ACS 800

Firmware Manual
ACS 800 Pump and Fan Control (PFC) Application Program 7.x

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Firmware Manual

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Introduction to This Manual

Chapter overview

This chapter includes a description of the contents of the manual. In addition, it contains information about the compatibility, safety, intended audience, and related publications.

Compatibility

This manual is compatible with the ACS 800 Pump and Fan Control (PFC) Application Program version 7.0 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 a 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; and control through the I/O* 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.
- *Program features* contains the feature descriptions and the reference lists of the user settings and diagnostic signals.
- *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.
- *Fault tracing* lists the warning and fault messages with the possible causes and remedies.

- *Fieldbus control* describes the communication through the serial communication links.
- *PFC Application Example* presents an existing two-pump PFC application.
- *Additional data: actual signals and parameters* contains more information on the actual signals and parameters.

Related Publications

In addition to this manual, the ACS 800 user documentation includes the following manuals:

- Hardware manuals
- Several user’s manuals for the optional devices for the ACS 800.

Start-up; and control through the I/O

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

A step-by-step instruction for starting up the drive follows. Before you begin, ensure you have the motor nameplate data at hand.

Note: Before beginning the start-up, ensure that all active interlock inputs (if any) are ON at the digital I/O terminals of the RMIO board of the drive. See the chapter *Actual signals and parameters*, parameter 42.04.

	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 xx kW` `ID NUMBER 1`

	… then the Actual Signal Display.
	Drive set-up can now be started.
		`1 -> 0.0 rpm O`
		`ACT VAL1 0.00 bar`
		`CURRENT 0.00 A`
		`FREQ 0.00 Hz`

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 Hz     O
99 START-UP DATA
01 LANGUAGE
ENGLISH
```

```
1   ->  0.0 Hz     O
99 START-UP DATA
01 LANGUAGE
[ENGLISH]
```

☐ Select the Application Macro. The general parameter setting procedure is given above.

```
1   ->  0.0 Hz     O
99 START-UP DATA
02 APPLICATION MACRO
[ ]
```

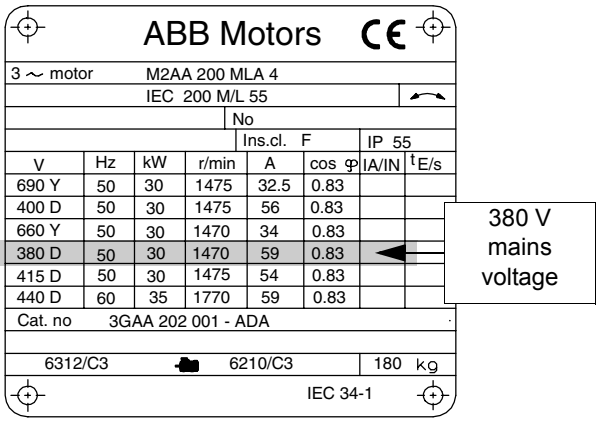
☐ Select the motor control mode. The general parameter setting procedure is given above.

DTC is suitable in most cases. The SCALAR control mode is recommended

- for multimotor drives when the number of the motors connected to the drive is variable
- when the nominal current of the motor is less than 1/6 of the nominal current of the inverter
- when the inverter is used for test purposes with no motor connected.

```
1   ->   0.0 Hz   O
99 START-UP DATA
04 MOTOR CTRL MODE
[DTC]
```

☐ Enter the motor data from the motor nameplate:



Note: Set the motor data to exactly the same value as on the motor nameplate. For example, if the motor nominal speed is 1440 rpm on the nameplate, setting the value of parameter 99.08 MOTOR NOM SPEED to 1500 rpm results in the wrong operation of the drive.

- 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.)

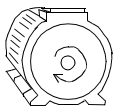
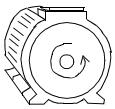
```
 1   ->  0.0 Hz     O
99 START-UP DATA
05 MOTOR NOM VOLTAGE
[ ]
```

- motor nominal current

Allowed range: approx. 1/6 × I_{2hd} … 2 × I_{2hd} of ACS800

```
 1   ->  0.0 Hz     O
99 START-UP DATA
06 MOTOR NOM CURRENT
[ ]
```

	- motor nominal frequency Range: 8 … 300 Hz	1 -> 0.0 Hz O 99 START-UP DATA 07 MOTOR NOM FREQ [ ]
	- motor nominal speed Range: 1 …18000 rpm	1 -> 0.0 Hz O 99 START-UP DATA 08 MOTOR NOM SPEED [ ]
	-motor nominal power Range: 0 …9000 kW	1 -> 0.0 Hz O 99 START-UP DATA 09 MOTOR NOM POWER [ ]
	When the motor data has been entered, a warning appears. It indicates that the motor parameters have been set, and the drive is ready to start the motor identification (ID Magnetisation or ID Run).	1 -> 0.0 Hz O ** WARNING ** ID MAGN REQ
☐	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. The ID Run (STANDARD or REDUCED) should be selected instead 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. For more information, see the subsection *How to perform the ID Run* below.	1 -> 0.0 Hz O 99 START-UP DATA 10 MOTOR ID RUN [ID MAGN]
	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 the ⏼ to start the Identification Magnetisation. The motor is magnetised at zero speed for 20 to 60 s. Two warnings are displayed: The upper warning is displayed while the magnetisation is in progress. The lower warning is displayed after the magnetisation is completed.	1 L-> 0.0 Hz I ** WARNING ** ID MAGN 1 L-> 0.0 Hz 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 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 L->[xxx] Hz I ACT VAL1 xxx bar CURRENT xx A FREQ xx Hz

	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
FREQUENCY LIMITS AND ACCELERATION/DECELERATION TIMES		
☐	Set the minimum frequency.	1 L-> 0.0 Hz O 20 LIMITS 01 MINIMUM FREQ [ ]
☐	Set the maximum frequency.	1 L-> 0.0 Hz O 20 LIMITS 02 MAXIMUM FREQ [ ]
☐	Set the acceleration time 1. **Note:** Also set acceleration time 2 if two acceleration times will be used in the application.	1 L-> 0.0 rpm O 22 ACCEL/DECEL 02 ACCEL TIME 1 [ ]
☐	Set the deceleration time 1. **Note*:*** Also set deceleration time 2 if two deceleration times will be used in the application.	1 L-> 0.0 rpm O 22 ACCEL/DECEL 03 DECEL TIME 1 [ ]
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 (PFC macro) parameter settings are valid.

PRELIMINARY SETTINGS	
Ensure the PFC macro is active.	See parameter 99.02.
Ensure the control connections are wired according to the connection diagram given for the PFC macro.	See the 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 DI6 on.	`1 -> 0.0 Hz I`
	`ACT VAL1 0.00 bar`
	`CURRENT 0.00 A`
	`FREQ 0.00 Hz`

Regulate the speed by adjusting the voltage of analogue input AI1.	`1 -> 45.0 Hz I`
	`ACT VAL1 10.00 bar`
	`CURRENT 80.00 A`
	`FREQ 45.00 Hz`

STOPPING THE MOTOR	

Switch off digital input DI6.	`1 -> 45.0 Hz O`
	`ACT VAL1 0.00 bar`
	`CURRENT 0.00 A`
	`FREQ 0.00 Hz`

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 MINIMUM FREQUENCY $\leq$ 0 Hz.
- 20.02 MAXIMUM FREQUENCY > 80% of motor rated frequency
- 20.03 MAXIMUM CURRENT $\geq$ 100% · I_{hd}
- 20.04 MAXIMUM TORQUE > 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.

