects the address for status information indicated through 06.01 MAIN STATUS WORD bit 13.	+006.012.06
	-255.255.31...+255.255.31	Parameter index and bit number (1…24), e.g. +01.15.01. = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).	
92.08	MSW BIT14 SEL	Selects the address for status information indicated through 06.01 MAIN STATUS WORD bit 14.	+006.012.15
	-255.255.31...+255.255.31	Parameter index and bit number (1…24), e.g. +01.15.01. = signal 01.15 bit 1. If you need an inverted value, switch the sign of the pointer value (-01.15.01).	
99 START UP		Language selection. Definition of motor set-up data.	
99.01	LANGUAGE	Selects the display language.	ENGLISH
	ENGLISH		1

Index	Name/Selection	Description	Def FbEq
99.02	APPLICATION MACRO	Selects the application macro. After selection, this parameter is restored back to NO. Active macro can be seen from signal 01.21 ACTIVE APPL MACRO. See chapter *Application macros* for more information. **Note:** When default parameter values of a macro are changed, the new settings become valid immediately and stay valid even if the power of the drive is switched off and on. Back-up of the default parameter settings of each macro is still available.	NO
	NO	Current parameters are used.	1
	FACTORY	Factory for basic applications. (Exceptions: Parameter settings in group 99 and motor model remain unchanged.)	2
	USER 1 LOAD	User 1 macro loaded into use. Before loading, check that the saved parameter settings and the motor model are suitable for the application. (Exceptions: Setting of parameter 16.03 remain unchanged.)	3
	USER 1 SAVE	Save User 1 macro. Stores the current parameter settings and the motor model. Parameter 16.03 is not included in the macro	4
	USER 2 LOAD	User 2 macro loaded into use. Before loading, check that the saved parameter settings and the motor model are suitable for the application. (Exceptions: Setting of parameter 16.03 remain unchanged.)	5
	USER 2 SAVE	Save User 2 macro. Stores the current parameter settings and the motor model. Parameter 16.03 is not included in the macro	6
99.03	MOTOR NOM VOLT	Defines the nominal motor voltage. Must be equal to the value on the motor rating plate.	0 V
	1/2 … 2 · U_N	Voltage. Allowed range is 1/2 … 2 · U_N of the drive. **Note:** The stress on the motor insulations is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than the rating of the drive and the supply of the drive.	1 = 1 V
99.04	MOTOR NOM CURR	Defines the nominal motor current. Must be equal to the value on the motor rating plate. **Note:** Correct motor run requires that the magnetising current of the motor does not exceed 90 percent of the nominal current of the inverter.	0 A
	0 … 2 · I_{2hd}	Allowed range: approx. 1/6 … 2 · I_{2hd} of ACS800.	1 = 0.1 A
99.05	MOTOR NOM FREQ	Defines the nominal motor frequency.	50 Hz
	8…300 Hz	Nominal frequency (50 or 60 Hz typically)	800…30000
99.06	MOTOR NOM SPEED	Defines the nominal motor speed. Must be equal to the value on the motor rating plate. The motor synchronous speed or another approximate value must not be given instead! **Note:** If the value of parameter 99.06 is changed, the speed limits in parameter group 20 LIMITS change automatically as well.	1 rpm
	0…18000 rpm	Nominal speed	
99.07	MOTOR NOM POWER	Defines the nominal motor power. Set exactly as on the motor rating plate.	0 kW
	0...9000 kW	Nominal motor power	0…90000

Index	Name/Selection	Description	Def FbEq
99.08	ID RUN	Selects the type of the motor identification. During the identification, the drive will identify the characteristics of the motor for optimum motor control. The ID Run Procedure is described in chapter *Start-up*. **Note:** The ID Run (STANDARD or REDUCED) should be selected if: - the operation point is near zero speed, and/or - operation at torque range above the motor nominal torque within a wide speed range and without any measured speed feedback is required.	ID MAGN
	ID MAGN	No ID Run. The motor model is calculated at first start by magnetising the motor for 20 to 60 s at zero speed. This can be selected in most applications.	1
	STANDARD	Standard ID Run. Guarantees the best possible control accuracy. The ID Run takes about one minute. **Note:** The motor must be de-coupled from the driven equipment. **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...80% of the nominal speed during the ID Run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	2
	REDUCED	Reduced ID Run. Should be selected instead of the Standard ID Run: - if mechanical losses are higher than 20% (i.e. the motor cannot be de-coupled from the driven equipment) - 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). **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...80% of the nominal speed during the ID Run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	3

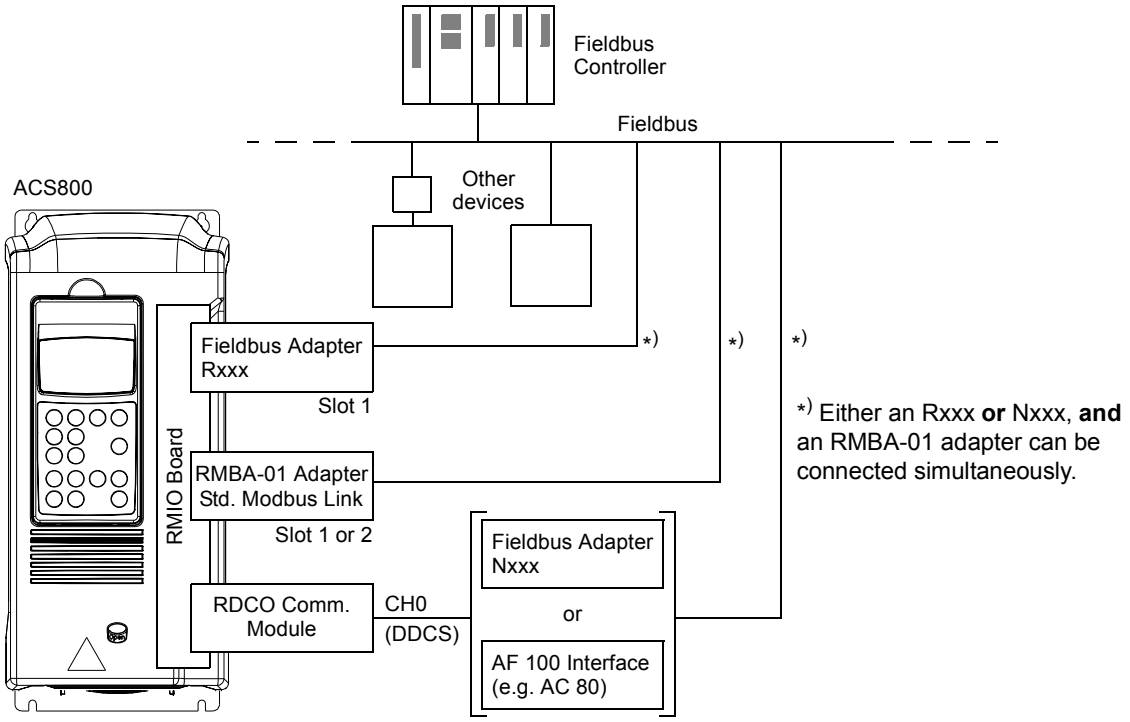
Fieldbus control

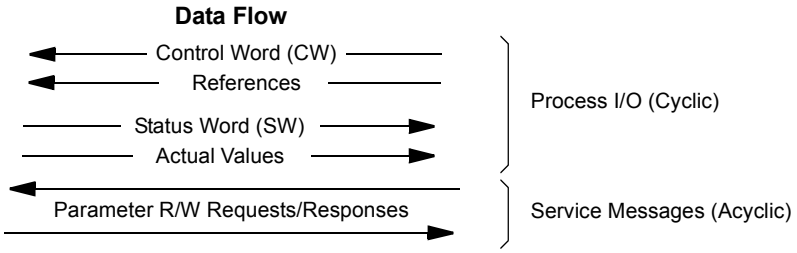
What this chapter contains

The chapter describes how the drive can be controlled by external devices over a communication network.

System overview

The drive can be connected to an external control system – usually a fieldbus controller – via an adapter module mounted in expansion slot 1 of the drive or via a fieldbus adapter connected to channel CH0 of an RDCO (DDCS Communication Option) module. (For connection to an Advant Fieldbus 100 system, an external AF 100 interface is used.)





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, e.g. digital and analogue inputs.

Setting up communication through a fieldbus adapter module

Note: For instructions on setting up an RMBA-01 module, see the section *Setting up communication through the Standard Modbus Link* below.

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

The communication between the drive and the fieldbus adapter module is then activated by setting parameter 70.01 COMM MODULE LINK. After the communication is initialised, the configuration parameters of the module become available in the drive at parameter group 51 COMM MODULE DATA.

Table 1 Communication set-up parameters for fieldbus adapter connection.

Parameter	Alternative settings	Setting for fieldbus control	Function/Information
COMMUNICATION INITIALISATION			
70.01 COMM MODULE LINK	NO FIELDBUS ADVANT STD MODBUS CUSTOMISED	FIELDBUS	Initialises communication between drive and fieldbus adapter module.
70.02 COMM PROFILE	ABB DRIVES GENERIC	ABB DRIVES or GENERIC	Selects the communication profile used by the drive. See the section *Communication profiles* below.
ADAPTER MODULE CONFIGURATION			
51.01 MODULE TYPE	–	–	Displays the type of the fieldbus adapter module.
51.02 (FIELDBUS PARAMETER 2)	These parameters are adapter module-specific. For more information, see the module manual. Note that not all of these parameters are necessarily visible.		
• • •			
51.26 (FIELDBUS PARAMETER 26)			
51.27 FBA PAR REFRESH*	**(0)** DONE **(1)** REFRESH	–	Validates any changed fieldbus parameter settings. After refreshing, the value reverts automatically to DONE.

Parameter	Alternative settings	Setting for fieldbus control	Function/Information
51.28 FILE CPI FW REV*	xyz (binary coded decimal)	–	Displays the CPI firmware revision of the fieldbus adapter configuration file stored in the memory of the drive. The CPI firmware version of the fieldbus adapter (refer to par. 51.32) must contain the same or a later CPI version to be compatible. x = major revision number; **y** = minor revision number; **z** = correction number. Example: **107** = revision 1.07.
51.29 FILE CONFIG ID*	xyz (binary coded decimal)	–	Displays the fieldbus adapter module configuration file identification stored in the memory of the drive. This information is drive application program-dependent.
51.30 FILE CONFIG REV*	xyz (binary coded decimal)	–	Displays the fieldbus adapter module configuration file revision stored in the memory of the drive. **x** = major revision number; **y** = minor revision number; **z** = correction number. Example: **1** = revision 0.01.
51.31 FBA STATUS	**(0)** IDLE **(1)** EXEC. INIT **(2)** TIME OUT **(3)** CONFIG ERROR **(4)** OFF-LINE **(5)** ON-LINE **(6)** RESET	–	Displays the status of the adapter module. IDLE = Adapter not configured. EXEC. INIT = Adapter initialising. TIME OUT = A timeout has occurred in the communication between the adapter and the drive. CONFIG ERROR = Adapter configuration error. The major or minor revision code of the CPI firmware revision stored in the adapter differs from that stated in the configuration file in the memory of the drive. OFF-LINE = Adapter is off-line. ON-LINE = Adapter is on-line. RESET = Adapter performing a hardware reset.
51.32 FBA CPI FW REV	–	–	Displays the CPI program revision of the module. **x** = major revision number; **y** = minor revision number; **z** = correction number. Example: **107** = revision 1.07.
51.33 FBA APPL FW REV	–	–	Displays the application program revision of the module. **x** = major revision number; **y** = minor revision number; **z** = correction number. Example: **107** = revision 1.07.

*Parameters 51.27 to 51.33 are only visible with a type Rxxx fieldbus adapter installed.

After the parameters in group 51 COMM MODULE DATA have been set, the drive control parameters (see the section *Drive control parameters*) must be checked and adjusted where necessary.

The new settings will take effect when the drive is next powered up, or when parameter 51.27 FBA PAR REFRESH is activated.

Setting up communication through the Standard Modbus Link

An RMBA-01 Modbus Adapter installed in slot 1 or 2 of the drive forms an interface called the Standard Modbus Link. The Standard Modbus Link can be used for external control of the drive by a Modbus controller (RTU protocol only).

It is possible to switch the control between the Standard Modbus Link and another fieldbus adapter, in which case the RMBA-01 is installed in slot 2, the fieldbus adapter in slot 1 (or connected to CH0 of the optional RDCO-0x board).

Communication set-up

The communication through the Standard Modbus Link is initialised by setting parameter 70.01 to STD MODBUS. Then, the communication parameters in group 52 must be adjusted. See the table below.

Table 2 Communication set-up parameters for the Standard Modbus Link.

Parameter	Alternative Settings	Setting for Control through the Standard Modbus Link	Function/Information
COMMUNICATION INITIALISATION			
70.01 COMM MODULE LINK	NO FIELDBUS ADVANT STD MODBUS CUSTOMISED	STD MODBUS	Initialises communication between drive (Standard Modbus Link) and Modbus-protocol controller. Activates communication parameters in group 52 STANDARD MODBUS.
70.02 COMM PROFILE	ABB DRIVES GENERIC	ABB DRIVES	Selects the communication profile used by the drive. See the section *Communication profiles* below.
COMMUNICATION PARAMETERS			
52.01 STATION NUMBER	1...247	–	Specifies the station number of the drive on the Standard Modbus Link.
52.02 BAUDRATE	600; 1200; 2400; 4800; 9600; 19200	–	Communication speed for the Standard Modbus Link
52.03 PARITY	NONE1STOPBIT NONE2STOPBIT ODD EVEN	–	Parity setting for the Standard Modbus Link

After the parameters in group 52 STANDARD MODBUS have been set, the drive control parameters (shown in the section *Drive control parameters*) should be checked and adjusted where necessary.

Modbus addressing

In the Modbus controller memory, the Control Word, the Status Word, the references, and the actual values are mapped as follows:

Data from fieldbus controller to drive	
Address	**Contents**
40001	Control Word
40002	Reference 1
40003	Reference 2
40007	Reference 3
40008	Reference 4
40009	Reference 5

Data from drive to fieldbus controller	
Address	**Contents**
40004	Status Word
40005	Actual 1
40006	Actual 2
40010	Actual 3
40011	Actual 4
40012	Actual 5

More information on Modbus communication is available from the Modicon website *http:\\www.modicon.com.*

Setting up an Advant Fieldbus 100 (AF 100) connection

The connection of a drive to an AF (Advant Fieldbus) 100 bus is similar to other fieldbusses, with the exception that one of the AF 100 interfaces listed below is substituted for the fieldbus adapter. The AF 100 interface is connected to channel CH0 on the RDCO board inside the drive using fibre optic cables.

The following is a list of suitable AF 100 interfaces:

- **AC 800M Advant Controller**
  DriveBus connection: CI858 DriveBus Communication Interface required. See *CI858 DriveBus Communication Interface User's Manual*, [3AFE68237432 (English)].
  For more information see *AC 800M Controller Hardware Manual*, [3BSE027941 (English)], *AC 800M/C Communication, Protocols and Design manual*, [3BSE028811 (English)] (ABB Industrial Systems, Västerås, Sweden).
- **CI810A Fieldbus Communication Interface (FCI)**
  TB811 (5 MBd) or TB810 (10 MBd) Optical ModuleBus Port Interface required
- **Advant Controller 70 (AC 70)**
  TB811 (5 MBd) or TB810 (10 MBd) Optical ModuleBus Port Interface required
- **Advant Controller 80 (AC 80)**
  Optical ModuleBus connection: TB811 (5 MBd) or TB810 (10 MBd) Optical ModuleBus Port Interface required
  DriveBus connection: Connectible to RMIO-01/02 Board with RDCO-01 Communication Option.

One of the above interfaces may already be present on the AF 100 bus. If not, an Advant Fieldbus 100 Adapter kit (NAFA-01) is separately available, containing the CI810A Fieldbus Communication Interface, TB810 and TB811 Optical ModuleBus Port Interfaces, and a TC505 Trunk Tap. (More information on these components is available from the *S800 I/O User's Guide,* 3BSE 008 878 [ABB Industrial Systems, Västerås, Sweden]).

Optical component types

The TB811 Optical ModuleBus Port Interface is equipped with 5 MBd optical components, while the TB810 has 10 MBd components. All optical components on a fibre optic link must be of the same type since 5 MBd components do not match 10 MBd components. The choice between TB810 and TB811 depends on the equipment it is connected to.

The TB811 (5 MBd) should be used when connecting to a drive with the following equipment:

- RMIO-01/02 Board with RDCO-02 Communication Option
- RMIO-01/02 Board with RDCO-03 Communication Option.

The TB810 (10 MBd) should be used when connecting to the following equipment:

- RMIO-01/02 Board with RDCO-01 Communication Option
- NDBU-85/95 DDCS Branching Units.

Communication Set-up

The communication between the drive and the AF 100 interface is activated by setting parameter 70.01 COMM MODULE LINK to ADVANT.

Table 3 Communication set-up parameters for AF 100 connection.

Parameter	Alternative Settings	Setting for Control through CH0	Function/Information
COMMUNICATION INITIALISATION			
70.01 COMM MODULE LINK	NO FIELDBUS ADVANT STD MODBUS CUSTOMISED	ADVANT	Initialises communication between drive (fibre optic channel CH0) and AF 100 interface. The transmission speed is 4 Mbit/s.
70.03 COMM MOD FLT FUNC	ABB DRIVES GENERIC	ABB DRIVES	Selects the communication profile used by the drive. See the section *Communication profiles* below.

After the communication activation parameters have been set, the AF 100 interface must be programmed according to its documentation, and the drive control parameters (see the section *Drive control parameters*) checked and adjusted where necessary.

In an Optical ModuleBus connection, the channel 0 address (parameter 70.04 CH0 NODE ADDR) is calculated from the value of the POSITION terminal in the appropriate database element (for the AC 80, DRISTD) as follows:

1. Multiply the hundreds of the value of POSITION by 16.

2. Add the tens and ones of the value of POSITION to the result.

For example, if the POSITION terminal of the DRISTD database element has the value of 110 (the tenth drive on the Optical ModuleBus ring), parameter 70.01 must be set to 16 × 1 + 10 = 26.

In an AC 80 DriveBus connection, the drives are addressed 1 to 12. The drive address (set with parameter 70.04 CH0 NODE ADDR) is related to the value of the DRNR terminal of ACSRX PC element.

Drive control parameters

After the fieldbus communication has been set up, the drive control parameters listed in the following table should be checked and adjusted where necessary.

The **Setting for fieldbus control** column gives the value to use when the fieldbus interface is the desired source or destination for that particular signal. The **Function/Information** column gives a description of the parameter.

The fieldbus signal routes and message composition are explained later under *The fieldbus control interface*.

Drive control parameters to be checked and adjusted for fieldbus control

Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
10.01 EXT1 START FUNC	MAIN DS WORD1	Enables the fieldbus Control Word (except bit 11) when EXT1 is selected as the active control location. See also par. 10.16 NET CONTROL.
10.04 EXT2 START FUNC	MAIN DS WORD1	Enables the fieldbus Control Word (except bit 11) when EXT2 is selected as the active control location.
10.16 NET CONTROL	0 or 1	Value 1 overrides the setting of par. 10.01 EXT1 START FUNC so that the fieldbus Control Word (except bit 11) is enabled when EXT1 is selected as the active control location. **Note:** Setting is not saved into permanent memory.
10.17 NET REFERENCE	0 or 1	1 = fieldbus reference REF1 overrides the speed reference defined by par. group 21 SPEED REFERENCE. EXT1 must be selected as the active control location with par. 11.01 CNTROL PLACE SEL and the drive control mode must be set to SPEED by par. 11.02 EXT1 CONTROL MODE. **Note:** The setting is not saved into permanent memory (will reset to zero when power is switched off).
11.01 CNTROL PLACE SEL	PROG DI1	Enables EXT1/EXT2 selection by fieldbus Control Word (05.02) bit 11 EXT CTRL LOC.
12.04 PROGRAMMABLE DI1	+05.02.11	
21.02/21.03/21.04 SPEED REF1...3 or 24.02/24.03 TORQ REF 1...2	MAIN DS REF1 MAIN DS REF2 AUX DS REF1 AUX DS REF2 AUX DES REF3	Fieldbus reference REF1/REF2 is used.
40.04 POS REF SEL	MAIN DS REF12	Position target reference from fieldbus
OUTPUT SIGNAL SOURCE		
14 RELAY OUTPUTS		Fieldbus data through relay outputs

Parameter	Setting for fieldbus control	Function/Information
15 ANALOGUE OUTPUTS		Fieldbus reference through analogue outputs

INPUT SIGNAL SOURCE		
12.04... 12.11 PROGRAMMABLE DI1...8		Source for freely programmable boolean information, (i.e. when PROG DI1...8 has been selected). Example: User macro change through fieldbus: parameter 16.03 USER MACRO IO CHG value is set to PROG DI1 and parameter value 12.04 PROGRAMMABLE DI1 is set to +05.02.12.

SYSTEM CONTROL INPUTS		
10.07 RUN ENABLE	PROG DI1	Enables the control of the Run Enable signal through fieldbus Control Word (05.02) bit 3 INHIBIT_ OPERATION.
12.04 PROGRAMMABLE DI1	+05.02.03	
10.15 RESET	PROG DI2	Enables fault reset through fieldbus Control Word (05.02) bit 7 RESET. **Note:** With Generic drive profile parameter 10.01 EXT1 START FUNC must be set to MAIN DS WORD1.
12.05 PROGRAMMABLE DI2	+05.02.07	
16.05 PARAMETER SAVE	DONE SAVE	Saves parameter value changes (including those made through fieldbus control) to permanent memory.

COMMUNICATION FAULT FUNCTIONS		
70.03 COMM MOD FLT FUNC	FAULT NO CONST SP1 LAST SPEED	Determines drive action in case fieldbus communication is lost. **Note:** The communication loss detection is based on monitoring of received Main data sets (whose sources are selected with parameters 90.04 MAIN DS SOURCE and 90.05 AUX DS SOURCE respectively).
70.07 MAIN DS TIMEOUT	0…60000 ms	Defines the time delay before a communication break fault is activated.

FIELDBUS REFERENCE TARGET SELECTION		
90.01 AUX DS REF3	0…30000	Defines the drive parameter into which the value of fieldbus reference REF3 is written. **Format: xxyy**, where **xx** = parameter group (10 to 89), **yy** = parameter Index. E.g. **3001** = parameter 30.01.
90.02 AUX DS REF4	0…30000	Defines the drive parameter into which the value of fieldbus reference REF4 is written. **Format:** see 90.01 AUX DS REF3 above.
90.03 AUX DS REF5	0…30000	Defines the drive parameter into which the value of fieldbus reference REF5 is written. **Format:** see 90.01 AUX DS REF3 above.

Parameter	Setting for fieldbus control	Function/Information
90.04 MAIN DS SOURCE	1...255	If 70.01 COMM MODULE LINK is set to CUSTOMISED, this parameter selects the source from which the drive reads the Main Reference data set (comprising the fieldbus Control Word, fieldbus reference REF1, and fieldbus reference REF2).
90.05 AUX DS SOURCE	1...255	If 70.01 COMM MODULE LINK is set to CUSTOMISED, this parameter selects the source from which the drive reads the Auxiliary Reference data set (comprising fieldbus references REF3, REF4 and REF5).

ACTUAL SIGNAL SELECTION FOR FIELDBUS		
92.01 MAIN DS STATUS WORD	6.01	The Status Word is transmitted as the first word of the Main Actual Signal data set.
92.02 MAIN DS ACT1	0…30000	Selects the Actual signal or parameter value to be transmitted as the second word (ACT1) of the Main Actual Signal data set. **Format:** (**x**)**xyy,** where (**x**)**x** = actual signal group or parameter group, **yy** = actual signal or parameter index. E.g. **104** = actual signal 1.04 FREQUENCY; **2202** = parameter 22.02 ACCEL TIME 1. **Note:** With the Generic Drive communication profile active (par. 70.02 = GENERIC), this parameter is fixed to **103** (actual signal 1.03 SPEED – in DTC motor control mode).
92.03 AUX DS REF5	0…30000	Selects the Actual signal or parameter value to be transmitted as the third word (ACT2) of the Main Actual Signal data set. **Format:** see 92.02 MAIN DS ACT1 above.
92.04 MAIN DS SOURCE	0…30000	Selects the Actual signal or parameter value to be transmitted as the first word (ACT3) of the Auxiliary Actual Signal data set. **Format:** see 92.02 MAIN DS ACT1 above.
92.05 AUX DS SOURCE	0…30000	Selects the Actual signal or parameter value to be transmitted as the second word (ACT4) of the Auxiliary Actual Signal data set. **Format:** see 92.02 MAIN DS ACT1 above.
92.06 AUX DS ACT5	0…30000	Selects the Actual signal or parameter value to be transmitted as the third word (ACT5) of the Auxiliary Actual Signal data set. **Format:** see 92.02 MAIN DS ACT1 above.
92.07 MSW BIT13 SEL	0…30000	Selects the status information to be transmitted as bit 13 of the 06.01 MAIN STATUS WORD.
92.08 MSW BIT14 SEL	0…30000	Selects the status information to be transmitted as bit 14 of the 06.01 MAIN STATUS WORD.

Actual Values

Actual Values (ACT) are 16-bit words containing information on selected operations of the drive. The functions to be monitored are selected with the parameters in group 92 DSET TR ADDR. The scaling of the integers sent to the master as Actual Values depends on the selected function; please refer to *Actual signals and parameters*.

Note: Position parameter selections with group 92 DSET TR ADDR is not supported by the application program.

The fieldbus control interface

The communication between a fieldbus system and the drive employs *data sets.* One data set (abbreviated DS) consists of three 16-bit words called data words (DW). The ACS800 Motion Control Application Program supports the use of four data sets, two in each direction.

The two data sets for controlling the drive are referred to as the Main Reference data set and the Auxiliary Reference data set. The sources from which the drive reads the Main and Auxiliary Reference data sets are defined by parameters 90.04 MAIN DS SOURCE and 90.05 AUX DS SOURCE respectively. The contents of the Main Reference data set word 1 is fixed. The contest of Main Reference data set 2 and 3 can be selected as speed or torque reference with parameters 21.02...21.04, 24.02...24.03 or as position reference with parameter 40.04. The contents of the Auxiliary Reference data set can be selected with parameters 90.01...90.03.

The two data sets containing actual information on the drive are referred to as the Main Actual Signal data set and the Auxiliary Actual Signal data set. The contents of both data sets are partly selectable with the parameters at group 92 DSET TR ADDR.

	Data from fieldbus controller to drive		
	Word	**Contents**	**Selector**
***Index**	**Main Reference data set DS1**		
1	1st word	Control Word	(Fixed)
2	2nd word	Reference 1	speed/torque ref
3	3rd word	Reference 2	speed/torque ref
***Index**	**Auxiliary Reference data set DS3**		
7	1st word	Reference 3	par. 90.01, speed/torque ref
8	2nd word	Reference 4	par. 90.02, speed/torque ref
9	3rd word	Reference 5	par. 90.03, speed/torque ref

	Data from drive to fieldbus controller		
	Word	**Contents**	**Selector**
***Index**	**Main Actual Signal data set DS2**		
4	1st word	Status Word	(Fixed)
5	2nd word	Actual 1	**par. 92.02
6	3rd word	Actual 2	par. 92.03
***Index**	**Aux. Actual Signal data set DS4**		
10	1st word	Actual 3	Par. 92.04
11	2nd word	Actual 4	Par. 92.05
12	3rd word	Actual 5	Par. 92.06

*The index number is required when data word allocation to process data is defined via the fieldbus parameters at group 51 COMM MODULE DATA. This function is dependent on the type of the fieldbus adapter.

**With the Generic Drive communication profile active, Actual 1 is fixed to actual signal 01.03 SPEED.

The update time for the Main Reference and Main Actual Signal data sets is 6 milliseconds; for the Auxiliary Reference and Auxiliary Actual Signal data sets, it is 100 milliseconds.

The Control Word and the Status Word

The Control Word (CW) is the principal means of controlling the drive from a fieldbus system.

It is effective when the active control location (EXT1 or EXT2, see parameters 10.01 EXT1 START FUNC and 10.04 EXT2 START FUNC) is set to MAIN DS WORD1, or if parameter 10.16 NET CONTROL is set to 1 (with Generic Drive communication profile only).

The Control Word is sent by the fieldbus controller to the drive. The drive switches between its states according to the bit-coded instructions of the Control Word.

The Status Word (SW) is a word containing status information, sent by the drive to the fieldbus controller.

See the section *Communication profiles* below for information on the composition of the Control Word and the Status Word.

Fieldbus references

All references (REF) except position references are 16-bit signed integers.
A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference value.