```
1 L ->  45.0 Hz     O
99 START-UP DATA
10 MOTOR ID RUN
[STANDARD]
```

- Press ***ENTER*** to verify selection. The following message will be displayed:

```
1 L ->  45.0 Hz     O
ACS800 55 kW
**WARNING**
ID RUN SEL
```

- To start the ID Run, press the ⏀ key. The Run Enable signal must be active (see parameter 16.01 RUN ENABLE). With the PFC macro, the interlocks must be on (see parameter 81.20 INTERLOCKS).

Warning when the ID Run is started	Warning during the ID Run	Warning after a successfully completed ID Run
1 L -> 45.0 Hz I ACS800 55 kW **WARNING** MOTOR STARTS	1 L -> 45.0 Hz I ACS800 55 kW **WARNING** ID RUN	1 L -> 45.0 Hz I ACS800 55 kW **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 by pressing the control panel stop key ( ).
- After the ID Run is started with the start key ( ), it is possible to monitor the actual values by first pressing the ***ACT*** key and then a double-arrow key ( ).

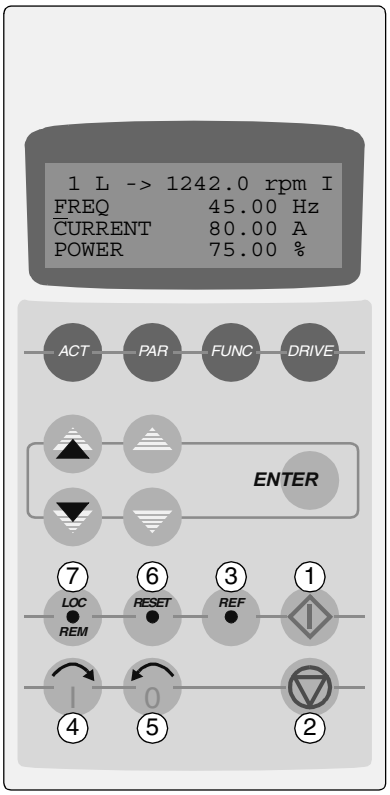
Control panel

Chapter overview

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

The same control panel is used with all ACS 800 series drives, so the instructions given apply to all ACS 800 types. The display examples shown are based on the Standard 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).

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)

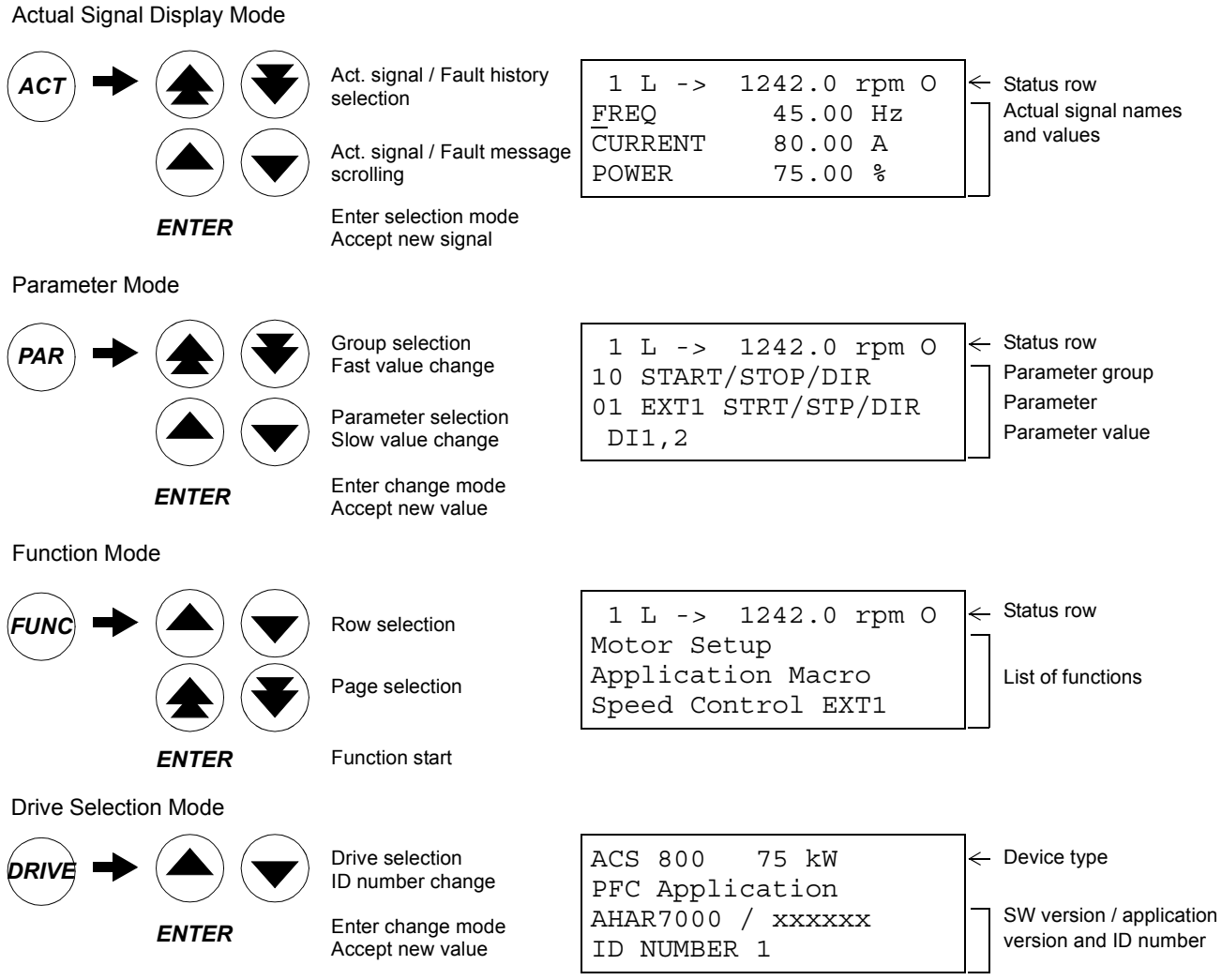
The use of single arrow keys, double arrow keys and ENTER depend on the operation mode of the panel.

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

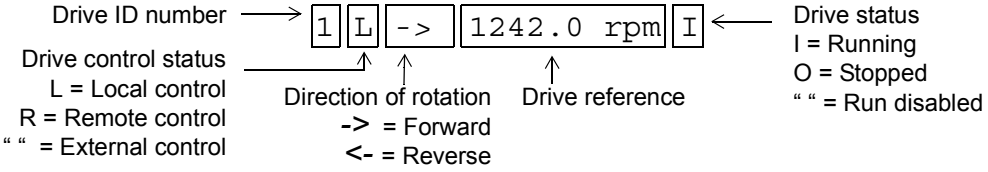
Panel operation mode keys and displays

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.



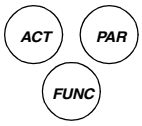
Drive control with the panel

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

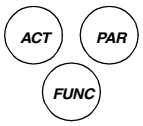
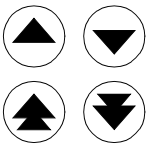
- start, stop, and change direction of the motor
- give the motor speed reference or torque reference
- give a process reference (when the process PID control is active)
- reset the fault and warning messages
- change between local and external drive control.

The panel can be used for control of the drive control 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 FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
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 FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
3.	To stop		1 L ->1242.0 rpm O FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
4.	To start		1 L ->1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
5.	To change the direction to reverse.		1 L <-1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
6.	To change the direction to forward.		1 L ->1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %

How to set speed reference

Step	Action	Press Key	Display
1.	To show the status row.		1 ->1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
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 FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
3.	To enter the Reference Setting function.		1 L ->[1242.0 rpm]I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
4.	To change the reference. (slow change) (fast change)		1 L ->[1325.0 rpm]I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
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 FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %

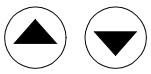
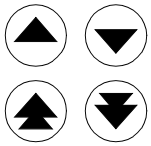
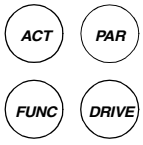
Actual signal display mode

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

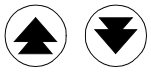
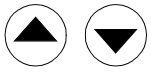
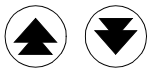
Step	Action	Press key	Display
1.	To enter the Actual Signal Display Mode.		1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
2.	To select a row (a blinking cursor indicates the selected row).		1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
3.	To enter the actual signal selection function.	***ENTER***	1 L -> 1242.0 rpm I 1 ACTUAL SIGNALS 04 CURRENT 80.00 A
4.	To select an actual signal. To change the actual signal group.		1 L -> 1242.0 rpm I 1 ACTUAL SIGNALS 05 TORQUE 70.00 %
5.a	To accept the selection and to return to the Actual Signal Display Mode.	***ENTER***	1 L -> 1242.0 rpm I FREQ 45.00 Hz TORQUE 70.00 % POWER 75.00 %
5.b	To cancel the selection and keep the original selection. The selected keypad mode is entered.		1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %

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 FREQUENCY CURRENT POWER
2.	To return to the Actual Signal Display Mode.	**Release** 	1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %

How to view and reset the fault history

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 FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
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 FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %

How to display and reset an active fault

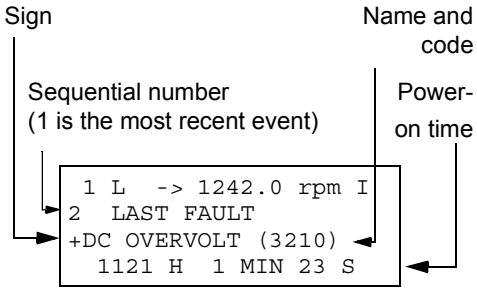
WARNING! If an external source for start command is selected and it is ON, the drive will start immediately after fault reset. If the cause of the fault has not been removed, the drive will trip again.

Step	Action	Press Key	Display
1.	To display an active fault.	ACT	1 L -> 1242.0 rpm ACS 801 75 kW ** FAULT ** ACS800 TEMP
2.	To reset the fault.	RESET	1 L -> 1242.0 rpm O FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %

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.

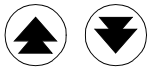
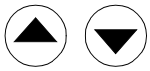
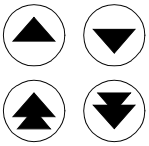
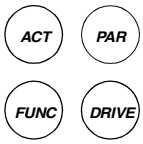
Parameter mode

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.

How to select a parameter and change the value

Step	Action	Press key	Display
1.	To enter the Parameter Mode.	PAR	1 L -> 1242.0 rpm O 10 START/STOP/DIR 01 EXT1 STRT/STP/DIR DI1,2
2.	To select a group.		1 L -> 1242.0 rpm O 11 REFERENCE SELECT 01 KEYPAD REF SEL REF1 (rpm)
3.	To select a parameter within a group.		1 L -> 1242.0 rpm O 11 REFERENCE SELECT 03 EXT REF1 SELECT AI1
4.	To enter the parameter setting function.	***ENTER***	1 L -> 1242.0 rpm O 11 REFERENCE SELECT 03 EXT REF1 SELECT [AI1]
5.	To change the parameter value. - (slow change for numbers and text) - (fast change for numbers only)		1 L -> 1242.0 rpm O 11 REFERENCE SELECT 03 EXT REF1 SELECT [AI2]
6a.	To save the new value.	***ENTER***	1 L -> 1242.0 rpm O 11 REFERENCE SELECT 03 EXT REF1 SELECT AI2
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 REFERENCE SELECT 03 EXT REF1 SELECT AI1

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 1 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:

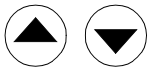
- Upload before downloading.
- Ensure the program versions of the destination drive are the same as the versions of the source drive, see parameters 33.01 and 33.02.
- Before removing the panel from a drive, ensure the panel is in remote operating mode (change with the LOC/REM key).
- Stop the drive before downloading.

Before upload, repeat the following steps in each drive:

- Setup the motors.
- Activate the communication to the optional equipment. (See parameter group 98 OPTION MODULES.)

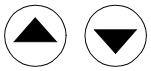
Before upload, do the following in the drive from which the copies are to be taken:

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