The table below shows the fieldbus reference scaling:

Reference	Reference scaling
Torque	10000 = 100% of the motor nominal torque
Speed	20000 = par. 19.01
Position	See par. 19.12...19.15

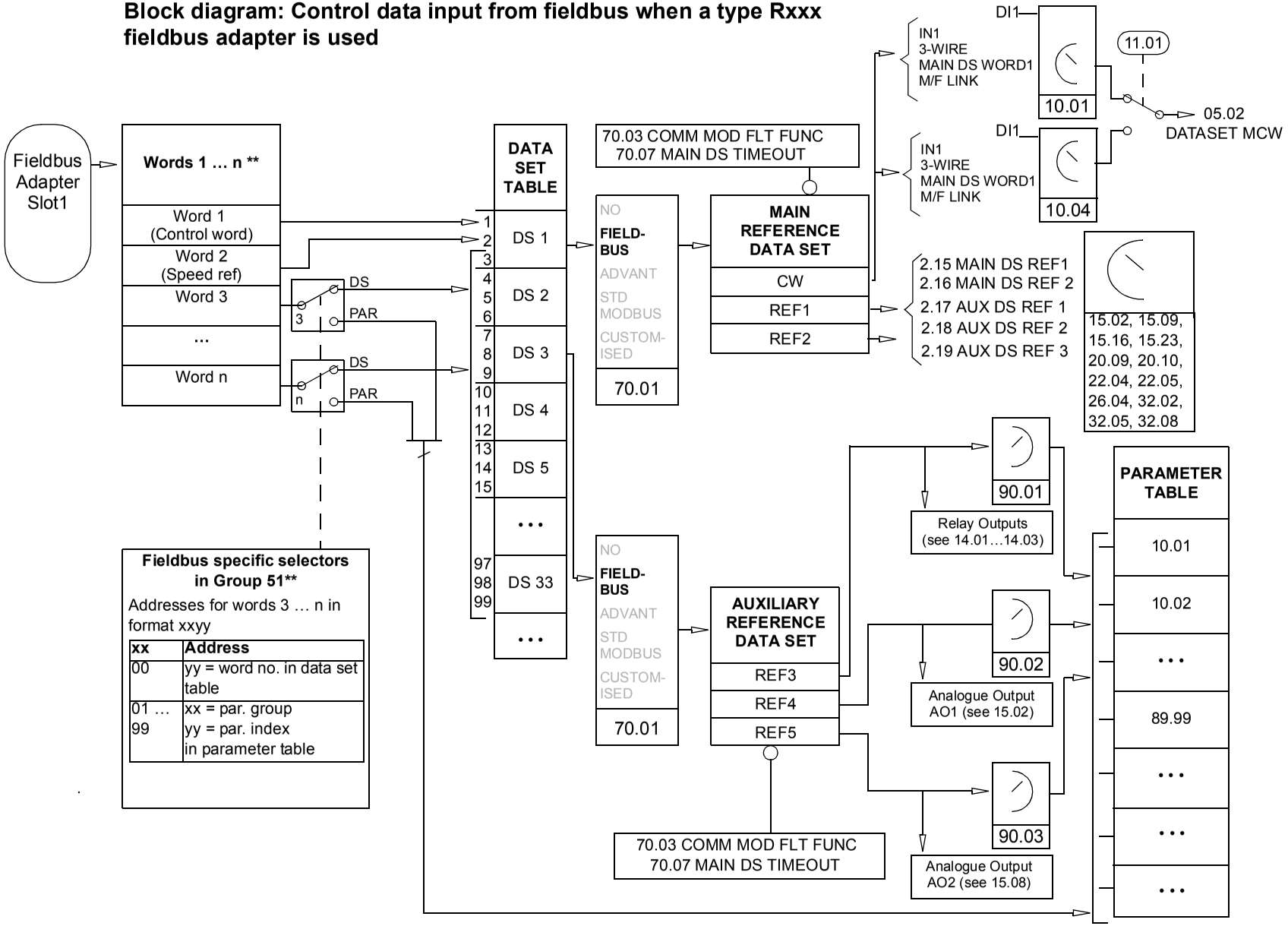
Reference handling

With the Generic Drive communication profile, the limit "Max.Ref." is defined by parameter 99.06 MOTOR NOM SPEED.

The use of REF2 is not supported by the Generic Drive communication profile.

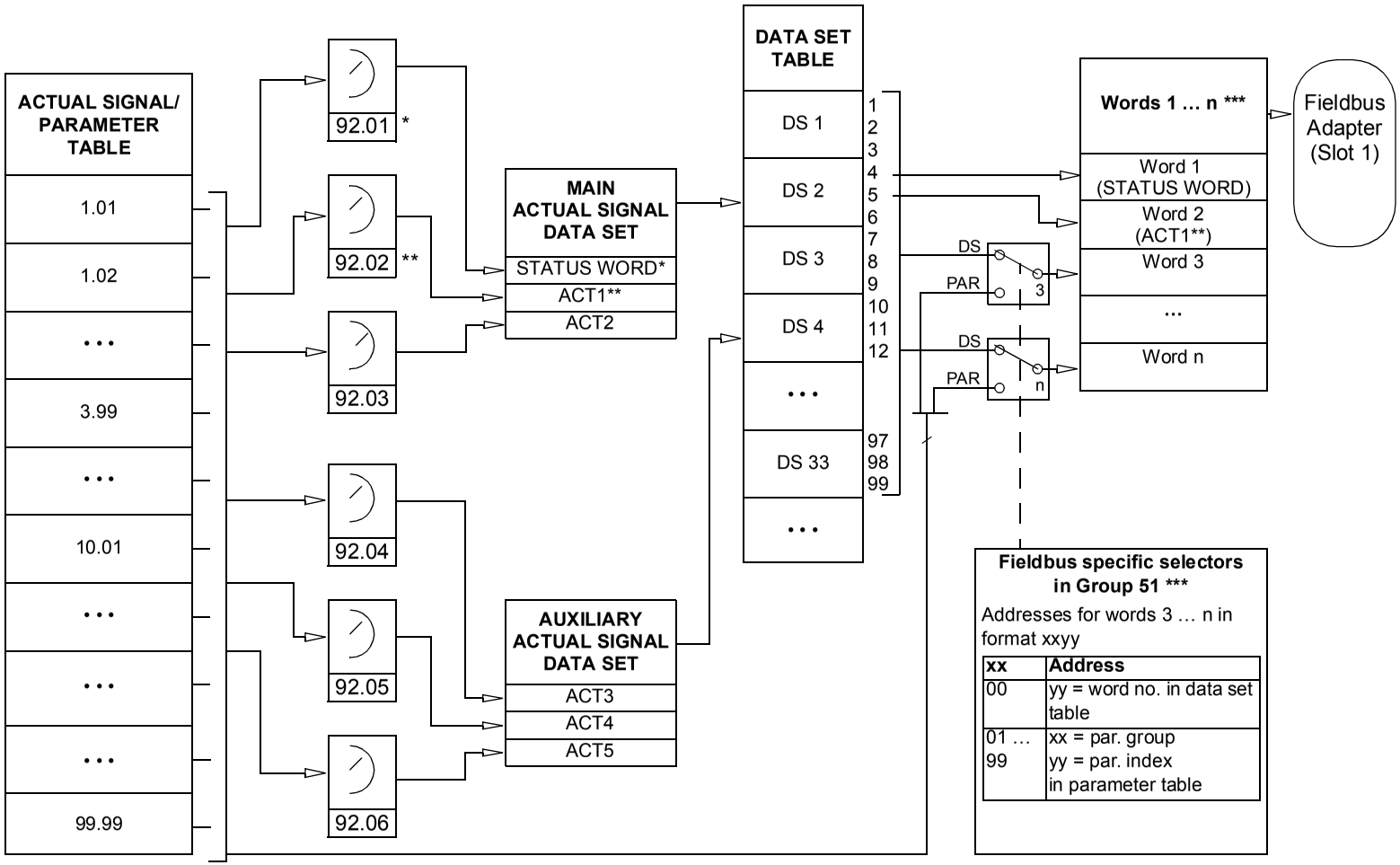
For information on the scaling of the fieldbus reference, see the manual delivered with the fieldbus adapter (Generic Drive profile).

Block diagram: Control data input from fieldbus when a type Rxxx fieldbus adapter is used



** See the fieldbus adapter user's manual for more information.

Block diagram: Actual value selection for fieldbus when a type Rxxx fieldbus adapter is used

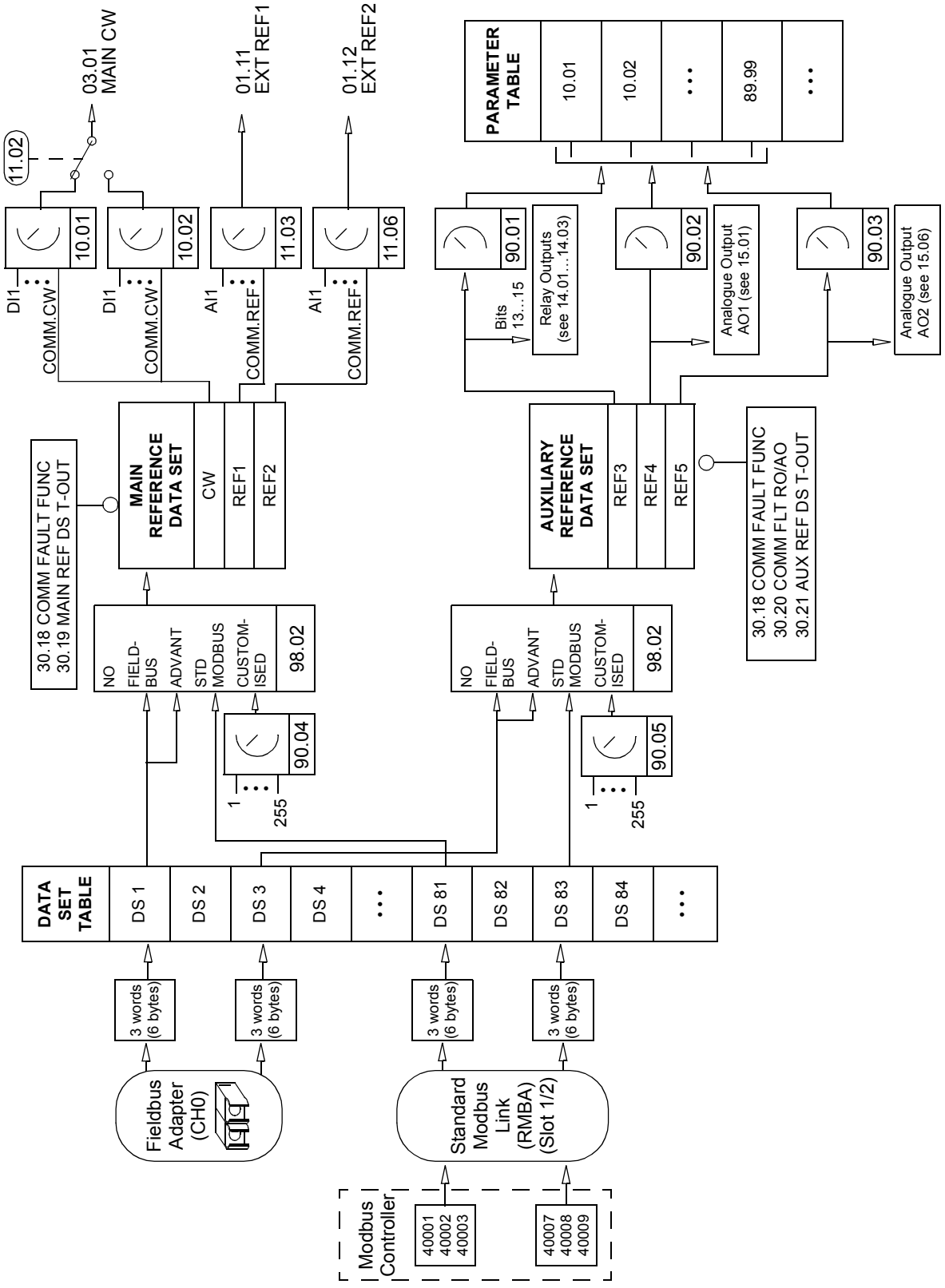


* Fixed to 06.01 MAIN STATUS WORD.

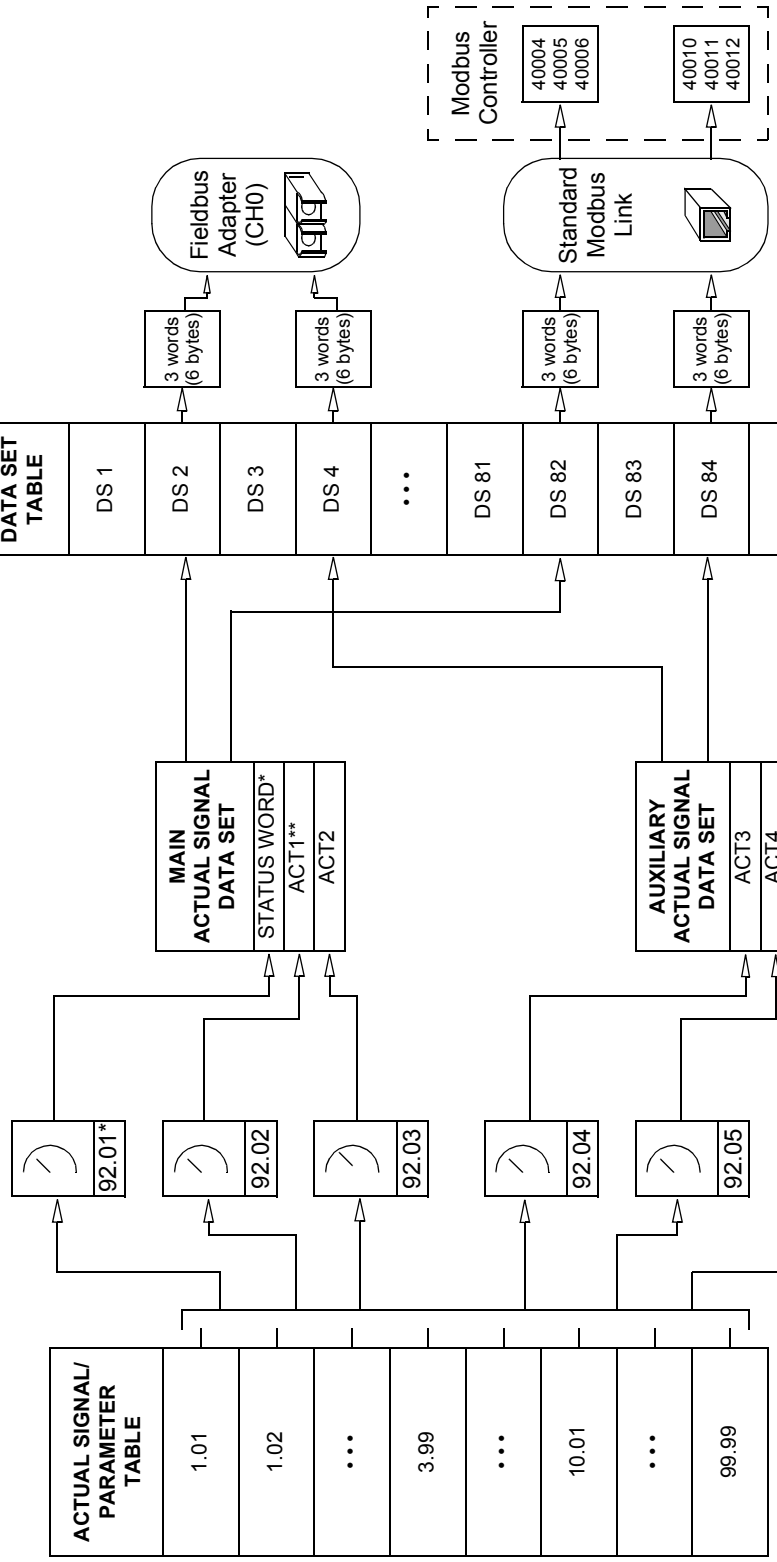
** Fixed to 01.03 SPEED when Generic communication profile is used.

*** See the fieldbus adapter user's manual for more information.

Block diagram: Control data input from fieldbus when a type Nxxx fieldbus adapter is used



Block Diagram: Actual value selection for fieldbus when a type Nxxx fieldbus adapter is used



* Fixed to 06.01 MAIN STATUS WORD.

** Fixed to 01.03 SPEED when Generic communication profile is used.

Communication profiles

The ACS800 supports two communication profiles:

- ABB Drives communication profile
- Generic Drive communication profile.

The ABB Drives communication profile should be selected with type Nxxx fieldbus adapter modules, and when the manufacturer-specific mode is selected (via the PLC) with type Rxxx fieldbus adapter modules.

The Generic Drive profile is supported by type Rxxx fieldbus adapter modules only.

ABB Drives communication profile

The ABB Drives communication profile is active when parameter 70.02 COMM PROFILE is set to ABB DRIVES. The Control Word, Status Word, and reference scaling for the profile are described below.

The ABB Drives communication profile can be used through both EXT1 and EXT2. The Control Word commands are in effect when par. 10.01 EXT1 START FUNC or 10.04 EXT2 START FUNC (whichever control location is active) is set to MAIN DS WORD1.

Control word for ABB Drives communication profile (05.01 MAIN CONTROL WORD)

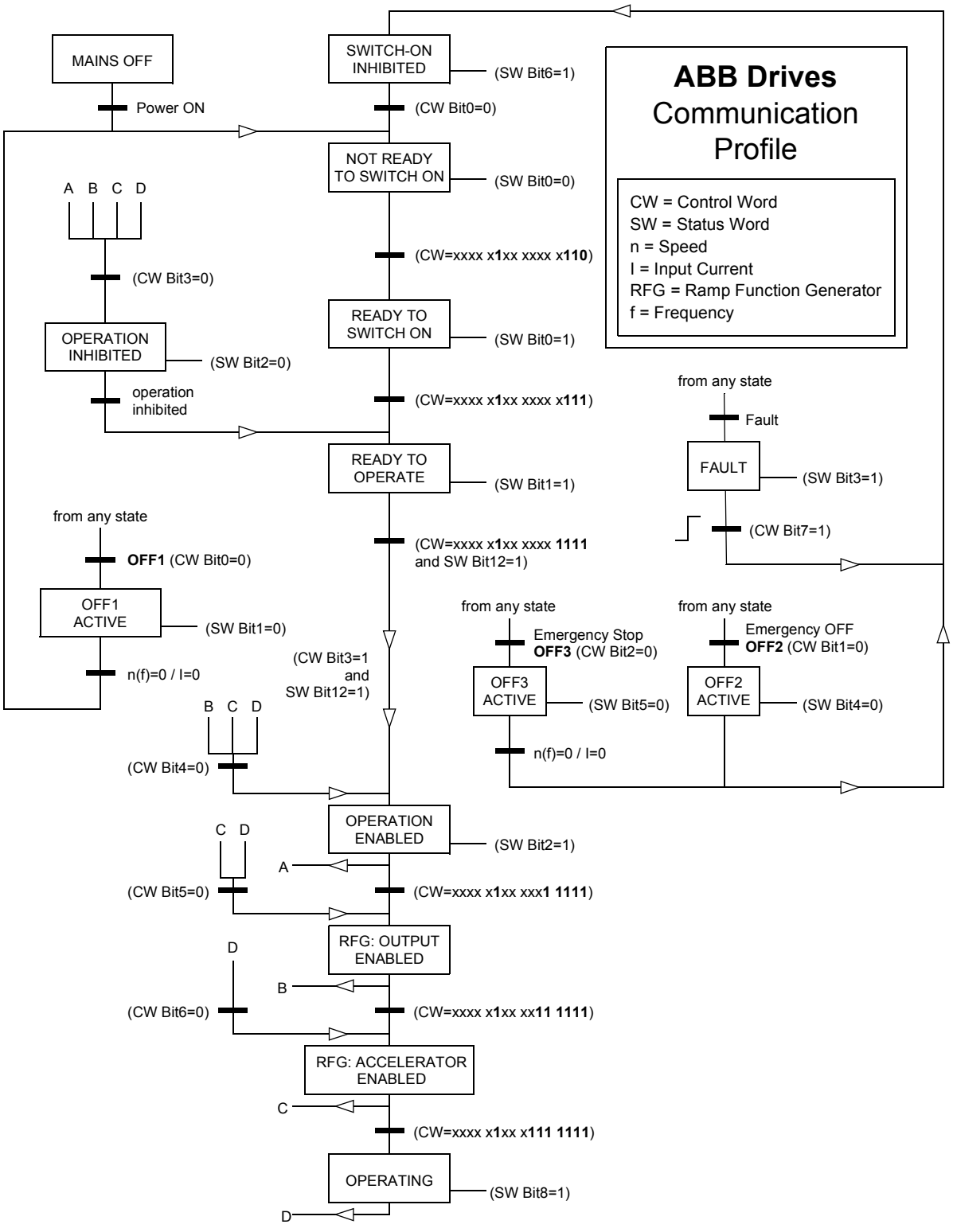
The Control Word for the ABB Drives communication profile. The upper case boldface text refers to the states shown in the ABB Communications Profile figure below.

Bit	Name	Value	Enter STATE/Description
0	OFF1 CONTROL	1	Enter **READY TO OPERATE.**
		0	Stop along currently active deceleration ramp (22.03/22.05). Enter **OFF1 ACTIVE;** proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2 CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Enter **OFF2 ACTIVE**; proceed to **SWITCH-ON INHIBITED.**
2	OFF3 CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by par. 22.07. Enter **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED.** **Warning:** Ensure motor and driven machine can be stopped using this stop mode.
3	INHIBIT_ OPERATION	1	Enter OPERATION ENABLED. **Note:** The Run Enable signal must be active; see parameter 10.07 RUN ENABLE.
		0	Inhibit operation. Enter **OPERATION INHIBITED.**
4	RAMP_OUT_ ZERO	1	Normal operation. Enter **RAMP FUNCTION GENERATOR: OUTPUT ENABLED.**
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Enable ramp function. Enter **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED.**
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Enter **OPERATING.**
		0	Force Ramp Function Generator input to zero.
7	RESET	0 ⇒ 1	Fault reset if an active fault exists. Enter **SWITCH-ON INHIBITED.** Effective, if parameter 10.15 RESET is set to PROG DI3 and 12.06 PROGRAMMABLE DI3 is set to +005.002.07.
		0	Continue normal operation.
8	INCHING_1	1	Not in use
		1 ⇒ 0	Not in use
9	INCHING_2	1	Not in use
		1 ⇒ 0	Not in use
10	REMOTE_CMD	1	Fieldbus control enabled
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus control enabled. Reference and deceleration/acceleration ramp are locked.
11	EXT CTRL LOC	1	Select External Control Location EXT2. Effective, if parameter 10.01 CNTRL PLACE SEL is set to PROG DI4 and 12.07 PROGRAMMABLE DI4 is set to +005.002.11.
		0	Select External Control Location EXT1. Effective, if parameter 10.01 CNTRL PLACE SEL is set to PROG DI4 and 12.07 PROGRAMMABLE DI4 is set to +005.002.11.
12 … 15	Reserved		

Status word for ABB Drives communication profile (06.01 MAIN STATUS WORD)

The Status Word for the ABB Drives communication profile. The upper case boldface text refers to the states shown in the ABB Communications Profile figure below.

Bit	Name	Value	STATE/Description
0	RDY_ON	1	**READY TO SWITCH ON**
		0	**NOT READY TO SWITCH ON**
1	RDY_RUN	1	**READY TO OPERATE**
		0	**OFF1 ACTIVE**
2	RDY_REF	1	**OPERATION ENABLED**
		0	**OPERATION INHIBITED**
3	TRIPPED	1	**FAULT**
		0	No fault
4	OFF_2_STA	1	OFF2 inactive
		0	**OFF2 ACTIVE**
5	OFF_3_STA	1	OFF3 inactive
		0	**OFF3 ACTIVE**
6	SWC_ON_INHIB	1	**SWITCH-ON INHIBITED**
		0	
7	ALARM	1	Warning/Alarm
		0	No Warning/Alarm
8	AT_SETPOINT	1	**OPERATING.** Actual value equals reference value (= is within tolerance limits).
		0	Actual value differs from reference value (= is outside tolerance limits).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2)
		0	Drive control location: LOCAL
10	ABOVE_LIMIT	1	Actual speed (01.03 SPEED) value equals or exceeds the supervision function 1 limit (32.03 SUP FUNC1 LIMIT). Valid in both directions regardless of parameter 32.01 SUPERVISION FUNC1 and 32.02 SUP FUNC1 VALUE values.
		0	Actual speed value is within supervision limit.
11	EXT CTRL LOC	1	External Control Location EXT2 selected
		0	External Control Location EXT1 selected
12	EXT RUN ENABLE	1	External Run Enable signal received
		0	No External Run Enable received
13, 14	Freely programmable		See parameters 92.07 MSW BIT13 SEL and 92.08 MSW BIT14 SEL.
15		1	Communication error detected by fieldbus adapter module (on fibre optic channel CH0).
		0	Fieldbus adapter (CH0) communication OK


MAINS OFF
Power ON
SWITCH-ON INHIBITED
(SW Bit6=1)
(CW Bit0=0)
NOT READY TO SWITCH ON
(SW Bit0=0)
A B C D
(CW=xxxx x**1**xx xxxx x**110**)
(CW Bit3=0)
READY TO SWITCH ON
(SW Bit0=1)
OPERATION INHIBITED
(SW Bit2=0)
operation inhibited
(CW=xxxx x**1**xx xxxx x**111**)
READY TO OPERATE
(SW Bit1=1)
from any state
Fault
FAULT
(SW Bit3=1)
(CW Bit7=1)
from any state
OFF1 (CW Bit0=0)
(CW=xxxx x**1**xx xxxx **1111** and SW Bit12=1)
OFF1 ACTIVE
(SW Bit1=0)
n(f)=0 / I=0
(CW Bit3=1 and SW Bit12=1)
from any state
Emergency Stop **OFF3** (CW Bit2=0)
OFF3 ACTIVE
(SW Bit5=0)
n(f)=0 / I=0
from any state
Emergency OFF **OFF2** (CW Bit1=0)
OFF2 ACTIVE
(SW Bit4=0)
B C D
(CW Bit4=0)
OPERATION ENABLED
(SW Bit2=1)
C D
A
(CW Bit5=0)
(CW=xxxx x**1**xx xxx**1 1111**)
RFG: OUTPUT ENABLED
D
B
(CW Bit6=0)
(CW=xxxx x**1**xx xx**11 1111**)
RFG: ACCELERATOR ENABLED
C
(CW=xxxx x**1**xx x**111 1111**)
OPERATING
(SW Bit8=1)
D
ABB Drives
Communication Profile
CW = Control Word
SW = Status Word
n = Speed
I = Input Current
RFG = Ramp Function Generator
f = Frequency

Generic Drive communication profile

The Generic Drive communication profile is active when parameter 70.02 COMM PROFILE is set to GENERIC. The Generic Drive profile realises the device profile for drives – speed control only – as defined by specific fieldbus standards such as PROFIDRIVE for PROFIBUS, AC/DC Drive for DeviceNet, Drives and Motion Control for CANopen, etc. Each device profile specifies its Control and Status Words, Reference and Actual value scaling. The profiles also define Mandatory services which are transferred to the application interface of the drive in a standardised way.

The proper functioning of the Generic Drive profile requires that Control Word commands are enabled by setting parameter 10.01 EXT1 START FUNC to MAIN DS WORD1.

Note 1: The Generic Drive communication profile requires the use of speed reference and EXT1 as the active control location.

Note 2: The Generic Drive profile is only available with type Rxxx fieldbus adapter modules.

Drive commands supported by the Generic Drive communication profile

Name	Description
STOP	The drive decelerates the motor to zero speed according to the active deceleration ramp (parameter 22.03 DECEL TIME1 or 22.05 DECEL TIME2).
START	The drive accelerates to the set reference value according to the active acceleration ramp (par. 22.02 ACCEL TIME 1or 22.04 ACCEL TIME2).
COAST STOP	The drive coasts to stop, i.e. the drive stops modulating. However, this command can be overridden by the Brake Control function, which forces the drive to decelerate to zero speed by the active deceleration ramp.
QUICK STOP	The drive decelerates the motor to zero speed within the emergency stop deceleration time defined by par. 22.07 OFF3 RAMP TIME.
CURRENT LIMIT STOP (CLS)	The drive decelerates the motor to zero speed according to the set current limit (par. 20.05 MAX CURRENT) or torque limit (20.07 TORQ MAX LIM1), whichever is first reached. The same procedure is valid in case of a Voltage Limit Stop (VLS).
INCHING1	With this command active, the drive accelerates the motor to Constant Speed 1 (defined by par. 21.07 CONST SPEED1). After the command is removed, the drive decelerates the motor to zero speed. **Note:** The speed reference ramps are not effective. The speed change rate is only limited by the current (or torque) limit of the drive. **Note:** Inching 1 takes priority over Inching 2.
INCHING2	With this command active, the drive accelerates the motor to Constant Speed 2 (defined by par. 21.08 CONST SPEED2). After the command is removed, the drive decelerates the motor to zero speed. **Note:** The speed reference ramps are not effective. The speed change rate is only limited by the current (or torque) limit of the drive. **Note:** Inching 1 takes priority over Inching 2.
RAMP OUT ZERO	When active, forces the output of the reference function generator to zero.
RAMP HOLD	When active, freezes the reference function generator output.
FORCED TRIP	Trips the drive. The drive will indicate a fault FORCED TRIP.
RESET	Resets an active fault.

Diverse status, fault, alarm and limit words

06.02 AUXILIARY STATUS WORD

Bit	Name	Description
0	Reserved	
1	OUT OF WINDOW	Speed difference is out of the window (in speed control)*.
2	Reserved	
3	MAGNETIZED	Flux has been formed in the motor.
4	Reserved	
5	SYNC RDY	Position counter is synchronised.
6	1 START NOT DONE	Drive has not been started after changing the motor parameters in group 99 START UP.
7	IDENTIF RUN DONE	Motor ID Run is successfully completed.
8	START INHIBITION	Prevention of unexpected start-up is active.
9	LIMITING	Control is at a limit. See actual signal *06.13 LIMIT WORD 1* below.
10	TORQ CONTROL	Torque reference is followed*.
11	ZERO SPEED	Absolute value of motor actual speed is below zero speed limit (4% of synchronous speed).
12	INTERNAL SPEED FB	Internal speed feedback is followed.
13	M/F COMM ERR	Master/Follower link (on CH2) communication error*
14 … 15	Reserved	

*See *Master/Follower Application Guide* [3AFY58962180 (English)].