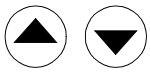
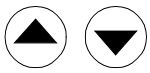
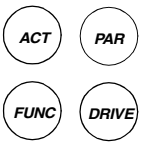
Step	Action	Press Key	Display
1.	Enter the Function Mode.		1 L -> 1242.0 rpm O Motor Setup Application Macro Speed Control EXT1
2.	Enter the page that contains the upload, download and contrast functions.		1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
3.	Select the upload function (a flashing cursor indicates the selected function).		1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
4.	Enter the upload function.	***ENTER***	1 L -> 1242.0 rpm O UPLOAD <=<=
5.	Switch to external control. (No L on the first row of the display.)		1 -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
6.	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 FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
3.	Enter the Function Mode.		1 L -> 1242.0 rpm O Motor Setup Application Macro Speed Control EXT1
4.	Enter the page that contains the upload, download and contrast functions.		1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=>>>> CONTRAST 4
5.	Select the download function (a flashing cursor indicates the selected function).		1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=>>>> CONTRAST 4
6.	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.		1 L -> 1242.0 rpm O Motor Setup Application Macro Speed Control EXT1
2.	Enter the page that contains the upload, download and contrast functions.		1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
3.	Select a function (a flashing cursor indicates the selected function).		1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
4.	Enter the contrast setting function.	***ENTER***	1 L -> 1242.0 rpm O CONTRAST [4]
5.	Adjust the contrast.		1 L -> 1242.0 rpm CONTRAST [6]
6.a	Accept the selected value.	***ENTER***	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 6
6.b	Cancel the new setting and retain the original value by pressing any of the mode selection keys. The selected mode is entered.		1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %

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*, Code: 3AFY 58919748 [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.

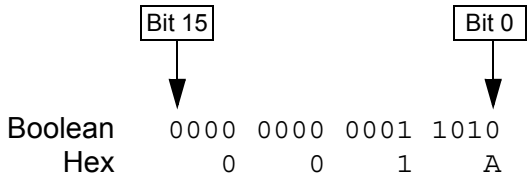
How to select a drive and change its panel link ID number

Step	Action	Press key	Display
1.	To enter the Drive Selection Mode.	DRIVE	ACS800 75 kW PFC Application AHAR7000 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 PFC Application AHAR7000 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.	ACT PAR FUNC	1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %

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:



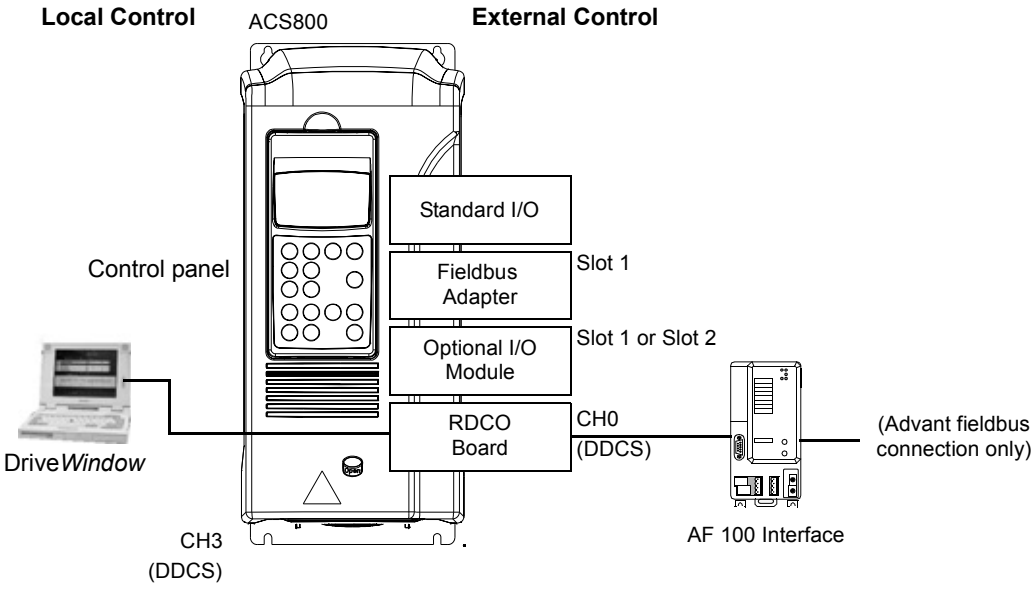
Program features

Chapter overview

The chapter describes 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 Drive*Window* can also control the drive.



Local control

The control commands are given from the control panel keypad when the drive is in local control. L indicates local control on the panel display.

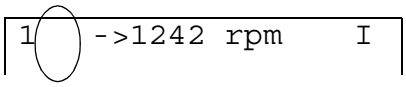
```
1 L ->1242 rpm    I
```

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

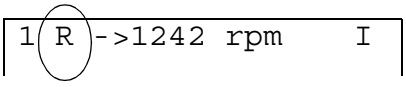
External control

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. In addition, it is also possible to set the control panel as the source for the external control.

External control is indicated by a blank on the panel display or with an R in those special cases when the panel is defined as a source for external control.



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



External Control by control panel

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

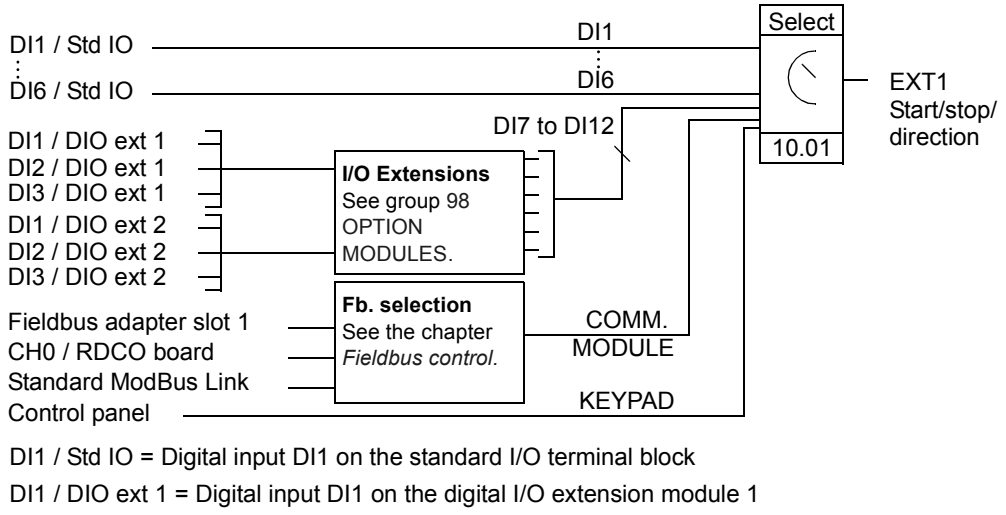
Panel key	**Additional information**
LOC/REM	Selection between local and external control
Parameter	
11.02	Selection between EXT1 and EXT2
10.01	Start, stop, direction source for EXT1
11.03	Reference source for EXT1
10.02	Start, stop, direction source for EXT2
11.06	Reference source for EXT2
Group 98 OPTION MODULES	Activation of the optional I/O and serial communication

Diagnostics

Actual signals	**Additional information**
01.11, 01.12	EXT1 reference, EXT2 reference
03.02	EXT1/EXT2 selection bit in a packed boolean word

Block diagram: start, stop, direction source for EXT1

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

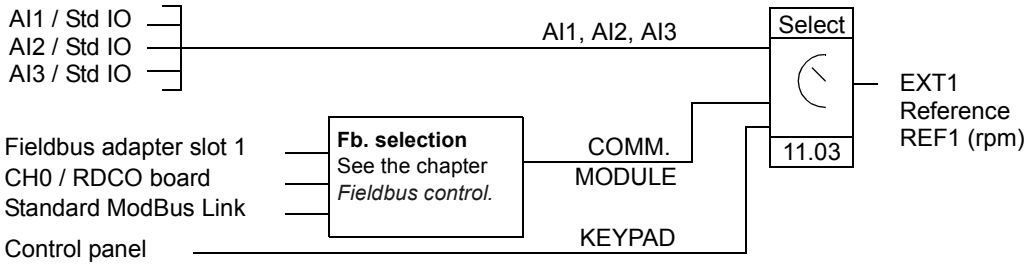


DI1 / Std IO = Digital input DI1 on the standard I/O terminal block

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

Block diagram: reference source for EXT1

The figure below shows the parameters that select the interface for the speed reference of external control location EXT1.



AI1 / Std IO = Analogue input AI1 on the standard I/O terminal block

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 by using mathematical functions: Addition, subtraction, multiplication, minimum selection, and maximum selection.

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.

Settings

Parameter	Additional information
Group 11 REFERENCE SELECT	External reference source, type and scaling
Group 20 LIMITS	Operating limits
Group 22 ACCEL/DECEL	Acceleration and deceleration ramps
Group 32 SUPERVISION	Reference supervision

Diagnostics

Actual signal	Additional information
01.11, 01.12	Values of external references
Group 02 ACTUAL SIGNALS	The 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

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). Each input can be inverted and filtered, and the maximum and minimum values can be adjusted.

Update cycles in the PFC Application Program

Input	Cycle
AI / standard	12 ms
AI / extension	12 ms

Settings

Parameter	Additional information
Group 11 REFERENCE SELECT	AI as a reference source
Group 13 ANALOGUE INPUTS	Processing of the standard inputs
30.01	Supervision of AI loss
Group 41 PFC CONTROL 1	AI as a PI process control reference
98.06	Activation of optional analogue inputs
98.08	Optional AI signal type definition (bipolar or unipolar)
98.09	Optional AI signal type definition (bipolar or unipolar)

Diagnostics

Actual value	Additional information
01.18, 01.19, 01.20	Values of standard inputs
01.38, 01.39	Value of optional inputs

Programmable analogue outputs

Two programmable current outputs (0/4 to 20 mA) are available as standard. 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 PFC Application Program

Output	Cycle
AO / standard	24 ms
AO / extension	24 ms

Settings

Parameter	Additional information
Group 15 ANALOGUE OUTPUTS	AO value selection and processing (standard outputs)
30.20	Operation of an externally controlled AO in a communication break
30.22	Supervision of the use of optional AO
Group 98 OPTION MODULES	Activation of optional I/O

Diagnostics

Actual value	Additional information
01.22, 01.23	Values of the standard outputs
01.28, 01.29	Values of the optional outputs

Programmable digital inputs

The drive has six programmable digital inputs (DI1 to DI6) as standard. Six extra inputs (DI7 to DI12) are available if optional digital I/O extension modules are used.

Update cycles in the PFC Application Program

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

Settings

Parameter	Additional information
Group 10 START/STOP/ DIR	DI as start, stop, direction
Group 11 REFERENCE SELECT	DI in reference selection
Group 12 CONSTANT FREQ	DI in constant frequency selection
Group 16 SYSTEM CTRL INPUTS	DI as external Run Enable, fault reset or user macro change signal