06.11 POS STATUS WORD 1

Bit	Name	Description
0	POS ENA	Position interpolator is enabled. (Source of the position interpolator enable command is selected with parameter 40.01 POS ENABLE SEL.)
1	POS START	Positioning start command is active
2	ENC2 ACT	Actual position value from encoder 2
3	Reserved	
4	POS SYN CYC OK	Synchron error is within the window defined by par. 32.15 SYNC ERR WINDOW and cyclic correction has been performed (CYC_DONE_ONES).
5	POS SYN ERR OK	Synchron error is within the window defined by par. 32.15 SYNC ERR WINDOW.
6	Reserved	
7	SYNC ERR CMP	Synchron control mode is used and synchron error is within the window defined by par. 32.15 SYNC ERR WINDOW.
8	POS POS RUN OK	Synchron error is within the window defined by par. 32.15 SYNC ERR WINDOW and position controller input 04.14 POSITION ERROR is within the window defined by par. 32.11 POSITION WINDOW.
9...11	Reserved	
12	DYN LIM ENA	Dynamic limiter enabled
13	POS SPEED ENA	Positive speed enabled
14	NEG SPEED ENA	Negative speed enabled
15	IPO HALT	Position interpolator stopped

06.12 POS STATUS WORD 2

Bit	Name	Description
0	POS SW1	Actual position value equals or exceeds par. 32.12 POS THRESHOLD 1 value.
1	POS SW2	Actual position value equals or exceeds par. 32.13 POS THRESHOLD 2 value.
2	POS SW3	Actual position value equals or exceeds par. 32.14 POS THRESHOLD 3 value.
3	POS RANGE	Position is between POS_SW1 and POS_SW2.
4	IN POS WIN	Distance to target is with the window defined by par. 32.11 POSITION WINDOW.
5	IN POS	Position interpolator has reached target position.
6	IN POS OK	Position interpolator has reached target position and 04.14 POSITION ERROR is within the window defined by par. 32.11 POSITION WINDOW.
7	POS OK	Position error is within the window defined by par. 32.11 POSITION WINDOW.
8	MAST REF PROBE	Master reference probe is active.
9	ACT POS PROBE	Actual position probe is active.
10...11	Reserved	
12	CYCLIC CORR	Cyclic correction is active.
13	CYC DONE ONCE	Cyclic correction has been performed at least once.
14	HOMING DONE	Homing has been performed.
15	HOMING DONE ONCE	Homing has been performed at least once.

06.13 LIMIT WORD 1

Bit	Name	Active Limit
0	TORQ MOTOR LIM	Pull-out limit
1	SPD TOR MIN LIM	Speed control torque minimum limit
2	SPD TOR MAX LIM	Speed control torque maximum limit
3	TORQ USER CUR LIM	User-defined current limit
4	TORQ INV CUR LIM	Internal current limit
5	TORQ MIN LIM	Any torque minimum limit
6	TORQ MAX LIM	Any torque maximum limit
7	TREF TORQ MIN LIM	Torque reference minimum limit
8	TREF TORQ MAX LIM	Torque reference maximum limit
9	FLUX MIN LIM	Flux reference minimum limit
10	FREQ MIN LIMIT	Speed/Frequency minimum limit
11	FREQ MAX LIMIT	Speed/Frequency maximum limit
12	DC UNDERVOLT	DC undervoltage limit
13	DC OVERVOLT	DC overvoltage limit
14	TORQUE LIMIT	Any torque limit
15	FREQ LIMIT	Any speed/frequency limit

06.14 LIMIT WORD 2

Bit	Name	Description
0	POWER MAX LIM	Limitation defined by par. 20.11 P MOTORING LIM is active.
1	POWER MIN LIM	Limitation defined by par. 20.11 P GENERATING LIM is active.
3...15	Not in use	

06.15 LIMIT WORD INV

The LIMIT WORD INV Word includes faults and warnings, which occur when the output current limit of the drive is exceeded. The current limit protects the drive in various cases, i.e. integrator overload, high IGBT temperature etc.

Bit	Name	Description
0	INTEGRAT 200	Current limit at 200% integrator overload. Temperature model is not active.*
1	INTEGRAT 150	Current limit at 150% integrator overload. Temperature model is not active.*
2	INT LOW FREQ	Current limit at high IGBT temperature with low output frequency (<10 Hz). Temperature model is not active.*
3	INTG PP TEMP	Current limit at high IGBT temperature. Temperature model is not active.*
4	PP OVER TEMP	Current limit at high IGBT temperature. Temperature model is active.
5	PP OVERLOAD	Current limit at high IGBT junction to case temperature. Temperature model is active. If the IGBT junction to case temperature continues to rise in spite of the current limitation, PP OVERLOAD alarm or fault occurs. See chapter *Fault tracing*.
6	INV POW LIM	Current limit at inverter output power limit
7	INV TRIP CUR	Current limit at inverter overcurrent trip limit
8	OVERLOAD CUR	Maximum inverter overload current limit. See par. 20.05 MAX CURRENT.
9	CONT DC CUR	Continuous dc-current limit
10	CONT OUT CUR	Continuous output current limit ($I_{cont.max}$)
11...15	Not in use	

*Not active with ACS800 Factory macro default settings.

06.16 AUX STATUS WORD3

Bit	Name	Description
0	REVERSED	Motor rotates in reverse direction.
1	EXT CTRL	External control is selected.
2	REF 2 SEL	Reference 2 is selected.
3	CONST SPEED	A Constant Speed 1/2 is selected.
4	STARTED	The drive has received a Start command.
5	USER 2 SEL	User Macro 2 has been loaded.
6	OPEN BRAKE	The Open Brake command is ON. See parameter group 28 BRAKE CTRL.
7	Not in use	
8	STOP DI STATUS	State of the interlock input on the RMIO board
9	READY	Ready to function: Run Enable signal on, no fault.
10	RUNNING	Running: Start signal on, Run Enable signal on, no active fault.
11...15	Reserved	

07.11 FAULT WORD 1

Bit	Name	Description
0	SHORT CIRC	For the possible causes and remedies, see chapter *Fault tracing*.
1	OVERCURRENT	
2	DC OVERVOLT	
3	ACS 800 TEMP	
4	EARTH FAULT	
5	THERMISTOR	
6	MOTOR TEMP	
7	SYSTEM FAULT	A fault is indicated by the 07.16 System Fault Word.
8	UNDERLOAD	For the possible causes and remedies, see chapter *Fault tracing*.
9	OVERFREQ	
10	LINE CONV	Fault on line side converter
11…15	Reserved	

07.12 FAULT WORD 2

Bit	Name	Description
0	SUPPLY PHASE	For the possible causes and remedies, see chapter *Fault tracing*.
1	NO MOT DATA	
2	DC UNDERVOLT	
3	Reserved	
4	RUN DISABLED	For the possible causes and remedies, see chapter *Fault tracing*.
5	ENCODER FLT	
6	I/O COMM	
7	CTRL B TEMP (4100)	
8	EXTERNAL FLT	
9	OVER SWFREQ (FF55)	Switching overfrequency fault
10	AI < MIN FUNC	For the possible causes and remedies, see chapter *Fault tracing*.
11	PPCC LINK	
12	CH0 FAULT	
13	PANEL LOSS	
14	MOTOR STALL	
15	MOTOR PHASE	

07.13 FAULT WORD POS

Bit	Name	Description
0	POSITION ERR	Position error. The position error supervision window is defined by parameter 32.10 POS ERROR WINDOW.
1	POS LIM ERR	Actual position error. Minimum and maximum position values are defined by parameters 42.01 POSITION MAX or 42.02 POSITION MIN.
2...15	Reserved	

07.14 FAULT WORD 4

Bit	Name	Description
0	Reserved	
1	MOTOR 1 TEMP	For the possible causes and remedies, see chapter *Fault tracing*.
2	MOTOR 2 TEMP	
3	BRAKE ACKN	
4 … 15	Reserved	

07.15 FAULT WORD 5

Bit	Name	Description
0	BR BROKEN	For the possible causes and remedies, see chapter *Fault tracing*.
1	BR WIRING	
2	BC SHORT CIR	
3	BR OVERHEAT	
4	BC OVERHEAT	
5	PP OVERLOAD	
6	INV DISABLED	
7	TEMP DIF	
8	POWERF INT	
9 … 15	Reserved	

07.16 SYSTEM FAULT WORD

Bit	Name	Description
0	FLT (F1_7)	Factory default parameter file error
1	USER MACRO	User Macro file error
2	FLT (F1_4)	FPROM operating error
3	FLT (F1_5)	FPROM data error
4	FLT (F2_12)	Internal time level 2 overflow
5	FLT (F2_13)	Internal time level 3 overflow
6	FLT (F2_14)	Internal time level 4 overflow
7	FLT (F2_15)	Internal time level 5 overflow
8	FLT (F2_16)	State machine overflow
9	FLT (F2_17)	Application program execution error
10	FLT (F2_18)	Application program execution error
11	FLT (F2_19)	Illegal instruction
12	FLT (F2_3)	Register stack overflow
13	FLT (F2_1)	System stack overflow
14	FLT (F2_0)	System stack underflow
15	Reserved	

07.17 INT board INIT FAUL

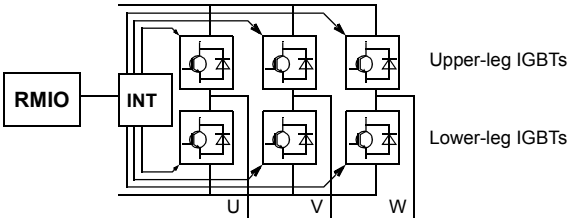
Bit	Name	Description
0	AINT FAULT	Wrong EPLD version
1	AINT FAULT	Wrong AINT board revision
2	AINT FAULT	Du/dt limitation hardware failure
3	AINT FAULT	Current measurement scaling error
4	AINT FAULT	Voltage measurement scaling error
5 … 15	Not in use	

07.18 INT FAULT INFO WORD

The INT FAULT INFO Word includes information on the location of faults PPCC LINK, OVERCURRENT, EARTH FAULT, SHORT CIRCUIT, ACS800 TEMP, TEMP DIF and POWERF INT (see *07.11 FAULT WORD 1*, *07.12 FAULT WORD 2*, *07.15 FAULT WORD 5* and chapter *Fault tracing*.

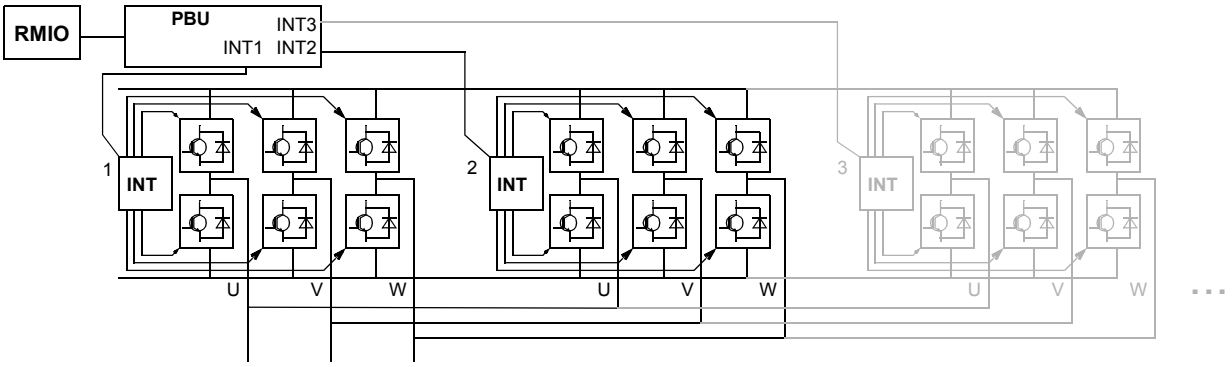
Bit	Name	Description
0	INT 1 FLT	INT 1 board fault (with NPBU/APBU board)*
1	INT 2 FLT	INT 2 board fault (with NPBU/APBU board)*
2	INT 3 FLT	INT 3 board fault (with NPBU/APBU board)*
3	INT 4 FLT	INT 4 board fault (with NPBU/APBU board)*
4	INT 5 FLT	INT 5 board fault (With APBU board)*
5	INT 6 FLT	INT 6 board fault (With APBU board)*
6	INT 7 FLT	INT 7 board fault (With APBU board)*
7	INT 8 FLT	INT 8 board fault (With APBU board)*
8	INT 9 FLT	INT 9 board fault (With APBU board)*
9	INT 10 FLT	INT 10 board fault (With APBU board)*
10	INT 11 FLT	INT 11 board fault (With APBU board)*
11	INT 12 FLT	INT 12 board fault (With APBU board)*
12...14	Not in use	
15	PBU FLT	PBU board fault
*Used only with parallel connected inverters.		

Inverter block diagram



RMIO	Motor Control and I/O Board
INT	Main Circuit Interface Board
PBU	PPCS Link Branching Unit

Inverter unit block diagram (2 to 12 parallel Inverters)



07.19 INT SC INFO

The INT SC INFO Word includes information on the location of the SHORT CIRCUIT fault (see *07.11 FAULT WORD 1* and chapter *Fault tracing*).

Bit	Name	Description
0	U-PH SC U	Phase U upper-leg IGBT(s) short circuit
1	U-PH SC L	Phase U lower-leg IGBT(s) short circuit
2	V-PH SC U	Phase V upper-leg IGBT(s) short circuit
3	V-PH SC L	Phase V lower-leg IGBT(s) short circuit
4	W-PH SC U	Phase W upper-leg IGBT(s) short circuit
5	W-PH SC L	Phase W lower-leg IGBT(s) short circuit
6...15	Not in use	

07.20 ALARM WORD 1

Bit	Name	Description
0	START INHIBIT	For the possible causes and remedies, see chapter *Fault tracing*.
1	Reserved	
2	THERMISTOR	For the possible causes and remedies, see chapter *Fault tracing*.
3	MOTOR TEMP	
4	ACS800 TEMP	
5	ENCODER ERR	
6	T MEAS ALM	
7...11	Reserved	
12	COMM MODULE	For the possible causes and remedies, see chapter *Fault tracing*.
13	Reserved	
14	EARTH FAULT	For the possible causes and remedies, see chapter *Fault tracing*.
15	Reserved	

07.21 ALARM WORD 2

Bit	Name	Description
0	Reserved	
1	UNDERLOAD	For the possible causes and remedies, see chapter *Fault tracing*.
2, 3	Reserved	
4	ENCODER	For the possible causes and remedies, see chapter *Fault tracing*.
5,6	Reserved	
7	POWFAIL FILE (FFA0)	Error in restoring POWERFAIL.DDF
8	ALM (OS_17)	Error in restoring POWERDOWN.DDF
9	MOTOR STALL	For the possible causes and remedies, see chapter *Fault tracing*.
10	AI < MIN FUNC	
11, 12	Reserved	
13	PANEL LOSS	For the possible causes and remedies, see chapter *Fault tracing*.
14, 15	Reserved	

07.23 ALARM WORD 4

Bit	Name	Description
0	Reserved	
1	MOTOR 1 TEMP	For the possible causes and remedies, see chapter *Fault tracing*.
2	MOTOR 2 TEMP	
3	BRAKE ACKN	
4	Reserved	
5	MACRO CHANGE	For the possible causes and remedies, see chapter *Fault tracing*.
6…15	Reserved	

07.24 ALARM WORD 5

Bit	Name	Description
0	REPLACE FAN	For the possible causes and remedies, see chapter *Fault tracing*.
1	SYNCRO SPEED	
2	BR OVERHEAT	
3	BC OVERHEAT	
4	IN CHOKE TEMP	
5	PP OVERLOAD	
6	INV DISABLED	
7	CUR UNBAL	
8…15	Reserved	

Fault tracing

What this chapter contains

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

Safety

WARNING! Only qualified electricians are allowed to maintain the drive. The *Safety Instructions* on the first pages of the appropriate hardware manual must be read before you start working on the drive.

Warning and fault indications

A warning or fault message on the panel display indicates abnormal drive status. Most warning and fault causes can be identified and corrected using this information. If not, an ABB representative should be contacted.

If the drive is operated with the control panel detached, the red LED in the panel mounting platform indicates the fault condition. (Note: Some drive types are not fitted with the LEDs as standard).

The four digit code number in brackets after the message is for the fieldbus communication (see chapter *Fieldbus control*).

How to reset

The drive can be reset either by pressing the keypad ***RESET*** key, by digital input or fieldbus, or switching the supply voltage off for a while. When the fault has been removed, the motor can be restarted.

Fault history

When a fault is detected, it is stored in the Fault History. The latest faults and warnings are stored together with the time stamp at which the event was detected. See chapter *Control panel* for more information.

Warning messages generated by the drive

WARNING	CAUSE	WHAT TO DO
ACS800 TEMP (4210)	Drive IGBT temperature is excessive. Fault trip limit is 100%.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
AI < MIN FUNC (8110) Programmable Fault Function 13.28 and 13.29	Analogue control signal is below minimum allowed value due to incorrect signal level or failure in control wiring.	Check for proper analogue control signal levels. Check control wiring. Check Fault Function parameters.
BACKUP USED	PC-stored backup of drive parameters is downloaded into use.	Wait until download is completed.
BC OVERHEAT (7114)	Brake chopper overload	Stop drive. Let chopper cool down. Check parameter settings of resistor overload protection function (see parameter group 27 BRAKE CHOPPER). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
BRAKE ACKN (FF74)	Unexpected state of brake acknowledge signal.	See parameter group 28 BRAKE CTRL. Check connection of brake acknowledgement signal.
BR OVERHEAT (7112)	Brake resistor overload	Stop drive. Let resistor cool down. Check parameter settings of resistor overload protection function (see parameter group 27 BRAKE CHOPPER). Check that braking cycle meets allowed limits.
CALIBRA DONE (FF37)	Calibration of output current transformers is completed.	Continue normal operation.
CALIBRA REQ (FF36)	Calibration of output current transformers is required.	Calibration starts automatically. Wait for a while.
COMM MODULE (7510) Programmable Fault Function	Cyclical communication between drive and master is lost.	Check status of fieldbus communication. See chapter *Fieldbus control*, or appropriate fieldbus adapter manual. Check parameter settings: - group 51 COMM MODULE DATA (for fieldbus adapter) - group 52 STANDARD MODBUS (for Standard Modbus Link) Check cable connections. Check if master communicates.

WARNING	CAUSE	WHAT TO DO
CUR UNBAL xx (2330) Programmable Fault Function 30.16	Drive has detected excessive output current unbalance in inverter unit of several parallel connected inverter modules. This can be caused by external fault (earth fault, motor, motor cabling, etc.) or internal fault (damaged inverter component). xx (2...12) refers to faulty inverter module number.	Check motor. Check motor cable. Check there are no power factor correction capacitors or surge absorbers in motor cable.
DC BUS LIM (3211)	Drive limits torque due to too high or too low intermediate circuit DC voltage.	Informative alarm
EARTH FAULT (2330) Programmable Fault Function 30.16	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check motor. Check motor cable. Check there are no power factor correction capacitors or surge absorbers in motor cable.
ENCODER A<>B (7302)	Pulse encoder phasing is wrong: Phase A is connected to terminal of phase B and vice versa.	Interchange connection of pulse encoder phases A and B.
ENCODER ERR (7301)	Communication fault between pulse encoder and pulse encoder interface module and between module and drive.	Check pulse encoder and its wiring, pulse encoder interface module and its wiring and parameter group 50 ENCODER MODULES settings.
ENCODER2 ERR (7381)	Communication fault between pulse encoder and pulse encoder interface module and between module and drive.	Check pulse encoder and its wiring, pulse encoder interface module and its wiring and parameter group 50 ENCODER MODULES settings.
ID DONE (FF32)	Drive has performed motor identification magnetisation and is ready for operation. This warning belongs to normal start-up procedure.	Continue drive operation.
ID MAGN (FF31)	Motor identification magnetisation is on. This warning belongs to normal start-up procedure.	Wait until drive indicates that motor identification is completed.
ID MAGN REQ (FF30)	Motor identification is required. This warning belongs to normal start-up procedure. Drive expects user to select how motor identification should be performed: By Identification Magnetisation or by ID Run.	Start Identification Magnetisation by pressing Start key, or select ID Run and start (see parameter 99.08 ID RUN).
ID N CHANGED (FF68)	Drive ID number has been changed from 1.	Change ID number back to 1. See chapter *Control panel.*
ID RUN FAIL (FF84)	Motor ID Run is not completed successfully.	Check maximum speed (parameter 20.02 MAX SPEED). It should be at least 80% of motor nominal speed (parameter 99.05 MOTOR NOM FREQ).
ID RUN SEL (FF33)	Motor Identification Run is selected, and drive is ready to start ID Run. This warning belongs to ID Run procedure.	Press Start key to start Identification Run.

WARNING	CAUSE	WHAT TO DO
IN CHOKE TEMP (FF81)	Excessive input choke temperature	Stop drive. Let it cool down. Check ambient temperature. Check that fan rotates in correct direction and air flows freely.
IO CONFIG (FF8B)	Input or output of optional I/O extension or fieldbus module has been selected as signal interface in application program but communication to appropriate I/O extension module has not been set accordingly.	Check option module parameter settings (70.01 COMM MODULE LINK, 70.02 COMM PROFILE, 12 DIGITAL INPUTS, 13 ANALOGUE INPUTS, 50 ENCODER MODULES).
INV CURR LIM (2212)	Drive limits inverter current.	Informative alarm
INV DISABLED (3200)	Optional DC switch has opened while drive was stopped.	Close DC switch. Check AFSC-0x Fuse Switch Controller unit.
MACRO CHANGE (FF69)	Macro is restoring or User macro is being saved.	Wait until drive has finished task.
MOT CUR LIM (2300)	Drive limits motor current according to current limit defined by parameter 20.05 MAX CURRENT.	Informative alarm Check parameter 20.05 MAX CURRENT settings.
MOTOR STALL (7121) Programmable Fault Function 30.09...30.11	Motor is operating in stall region due to e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check Fault Function parameters.
MOTOR STARTS (FF34)	Motor Identification Run starts. This warning belongs to ID Run procedure.	Wait until drive indicates that motor identification is completed.
MOTOR TEMP (4310) Programmable Fault Function 30.03...30.08	Motor temperature is excessive due to excessive load, insufficient motor power, inadequate cooling or incorrect start-up data.	Check motor ratings, load and cooling. Check start-up data. Check Fault Function parameters.
MOTOR 1 TEMP (4312)	Measured motor temperature has exceeded alarm limit set by parameter 35.02 MOT 1 TEMP ALM L.	Check value of alarm limit. Check that actual number of sensors corresponds to value set by parameter. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc.

WARNING	CAUSE	WHAT TO DO
MOTOR 2 TEMP (4313)	Measured motor temperature has exceeded alarm limit set by parameter 35.05 MOT 2 TEMP ALM L.	Check value of alarm limit. Check that actual number of sensors corresponds to value set by parameter. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc.
MOTOR POW LIM (FF86)	Drive limits motor power according to limits defined by parameters 20.11 and 20.12.	Informative alarm Check parameter 20.11 P MOTORING LIM and 20.12 P GENER LIM settings.
MOTOR TORQ LIM (FF58)	Drive limits motor torque according to calculated motor pull-out torque limit and minimum and maximum torque limits defined by parameters 20.07 and 20.08.	Informative alarm Check parameter 20.07 TORQ MAX LIM1 and 20.08 TORQ MIN LIM1 settings. If LIMIT WORD 1 bit 0 TORQ MOTOR LIM is 1, - check motor parameter settings (parameter group 99 START UP) - ensure that ID run has been completed successfully.
PANEL LOSS (5300) Programmable Fault Function 30.01	Control panel selected as active control location for drive has ceased communicating.	Check panel connection (see appropriate hardware manual). Check control panel connector. Replace control panel in mounting platform. Check Fault Function parameters.
POINTER ERROR (FFD0)	Source selection (pointer) parameter points to non-existing parameter index.	Check source selection (pointer) parameter settings.
PP OVERLOAD (5482)	Excessive IGBT junction to case temperature. This can be caused by excessive load at low frequencies (e.g. fast direction change with excessive load and inertia).	Increase ramp time. Reduce load.
REPLACE FAN (4280)	Running time of inverter cooling fan has exceeded its estimated life time.	Replace fan.
START INHIBI (FF7A)	Optional start inhibit hardware logic is activated.	Check start inhibit circuit (AGPS board).
START INTERL (FF8D)	No Start Interlock signal received.	Check circuit connected to Start Interlock input on RMIO board.
SYNCRO SPEED (FF87)	Value of motor nominal speed set to parameter 99.06 MOTOR NOM SPEED is not correct: Value is too near synchronous speed of motor. Tolerance is 0.1%. This warning is active only in DTC mode.	Check nominal speed from motor rating plate and set parameter 99.06 exactly accordingly.

WARNING	CAUSE	WHAT TO DO
TGT POS LIM (8612)	Target position exceeds set limits.	Check position limit parameters 42.02 POSITION MIN and 42.01 POSITION MAX.
TEMP DIF xx y (4380)	Excessive temperature difference between several parallel connected inverter modules. xx (1...12) refers to inverter module number and y refers to phase (U, V, W). Alarm is indicated when temperature difference is 15°C. Fault is indicated when temperature difference is 20°C. Excessive temperature can be caused e.g. by unequal current sharing between parallel connected inverters.	Check cooling fan. Replace fan. Check air filters.
THERMISTOR (4311) Programmable Fault Function 30.03 and 30.04	Motor temperature is excessive. Motor thermal protection mode selection is THERMISTOR.	Check motor ratings and load. Check start-up data. Check thermistor connections to digital input DI6.
T MEAS ALM (FF91)	Motor temperature measurement is out of acceptable range.	Check connections of motor temperature measurement circuit. See chapter *Basic program features* for circuit diagram.
UNDERLOAD (FF6A) Programmable Fault Function 30.12...30.14	Motor load is too low. This can be caused by release mechanism in driven equipment.	Check for problem in driven equipment. Check Fault Function parameters.

Warning messages generated by the control panel

WARNING	CAUSE	WHAT TO DO
DOWNLOADING FAILED	Download function of panel has failed. No data has been copied from panel to drive.	Make sure panel is in local mode. Retry (there might be interference on link). Contact local ABB representative.
DRIVE INCOMPATIBLE DOWNLOADING NOT POSSIBLE	Program versions in panel and drive do not match. It is not possible to copy data from panel to drive.	Check program versions. See parameter group 33 INFORMATION.
DRIVE IS RUNNING DOWNLOADING NOT POSSIBLE	Downloading is not possible while motor is running.	Stop motor. Perform downloading.
NO COMMUNICATION (X)	Cabling problem or hardware malfunction on Panel Link.	Check Panel Link connections. Press RESET key. Panel reset may take up to half a minute, please wait.
	(4) = Panel type not compatible with drive application program version.	Check panel type and drive application program version. Panel type is printed on panel cover. Application program version is stored in parameter 33.01 SOFTWARE VERSION.
NO FREE ID NUMBERS ID NUMBER SETTING NOT POSSIBLE	Panel Link already includes 31 stations.	Disconnect another station from link to free ID number.
NOT UPLOADED DOWNLOADING NOT POSSIBLE	No upload function has been performed.	Perform upload function before downloading. See chapter *Control panel*.
UPLOADING FAILED	Upload function of panel has failed. No data has been copied from drive to panel.	Retry (there might be interference on link). Contact local ABB representative.
WRITE ACCESS DENIED PARAMETER SETTING NOT POSSIBLE	Certain parameters do not allow changes while motor is running. If tried, no change is accepted, and warning is displayed. Parameter lock is on.	Stop motor, then change parameter value. Open parameter lock (see parameter 16.01 PARAMETER LOCK).

Fault messages generated by the drive

FAULT	CAUSE	WHAT TO DO
ACS800 TEMP (4210)	Drive IGBT temperature is excessive. Fault trip limit is 100%.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
ACS TEMP xx y (4210)	Excessive internal temperature in inverter unit of several parallel inverter modules. xx (1...12) refers to faulty inverter module number and y refers to faulty phase (U, V, W).	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
AI < MIN FUNC (8110) Programmable Fault Function 13.28 and 13.29	Analogue control signal is below minimum allowed value due to incorrect signal level or failure in control wiring.	Check for proper analogue control signal levels. Check control wiring. Check Fault Function parameters.
BACKUP ERROR (FFA2)	Failure when restoring PC-stored backup of drive parameters.	Retry. Check connections. Check that parameters are compatible with drive.
BC OVERHEAT (7114)	Brake chopper overload	Let chopper cool down. Check parameter settings of resistor overload protection function (see parameter group 27 BRAKE CHOPPER). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
BC SHORT CIR (7113)	Short circuit in brake chopper IGBT(s)	Replace brake chopper. Ensure brake resistor is connected and not damaged.
BRAKE ACKN (FF74)	Unexpected state of brake acknowledge signal	See parameter group 28 BRAKE CTRL. Check connection of brake acknowledgement signal.
BR BROKEN (7110)	Brake resistor is not connected or it is damaged. Resistance rating of brake resistor is too high.	Check resistor and resistor connection. Check that resistance rating meets specifications. See drive hardware manual.
BR OVERHEAT (7112)	Brake resistor overload	Let resistor cool down. Check parameter settings of resistor overload protection function (see parameter group 27 BRAKE CHOPPER). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
BR WIRIN (7111)	Wrong connection of brake resistor	Check resistor connection. Ensure brake resistor is not damaged.