22.01	DI as acceleration and deceleration ramp selection signal
30.03	DI as external fault source
30.05	DI in motor overtemperature supervision function
43.01	DI as sleep function activation signal (in PI process control)
98.03 … 98.04	Activation of the optional digital I/O extension modules

Diagnostics

Actual value	Additional information
01.17	Values of the standard digital inputs
01.40	Values of the optional digital inputs
Fault	
I/O COMM ERR (7000)	Communication loss to I/O

Programmable relay outputs

As standard there are three programmable relay outputs. Four outputs can be added by using two 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 PFC Application Program

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

Settings

Parameter	Additional information
Group 14 RELAY OUTPUTS	RO value selections and operation times
30.21	Operation of an externally controlled relay output on a communication break
Group 98 OPTION MODULES	Activation of optional relay outputs

Diagnostics

Actual value	Additional information
01.21	Standard relay output states
01.41	Optional relay output states

Actual signals

Several actual signals are available:

- 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
- PI controller actual values (if the PFC macro is selected)

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 outputs.

Settings

Parameter	Additional information
Group 15 ANALOGUE OUTPUTS	Selection of an actual signal to an analogue output
Group 92 D SET TR ADDR	Selection of an actual signal to a dataset (serial communication)

Diagnostics

Actual value	Additional information
Group 01 ACTUAL SIGNALS … 03 ACTUAL SIGNALS	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.

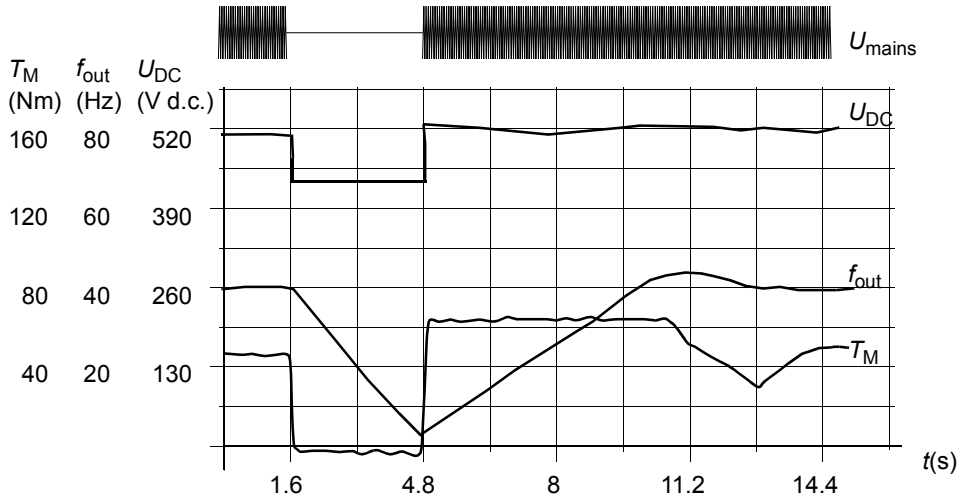
In demanding applications, a separate Identification Run can be performed.

Settings

Parameter 99.10.

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 5 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 21.01.

DC Magnetising

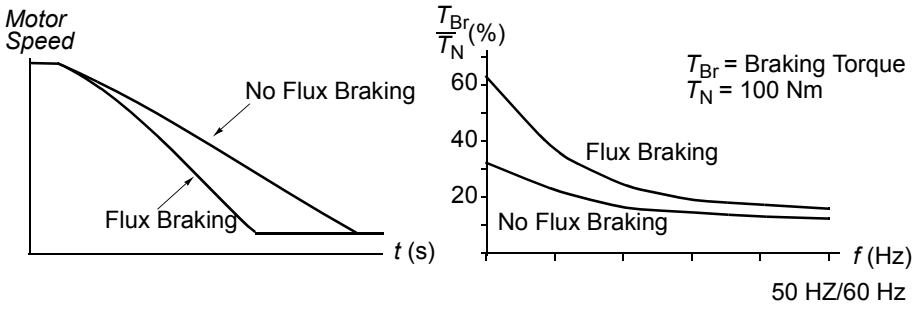
When DC Magnetising is activated, the drive automatically magnetises the motor before starting. This feature guarantees the highest possible breakaway torque, up to 200% of motor nominal torque. By adjusting the premagnetising time, it is possible to synchronise the motor start and e.g. a mechanical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

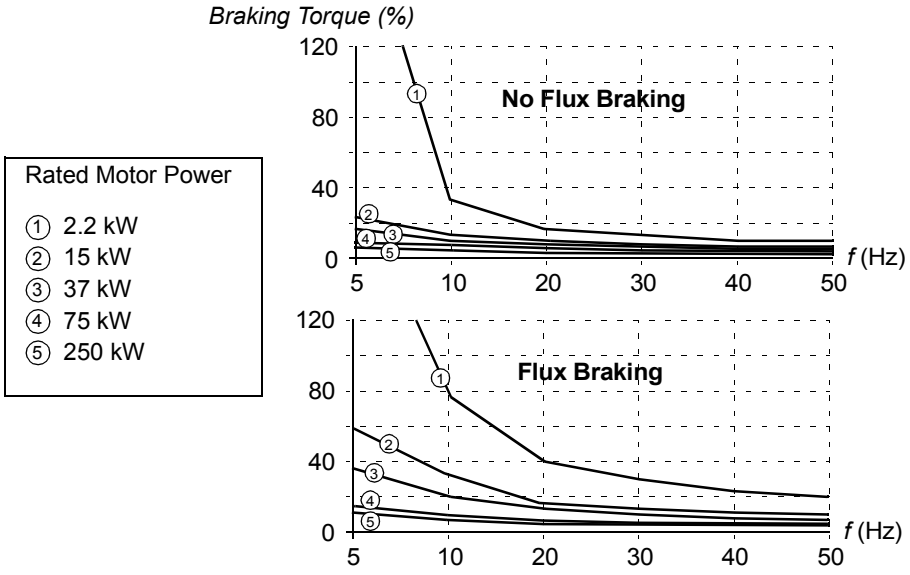
Settings

Parameters 21.01 and 21.02.

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 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 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% to 10%, depending on the load torque and speed.

Settings

Parameter 26.01.

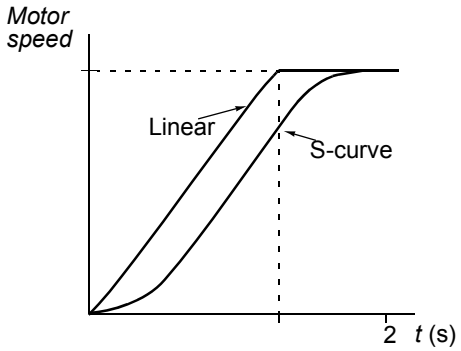
Acceleration and deceleration ramps

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.

Critical frequencies

A critical frequencies function is available for applications where it is necessary to avoid certain motor frequencies or frequency bands because of e.g. mechanical resonance problems.

Settings

Parameter group 25 CRITICAL FREQ.

Constant frequencies

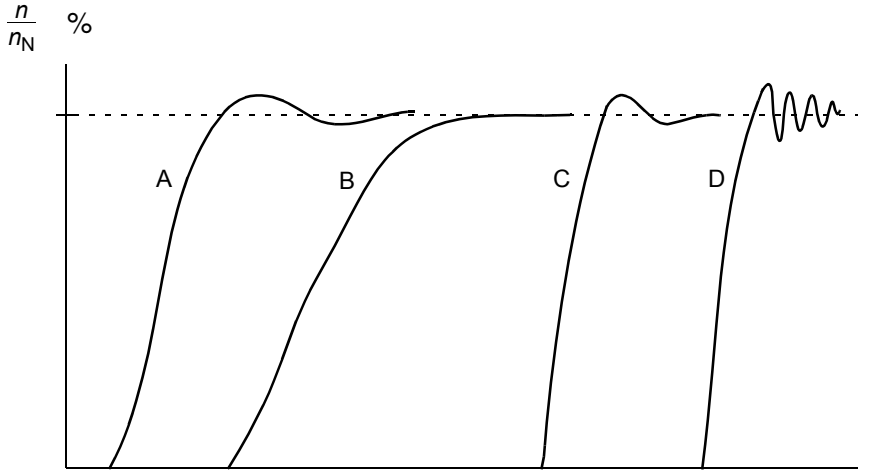
It is possible to predefine three constant frequencies. Constant frequencies are selectable through digital inputs. Constant frequency activation overrides the drive frequency reference.

Settings

Parameter group 12 CONSTANT FREQ.

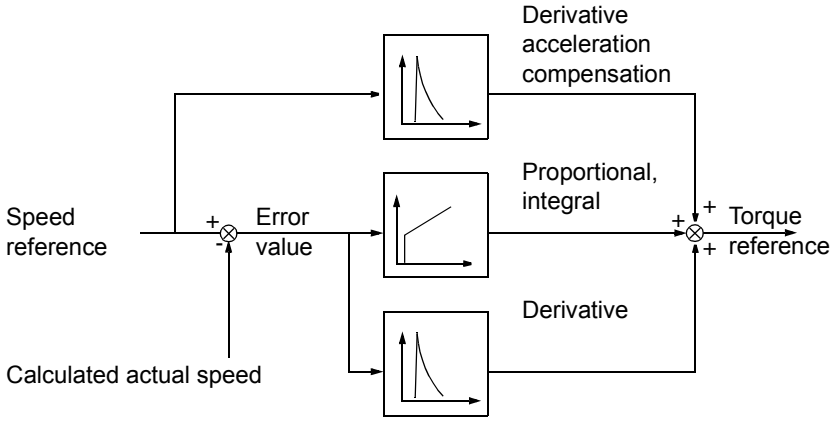
Speed controller tuning

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 Autotune Run. In Autotune Run, 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 group 23 SPEED CTRL and 20 LIMITS.

Diagnostics

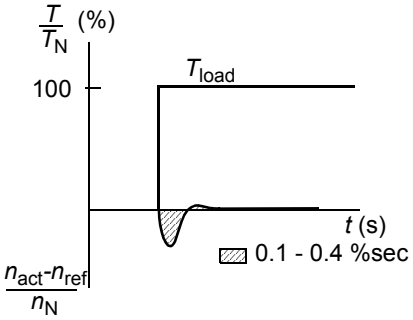
Actual signal 01.02.

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.



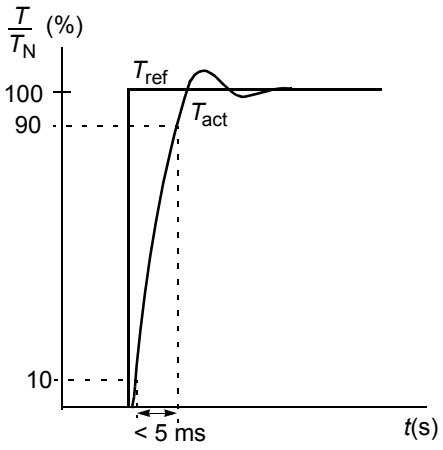
T_N = rated motor torque
n_N = rated motor speed
n_{act} = actual speed
n_{ref} = speed reference

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

Scalar control

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

It is recommended to activate the Scalar Control mode in the following special applications:

- In multimotor drives: 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification
- If the nominal current of the motor is less than 1/6 of the nominal output current of the drive
- If the drive is used without a motor connected (e.g. for test purposes)
- The drive runs a medium voltage motor via a step-up transformer.

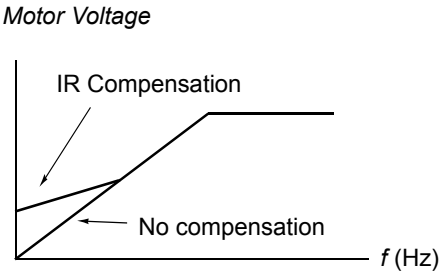
In the Scalar Control mode, some standard features are not available.

Settings

Parameter 99.04.

IR compensation for a scalar controlled drive

IR Compensation is active only when the motor control mode is Scalar (see the section *Scalar control* above). When IR Compensation is activated, the drive gives an extra voltage boost to the motor at low speeds. IR Compensation is useful in applications that require high breakaway torque. In Direct Torque Control, no IR Compensation is possible/needed.



Settings

Parameter 26.03.

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 26.05.

Programmable protection functions

AI<Min

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

Settings

Parameter 30.01.

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 30.02.

External Fault

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

Settings

Parameter 30.03.

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.

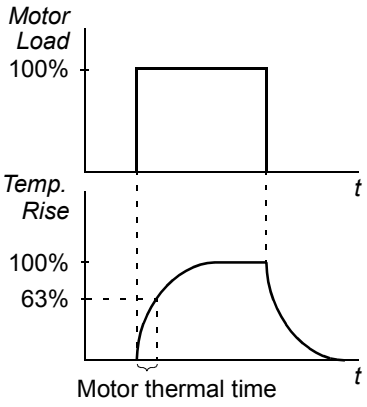
The Motor Thermal Protection modes are based either on a motor temperature thermal model or on an overtemperature indication from a motor thermistor.

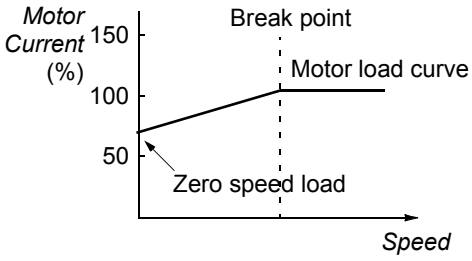
Motor temperature thermal model

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 30.04 to 30.09.

Pressure monitoring

The PFC application program contains protective functions for two-level analogue or single-level digital pressure monitoring of both the inlet and the outlet of the pump (or compressor, etc.).

In analogue monitoring, whenever the pressure being monitored meets the first limit, the drive indicates a warning, trips on a fault, or starts to follow a pre-set reference. When the second limit is met, the drive either stops or produces a fault.

In digital pressure monitoring, one limit is observed. Whenever the limit is met, the drive indicates a warning, trips on a fault, or starts to follow a pre-set reference.

Settings

Parameter group 44 PFC PROTECTION.

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 30.10 to 30.12.

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 30.13 to 30.15.

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 30.16.

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 30.17.

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 30.19 to 30.22.

Preprogrammed Faults

Overcurrent

The overcurrent trip limit for the drive is 1.65 · I_{max} to 2.17 · I_{max} depending on 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. If the inverter module temperature exceeds 115 °C, a warning is given. The temperature trip level is 125 °C.

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 if the ambient temperature is below -5 to 0 °C or above 73 to 82 °C (the exact limits vary within the given ranges depending on drive type).

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 (Direct Torque Control mode active) or frequency limit (Scalar Control active).