FAULT	CAUSE	WHAT TO DO
CHOKE OTEMP (FF82)	Excessive temperature of drive output filter. Supervision is in use in step-up drives.	Let drive cool down. Check ambient temperature. Check filter fan rotates in correct direction and air flows freely.
COMM MODULE (7510) Programmable Fault Function	Cyclical communication with drive and master station is lost.	Check status of fieldbus communication. See chapter *Fieldbus control*, or appropriate fieldbus adapter manual. Check parameter settings: - group 51 COMM MODULE DATA (for fieldbus adapter), or - group 52 STANDARD MODBUS (for Standard Modbus Link) Check cable connections. Check if master communicates.
CTRL B TEMP (4110)	Control board temperature is above 88°C.	Check ambient conditions. Check air flow. Check main and additional cooling fans.
CURR MEAS (2211)	Current transformer failure in output current measurement circuit.	Check current transformer connections to Main Circuit Interface Board, INT.
CUR UNBAL xx (2330) Programmable Fault Function 30.16	Drive has detected excessive output current unbalance in inverter unit of several parallel connected inverter modules. This can be caused by external fault (earth fault, motor, motor cabling, etc.) or internal fault (damaged inverter component). xx (2...12) refers to faulty inverter module number.	Check motor. Check motor cable. Check that there are no power factor correction or surge absorbers in motor cable.
DC HIGH RUSH (FF80)	Drive supply voltage is excessive. When supply voltage is over 124% of unit voltage rating (415, 500 or 690 V), motor speed rushes to trip level (40% of nominal speed).	Check supply voltage level, drive rated voltage and allowed voltage range of drive.
DC OVERVOLT (3210)	Excessive intermediate circuit DC voltage. DC overvoltage trip limit is $1.3 \cdot U_{1max}$, where U_{1max} is maximum value of mains voltage range. For 400 V units, U_{1max} is 415 V. For 500 V units, U_{1max} is 500 V. Actual voltage in intermediate circuit corresponding to mains voltage trip level is 728 VDC for 400 V units and 877 VDC for 500 V units.	Check that overvoltage controller is on (parameter 20.13 OVERVOLTAGE CTRL). 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.

FAULT	CAUSE	WHAT TO DO
DC UNDERVOLT (3220)	Intermediate circuit DC voltage is not sufficient due to missing mains phase, blown fuse or rectifier bridge internal fault. DC undervoltage trip limit is 0.6 · U_{1min}, where U_{1min} is minimum value of mains voltage range. For 400 V and 500 V units, U_{1min} is 380 V. For 690 V units, U_{1min} is 525 V. Actual voltage in intermediate circuit corresponding to mains voltage trip level is 307 VDC for 400 V and 500 V units, and 425 VDC for 690 V units.	Check mains supply and fuses.
EARTH FAULT (2330) Programmable Fault Function 30.16	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check motor. Check motor cable. Check there are no power factor correction capacitors or surge absorbers in motor cable.
ENCODER A<>B (7302)	Pulse encoder phasing is wrong: Phase A is connected to terminal of phase B and vice versa.	Interchange connection of pulse encoder phases A and B.
ENCODER FLT (7301)	Communication fault between pulse encoder and pulse encoder interface module and between module and drive.	Check pulse encoder and its wiring, module and its wiring and parameter group 50 ENCODER MODULES settings.
ENCODER2 FLT (7381)	Communication fault between pulse encoder and pulse encoder interface module and between module and drive.	Check pulse encoder and its wiring, module and its wiring and parameter group 50 ENCODER MODULES settings.
EXTERNAL FLT (9000) Programmable Fault Function 30.02	Fault in external device. (This information is configured through one of programmable digital inputs.)	Check external devices for faults. Check Fault Function parameters.
FAN OVERTEMP (FF83)	Excessive temperature of drive output filter fan. Supervision is in use in step-up drives.	Stop drive. Let it cool down. Check ambient temperature. Check fan rotates in correct direction and air flows freely.
FORCED TRIP (FF8F)	Generic Drive Communication Profile trip command	See appropriate communication module manual.
ID RUN FAIL (FF84)	Motor ID Run is not completed successfully.	Check maximum speed (parameter 20.02 MAX SPEED). It should be at least 80% of motor nominal speed (parameter 99.06).
INT CONFIG (5410)	Number of inverter modules is not equal to original number of inverters.	Check status of inverters. See signal 07.18 FAULTED INT INFO. Check fibre optic cables between APBU and inverter modules.
INV DISABLED (3200)	Optional DC switch has opened while drive was running or start command was given.	Close DC switch. Check AFSC-0x Fuse Switch Controller unit.

FAULT	CAUSE	WHAT TO DO
I/O COMM ERR (7000)	Fieldbus adapter (Rxxx type) communication error.	Check connections. Check fieldbus adapter parameters. See chapter *Fieldbus control, Setting up communication through a fieldbus adapter module.*
LINE CONV (FF51)	Fault on line side converter	Shift panel from motor side converter control board to line side converter control board. See line side converter manual for fault description.
MOTOR PHASE (FF56) Programmable Fault Function 30.15	One of motor phases is lost due to fault in motor, motor cable, thermal relay (if used) or internal fault.	Check motor and motor cable. Check thermal relay (if used). Check Fault Function parameters. Disable this protection.
MOTOR STALL (7121) Programmable Fault Function 30.09...30.11	Motor is operating in stall region due to e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check Fault Function parameters.
MOTOR TEMP (4310) Programmable Fault Function 30.03...30.08	Motor temperature is too high (or appears to be too high) due to excessive load, insufficient motor power, inadequate cooling or incorrect start-up data.	Check motor ratings, load and cooling Check start-up data. Check Fault Function parameters.
MOTOR 1 TEMP (4312)	Measured motor temperature has exceeded fault limit set by parameter 35.03 MOT 1 TEMP FLT L.	Check value of fault limit. Check that actual number of sensors corresponds to value set by parameter. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc.
MOTOR 2 TEMP (4313)	Measured motor temperature has exceeded fault limit set by parameter 35.06 MOT 2 TEMP FLT L.	Check value of fault limit. Check that actual number of sensors corresponds to value set by parameter. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc.
NO MOT DATA (FF52)	Motor data is not given or motor data does not match with inverter data.	Check motor data given by parameters 99.03...99.07.

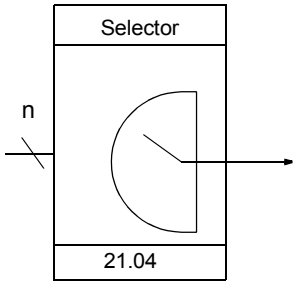
FAULT	CAUSE	WHAT TO DO
OVERCURR xx (2310)	Overcurrent fault in inverter unit of several parallel inverter modules. xx (2...12) refers to faulty inverter module number.	Check motor load. Check acceleration time. Check motor and motor cable (including phasing). Check encoder cable (including phasing). Check motor nominal values from group 99 START UP to confirm that motor model is correct. Check that there are no power factor correction or surge absorbers in motor cable.
OVERCURRENT (2310)	Output current exceeds trip limit.	Check motor load. Check acceleration time. Check motor and motor cable (including phasing). Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing).
OVERFREQ (7123)	Motor is turning faster than highest allowed speed due to incorrectly set minimum/ maximum speed, insufficient braking torque or changes in load when torque reference is used. Trip level is 40 Hz over operating range absolute maximum speed limit. Operating range limits are set by parameters 20.01 MIN SPEED and 20.02 MAX SPEED.	Check minimum/maximum speed settings. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
PANEL LOSS (5300) Programmable Fault Function 30.01	Control panel or DrivesWindow selected as active control location for drive has ceased communicating.	Check panel connection (see appropriate hardware manual). Check control panel connector. Replace control panel in mounting platform. Check Fault Function parameters. Check DrivesWindow connection.
POSITION ERR (8500)	Calculated position error exceeds limit set by parameter 32.10 POS ERROR WINDOW. Motor is stalled.	Check setting of parameter 32.10 POS ERROR WINDOW. Check that no torque limits are exceeded during positioning.
POS LIM ERR (8502)	Actual position value exceeds limits set by parameters 42.02 POSITION MIN and 42.01 POSITION MAX.	Check minimum and maximum position limits. Check parameters in group 43 HOMING.
POWERF INT xx (3381)	INT board powerfail in inverter unit consisting of several parallel inverter modules. xx refers to inverter module number.	Check that INT board power cable is connected. Check that POW board is working correctly. Replace INT board.
POWERF INT (3381)	INT board powerfail in several inverter units in parallel connected inverter modules.	

FAULT	CAUSE	WHAT TO DO
PPCC LINK (5210)	Fibre optic link to INT board is faulty.	Check fibre optic cables or galvanic link. With frame sizes R2...R6 link is galvanic. If RMIO is powered from external supply, ensure that supply is on.
PPCC LINK xx (5210)	INT board fibre optic connection fault in inverter unit consisting of several parallel inverter modules. xx refers to inverter module number.	Check connection from inverter module Main Circuit Interface Board, INT to PPCC Branching Unit, PBU. (Inverter module 1 is connected to PBU INT1 etc.)
PP OVERLOAD (5482)	Excessive IGBT junction to case temperature. This fault protects IGBT(s) and it can be activated by short circuit at output of long motor cables.	Check motor cables.
RUN DISABLED (FF54)	No Run enable signal received.	Check setting of parameter 10.07 RUN ENABLE. Switch on signal or check wiring of selected source.
SC INV xx y (2340)	Short circuit in inverter unit of several parallel inverter modules. xx (1...12) refers to faulty inverter module number and y refers to faulty phase (U, V, W).	Check motor and motor cable. Check power semiconductors (IGBT power plates) of inverter module.
SHORT CIRC (2340)	Short-circuit in motor cable(s) or motor Output bridge of converter unit is faulty.	Check motor and motor cable. Check there are no power factor correction capacitors or surge absorbers in motor cable. Consult ABB representative.
SLOT OVERLAP (FF8A)	Two option modules have same connection interface selection.	Check connection interface selections in groups 70 COMM INTERFACE, 51 COMM MODULE DATA and 12 DIGITAL INPUTS.
START INHIBI (FF7A)	Optional start inhibit hardware logic is activated.	Check start inhibit circuit (AGPS board).
SUPPLY PHASE (3130)	Intermediate circuit DC voltage is oscillating due to missing mains phase, blown fuse or rectifier bridge internal fault. Trip occurs when DC voltage ripple is 13% of DC voltage.	Check mains fuses. Check for mains supply imbalance.
TEMP DIF xx y (4380)	Excessive temperature difference between parallel connected inverter modules. xx (1...12) refers to inverter module number and y refers to phase (U, V, W). Alarm is indicated when temperature difference is 15°C. Fault is indicated when temperature difference is 20°C. Excessive temperature can be caused e.g. by unequal current sharing between parallel connected inverters.	Check cooling fan. Replace fan. Check air filters.
THERMAL MODE (FF50)	Motor thermal protection mode is set to DTC for high-power motor.	See parameter 30.04 MOT THERM P MODE.

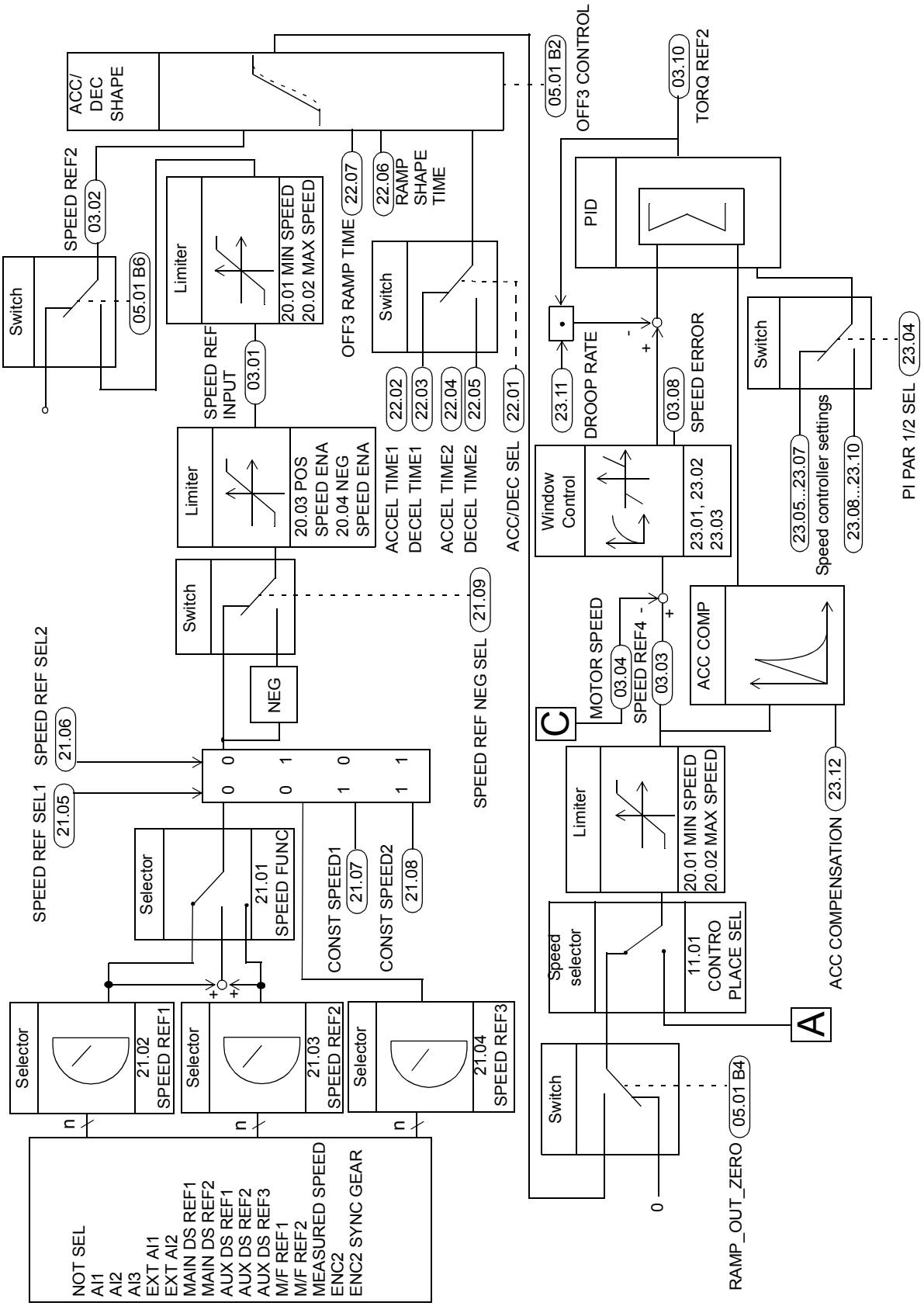
FAULT	CAUSE	WHAT TO DO
THERMISTOR (4311) Programmable Fault Function 30.03…30.04	Motor temperature is excessive. Motor thermal protection mode selection is THERMISTOR.	Check motor ratings and load. Check start-up data. Check thermistor connections. Check thermistor cabling.
UNDERLOAD (FF6A) Programmable Fault Function 30.12…30.14	Motor load is too low due to e.g. release mechanism in driven equipment.	Check for problem in driven equipment. Check Fault Function parameters.
USER MACRO (FFA1)	No User Macro saved or file is defective.	Create User Macro.