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 $1.5 \cdot P_{hd}$. If the limit is exceeded, the motor torque is automatically restricted. The function protects the input bridge of the drive against overload.

Automatic resets

The drive can automatically reset itself after overcurrent, overvoltage, undervoltage and “analogue input below a minimum” faults. The Automatic Resets must be activated by the user.

Settings

Parameter group 31 AUTOMATIC RESET.

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

Actual Signals	Additional information
03.04	Supervision limit indicating bits in a packed boolean word
Group 14 RELAY OUTPUTS	Supervision limit indication through a relay output

Parameter lock

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

Settings

Parameters 16.02 and 16.03.

Pump/Fan control

The PFC (Pump and fan control) macro is specially designed for multimotor pumping (or compressor, etc.) stations. While directly controlling one motor, the drive is able to start additional, direct-on-line motors whenever a higher capacity is needed. There is an Autochange function to alternate between the pumps so all pumps have an equal duty time, and the Interlocks function enables the drive to detect if any of the pumps are unavailable (e.g. switched off for maintenance) so the next available pump is started instead.

See the chapter *PFC Application Example.* See also the chapter *Application macros*, section *PFC (Pump and fan control) macro*, and the parameter groups listed below.

Settings

Parameter	Additional information
Group 14 RELAY OUTPUTS	Selection of digital outputs for starting and stopping of motors
Group 41 PFC CONTROL 1	Process reference selection, set-up of auxiliary motor start/stop frequencies
Group 42 PFC CONTROL 2	Set-up of auxiliary motors, start delays, Interlocks function and automatic motor alternation (Autochange function)
Group 44 PFC PROTECTION	Set-up of PFC protections (pressure monitoring)

Diagnostics

Actual value	Additional information
01.17, 01.40	Status of digital inputs
01.21, 01.41	Status of relay outputs
01.42	Time since latest Autochange

Process PI control

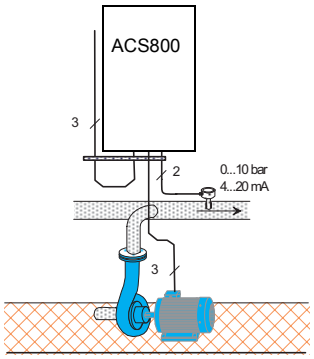
There is a built-in PI controller in the drive. The controller can be used to control process variables such as pressure, flow or fluid level.

When the process PI control is activated, a process reference (setpoint) is connected to the drive instead of a speed reference. An actual value (process feedback) is also brought back to the drive. The process PI control adjusts the drive speed in order to keep the measured process quantity (actual value) at the desired level (reference).

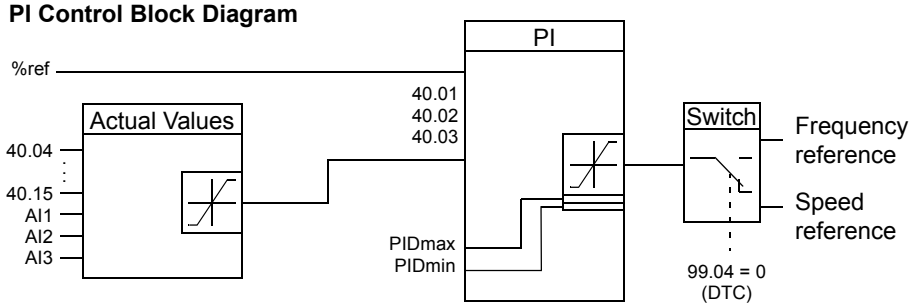
The block diagram below right illustrates the process PI control.

The figure on the left shows an application example: The controller adjusts the speed of a pressure boost pump according to the measured pressure and the set pressure reference.

Example:
Pressure boost pump



PI Control Block Diagram



%ref = external reference EXT REF2 (see parameter 11.06)

Settings

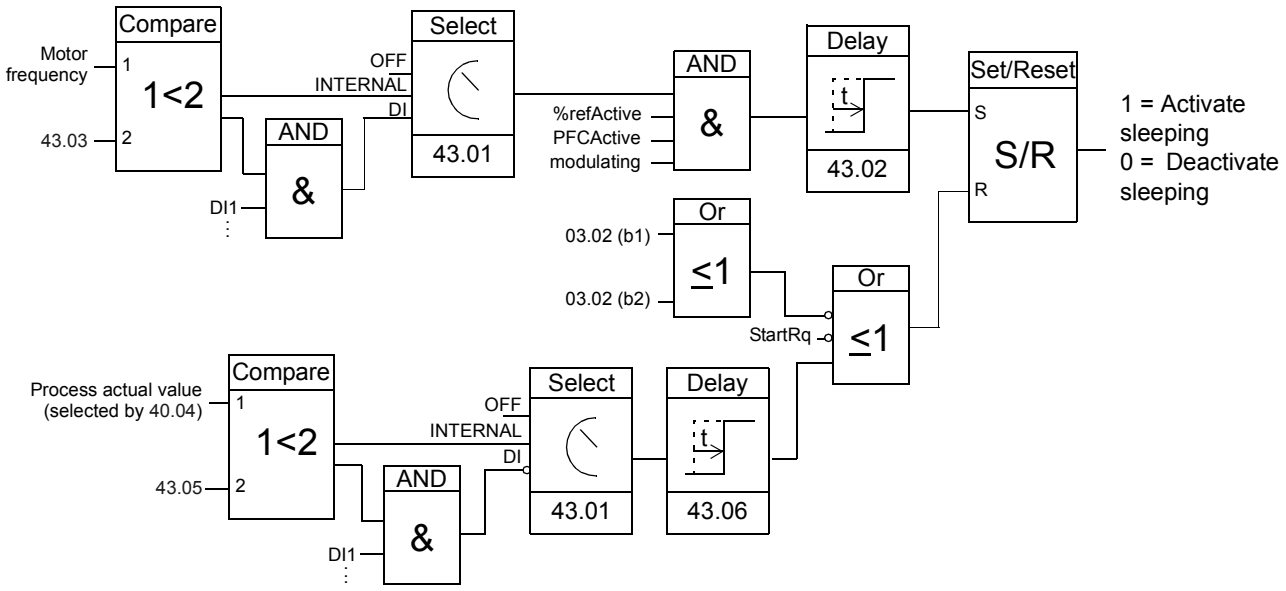
Parameter	Purpose
99.02	Application macro selection
Group 40 PI CONTROL	The settings of the process PI controller
32.09 to 32.14	The supervision limits for the process reference REF2 and the variables ACT1 and ACT2

Diagnostics

Actual Signals	Purpose
01.12, 01.24, 01.25 and 01.26	PID process controller reference, actual values and error value
Group 14 RELAY OUTPUTS	Supervision limit exceeded indication through a relay output
Group 15 ANALOGUE OUTPUTS	PID process controller values through standard analogue outputs

Sleep function for process PI control

The block diagram below illustrates the sleep function enable/disable logic.



Motor freq.: Drive output frequency
%refActive: The % reference (EXT REF2) is in use. See Parameter 11.02.
PFCActive: 99.02 is PFC
modulating: The inverter IGBT control is operating

Example: Sleep function for a PI controlled pressure boost pump

Water consumption falls at night. As a consequence, the PI process controller decreases the motor speed. However, due to natural losses in the pipes and the low efficiency of the centrifugal pump at low speeds, the motor does not stop but keeps rotating. The sleep function detects the slow rotation, and stops the unnecessary pumping after the sleep delay has passed. The drive shifts into sleep mode, still monitoring the pressure. The pumping restarts when the pressure falls under the allowed minimum level and the wake-up delay has passed.

Settings

Parameter	Additional information
99.02	PFC control activation
Group 43 SLEEP FUNCTION	Sleep function settings

Diagnostics

Warning SLEEP MODE on the panel display.

Application macros

Chapter overview

This chapter describes the intended use, operation and the default control connections of the standard application macros. 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 can select one of the macros by parameter 99.02.

There are two standard macros and two user macros. The table below contains a summary of the macros and describes suitable applications.

Macro	Suitable Applications
PFC	Pump/fan/compressor station with one to four parallel pumps.
Hand/Auto	Speed control applications. Switching between two external control devices is possible.
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

PFC (Pump and fan control) macro

Pump and Fan Control (PFC) macro can operate a pump (or fan or compressor) station with one to five parallel pumps. The control principle of a two-pump station is as follows:

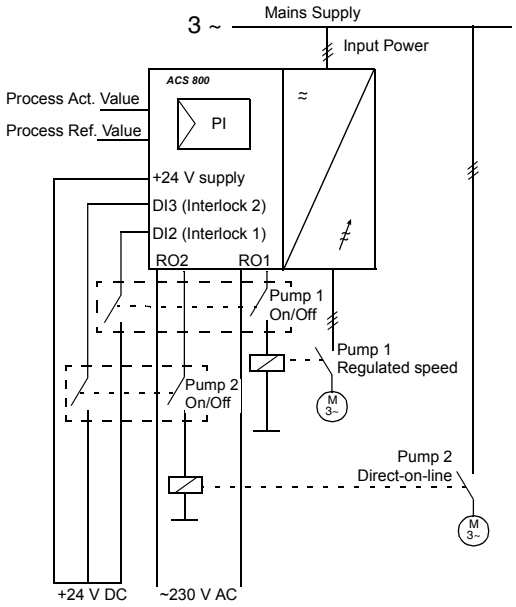
- The motor of pump 1 is connected to the drive. The capacity of the pump is controlled by varying the motor speed.
- The motor of pump 2 is connected direct-on-line. The pump can be switched on and off by the drive when necessary.
- The process reference and actual value are fed to the PI controller included in the PFC macro. The PI controller adjusts the speed (frequency) of pump 1 such that the process actual value follows the reference. When the frequency reference of the process PI controller exceeds the limit set by the user, the PFC macro automatically starts pump 2. When the frequency falls below the limit set by the user, the PFC macro automatically stops pump 2.
- Using the digital inputs of the drive, an interlocking function can be implemented; the PFC macro detects if a pump is switched off and starts the other pump instead.
- The PFC macro makes automatic pump alternation possible (not in use in the example below) so both pumps have an equal duty time. For more information on the alternation system and other useful features such as the Sleep function, Constant reference value, Reference steps and Regulator by-pass, see *Chapter 6 – Parameters* (Groups 41 and 42).

By default, the drive receives process reference (setpoint) through analogue input AI1, process actual value through analogue input AI2 and Start/Stop commands through digital input DI6. The interlocks are connected to digital input DI2 (Motor 1) and digital input DI3 (Motor 2).

The default output signals are given through analogue output AO1 (frequency) and AO2 (actual value of the process PI controller).

If the Control Panel is in Local control mode (“L” visible on the first row of the display), the drive follows the frequency reference given from the Panel. The automatic Pump and Fan Control (PFC) is bypassed: no process PI controller is in use and the direct-on-line motors are not started.

Operation diagram