Control block diagrams

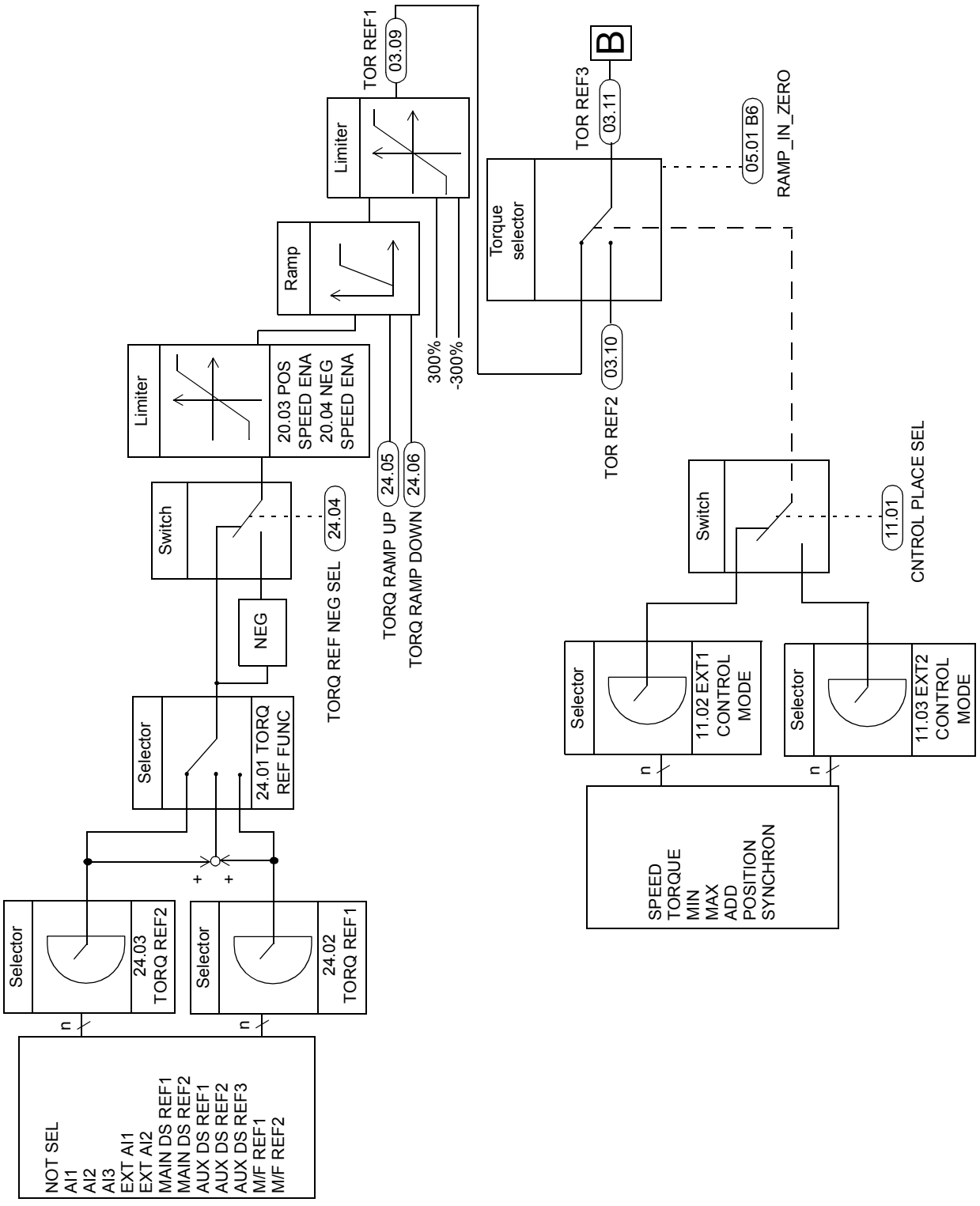
What this chapter contains

Symbol	Description
1.10	Actual signal or parameter
	Selector: selects one of the inputs to the output
X	Continued in/from block diagram X.

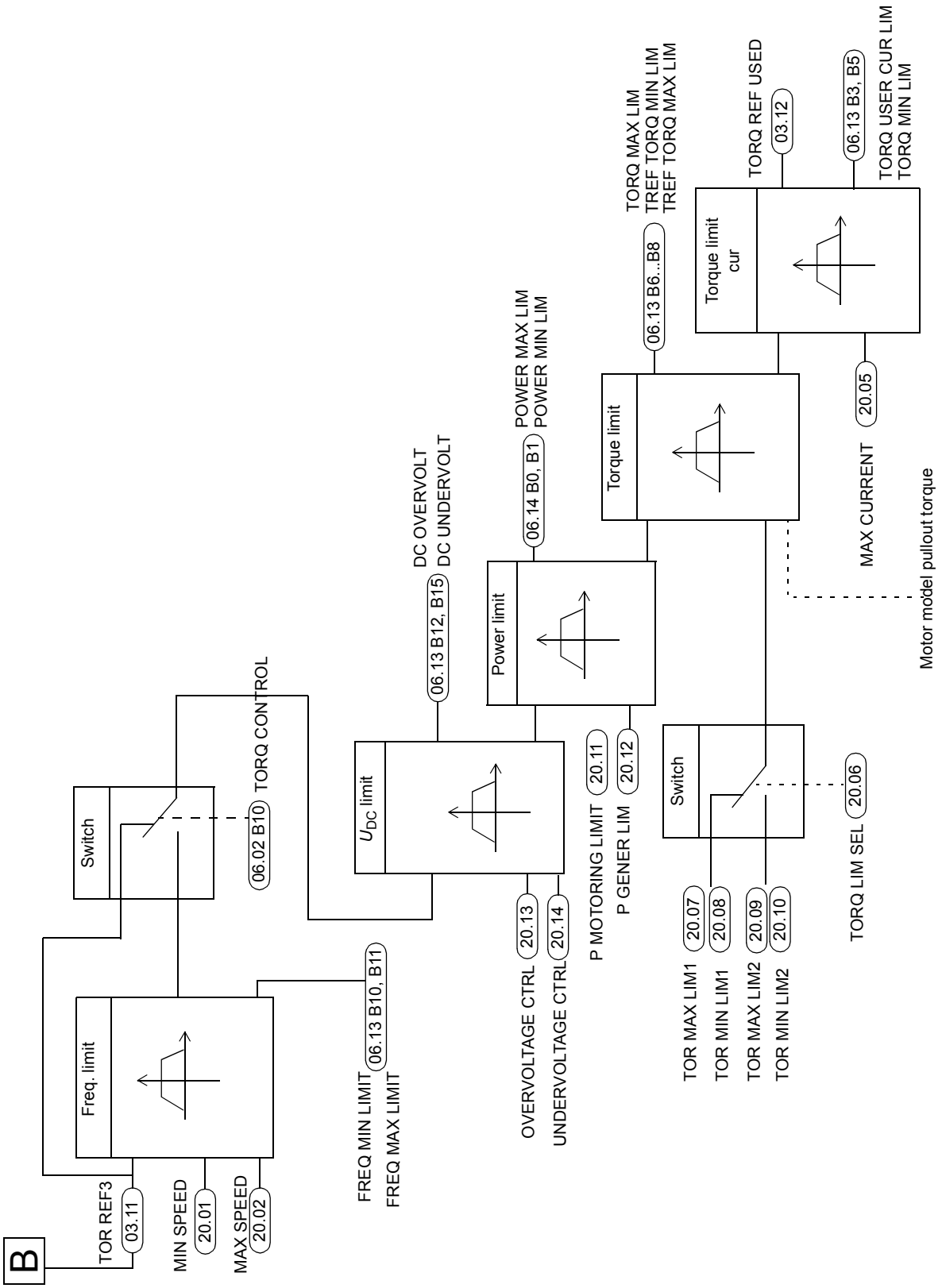
The following block diagram presents the speed reference chain:



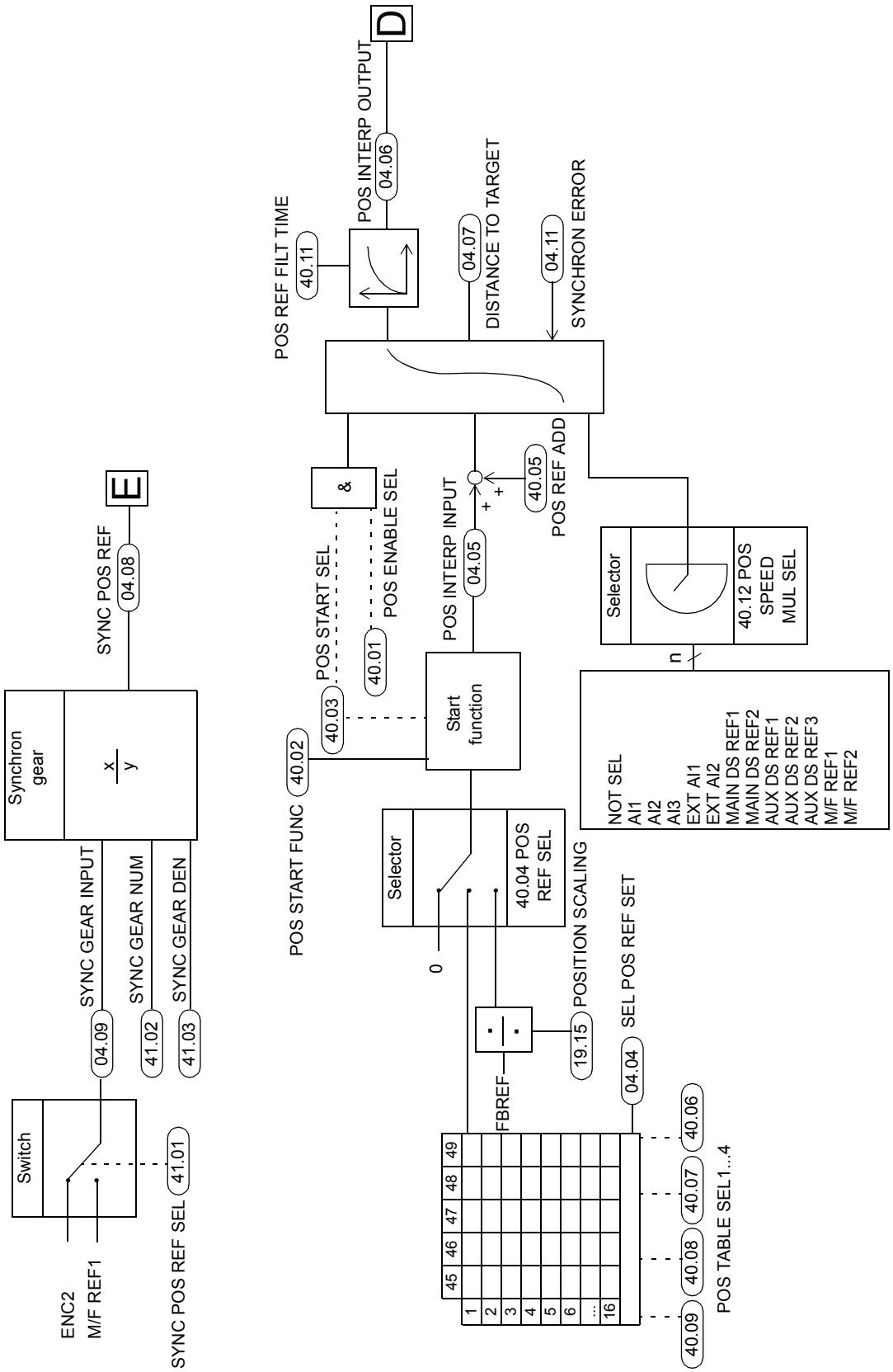
The following block diagram presents the torque reference selection:



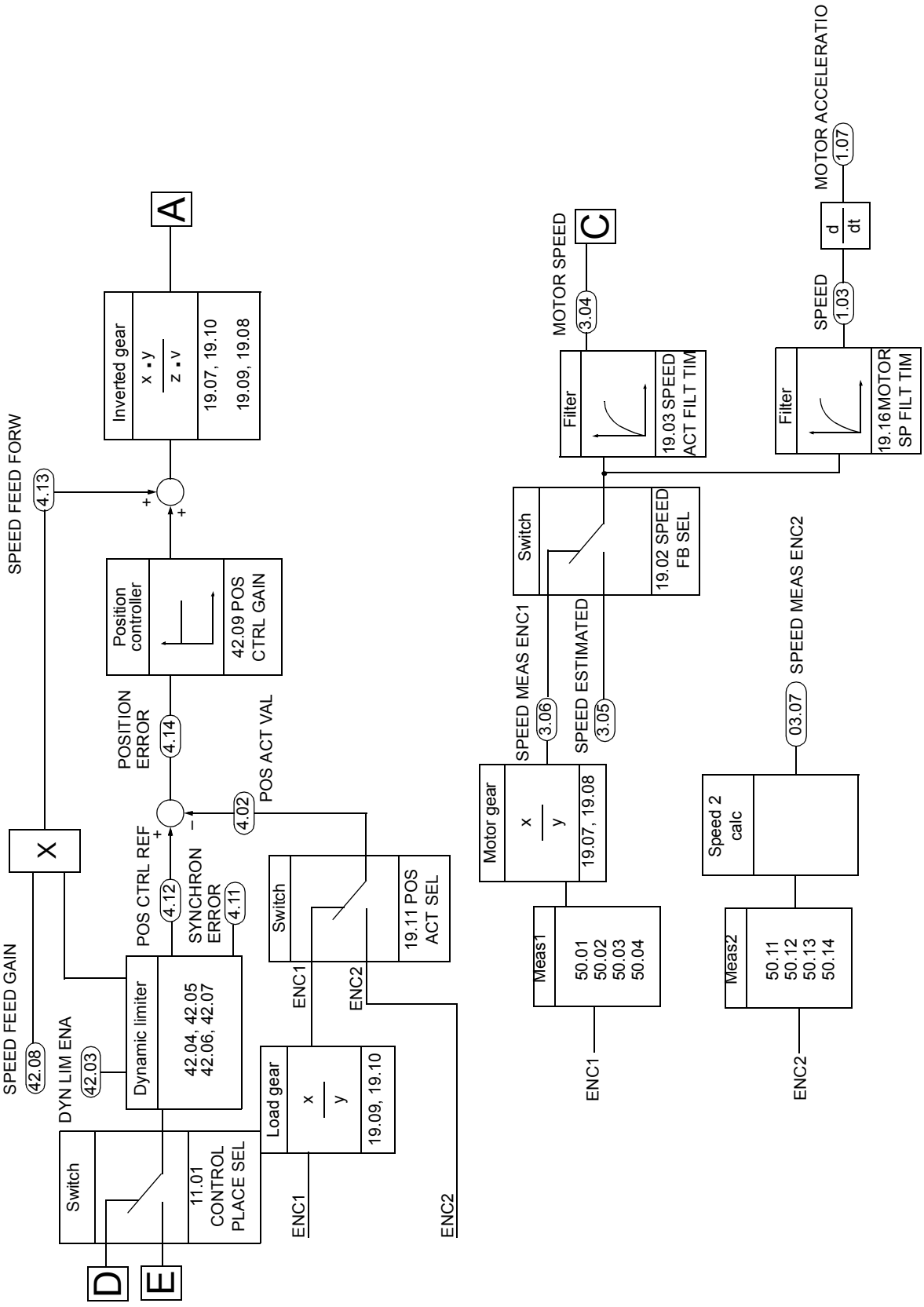
The following block diagram presents the torque reference limitation:



The following block diagram presents the synchron and position reference chains:



The following block diagram presents the load and motor gear calculations:



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