```
 1 L ->    45.0 Hz  I
ACT VAL1    10.00 bar
CURRENT     80.00 A
FREQ        45.00 Hz
```

Reference, Start/Stop, and Direction commands are given from the Control Panel. To change to External, press ***LOC REM***.

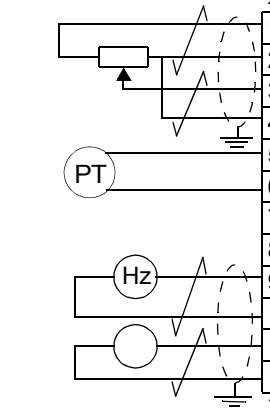
```
 1   ->    45.0 Hz  I
ACT VAL1    10.00 bar
CURRENT     80.00 A
FREQ        45.00 Hz
```

Reference is read from analogue input AI2. Start/Stop commands are given through digital input DI6.

Note: By default, automatic pump alternation is not in use.

Default control connections

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



X20		
1	VREF	Reference voltage -10 VDC
2	GND	1 kohm ≤ R_L ≤ 10 kohm
X21		
1	VREF	Reference voltage 10 VDC
2	GND	1 kohm ≤ R_L ≤ 10 kohm
3	AI1+	External reference 2 (process reference to PI
4	AI1-	controller). 0(2) … 10 V, R_{in} > 200 kohm
5	AI2+	Actual value 1 (process actual value to PI
6	AI2-	controller). 0(4) … 20 mA, R_{in} = 100 ohm
7	AI3+	By default, not in use.
8	AI3-	0(4) … 20 mA, R_{in} = 100 ohm.
9	AO1+	Frequency. 0(4) … 20 mA ≙
10	AO1-	0 … motor nom. speed, R_L ≤ 700 ohm
11	AO2+	Actual 1 (PI controller actual value).
12	AO2-	0(4) … 20 mA ≙
X22		
1	DI1	By default, not in use.
2	DI2	Interlock: motor 1 off/on
3	DI3	Interlock: motor 2 off/on
4	DI4	By default, not in use.
5	DI5	By default, not in use.
6	DI6	Stop/Start
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)
X23		
1	+24 V	Auxiliary voltage output, non-isolated,
2	GND	24 VDC, 250 mA
X25		
1	RO11	Relay output 1
2	RO12	**M1 START**
3	RO13	
X26		
1	RO21	Relay output 2
2	RO22	**M2 START**
3	RO23	
X27		
1	R031	Relay output 3
2	R032	**FAULT**
3	R033	

Hand/Auto macro

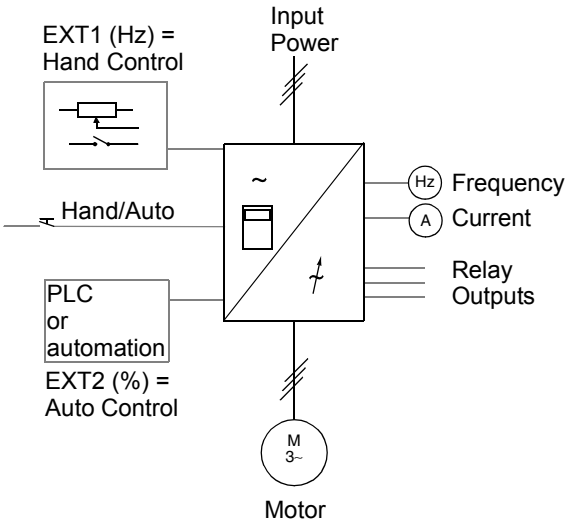
Start/Stop and Direction commands and reference settings can be given from one of two external control locations, EXT1 (Hand) or EXT2 (Auto). The Start/Stop/Direction commands of EXT1 (Hand) are connected to digital input DI1, and the reference signal is connected to analogue input AI1. The Start/Stop/Direction commands of EXT2 (Auto) are connected to digital input DI6, and the reference signal is connected to analogue input AI2. The selection between EXT1 and EXT2 is dependent on the status of digital input DI5. The drive is frequency-controlled.

The frequency reference and Start/Stop and Direction commands can also be given from the control panel.

The frequency reference in Auto Control (EXT2) is given as a percentage of the maximum frequency of the drive.

Two analogue and three relay output signals are available on terminal blocks. The default signals on the display of the control panel are FREQUENCY, CURRENT and CTRL LOC.

Operation diagram




```
 1 L ->   45.0 Hz I
FREQ       45.00 Hz
CURRENT    80.00 A
CTRL LOC LOCAL
```

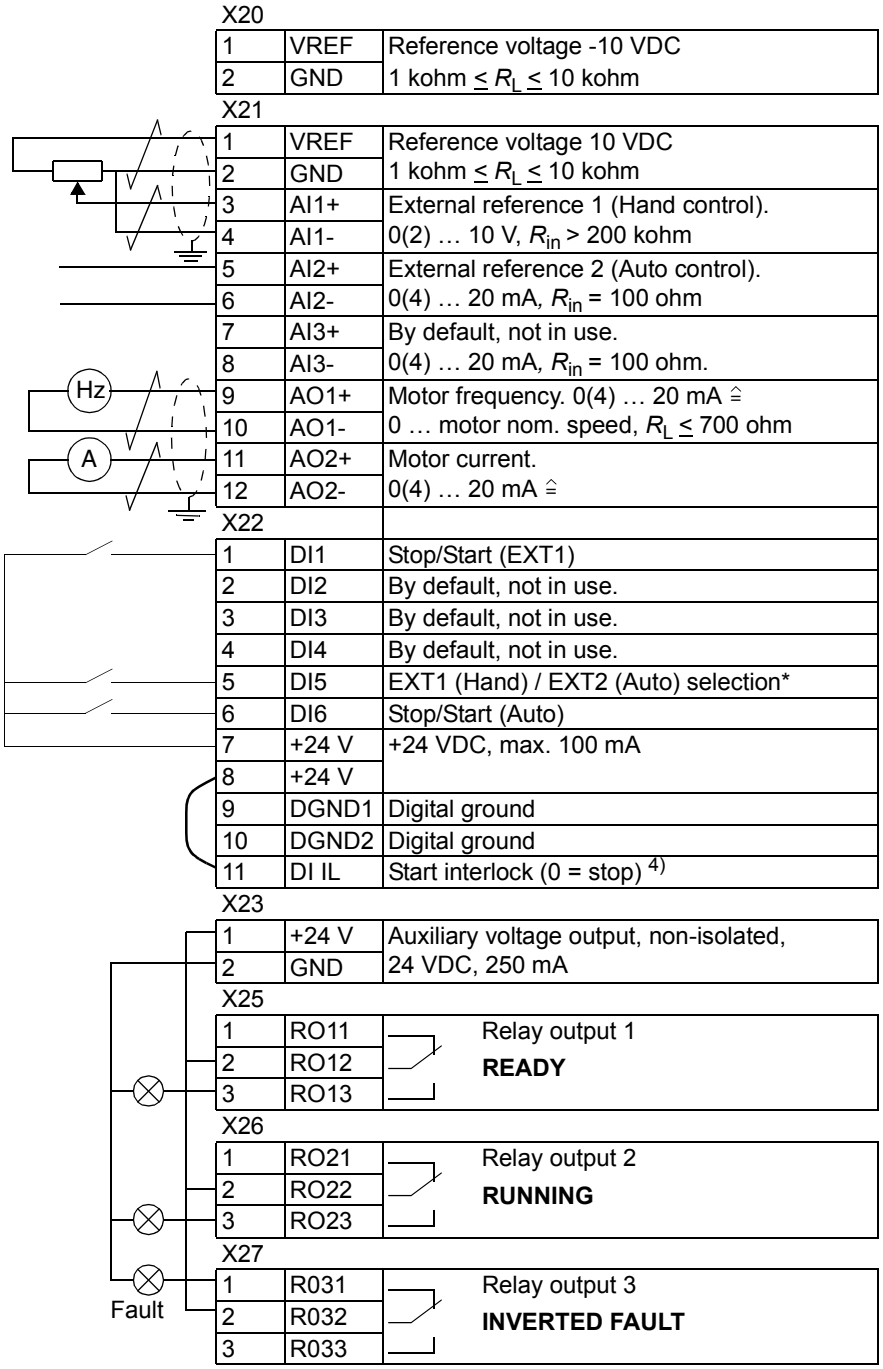
Local control: Reference, Start/Stop commands are given from the Control Panel. To change to External, press ***LOC REM***.

```
 1   ->   45.0 Hz I
FREQ       45.00 Hz
CURRENT    80.00 A
CTRL LOC EXT1
```

External control (Hand): Reference is read from analogue input AI1. Start/Stop commands are given through digital input DI1.

Default control connections

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



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

User macros

In addition to the standard application macros, 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 and the control location setting (Local or Remote) are also saved.

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 to USER 1 SAVE (press ENTER). The storing takes approximately 20 to 60 seconds.

To recall the user macro:

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

The user macro can also be switched via digital inputs (see parameter 16.05).

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

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

Chapter overview

The chapter describes the actual signals and parameters and gives the fieldbus equivalent values for each signal/parameter. More data is given in chapter *Additional data: actual signals and parameters*.

Terms and abbreviations

Term	Definition
Absolute Maximum Frequency	Value of 20.01 or 20.02 if the absolute value of the minimum limit is greater than the maximum limit.
Actual signal	Signal measured or calculated by the drive. Can be monitored by the user. No user setting possible.
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.

No.	Name/Value	Description	FbEq
01 ACTUAL SIGNALS		Basic signals for monitoring of the drive.	
01.02	SPEED	Calculated motor speed in rpm.	-20000 = -100% 20000 = 100% of motor abs. max. speed
01.03	FREQUENCY * **	Calculated drive output frequency.	-100 = -1 Hz 100 = 1 Hz
01.04	CURRENT * **	Measured motor current.	10 = 1 A
01.05	TORQUE	Calculated motor torque.	-10000 = -100% 10000 = 100% of motor nom. torque
01.06	POWER	Motor power.	0 = 0% 1000 = 100% of motor nom. power
01.07	DC BUS VOLTAGE V	Measured intermediate circuit voltage.	1 = 1 V
01.08	MAINS VOLTAGE	Calculated supply voltage.	1 = 1 V
01.09	OUTPUT VOLTAGE	Calculated motor voltage.	1 = 1 V
01.10	ACS 800 TEMP	Temperature of the heatsink.	1 = 1 °C
01.11	EXTERNAL REF 1	External reference REF1 in rpm. (Hz if value of parameter 99.04 is SCALAR.)	1 = 1 rpm (1 = 1 Hz)
01.12	EXTERNAL REF 2	External reference REF2. 100% corresponds to maximum process reference (PFC macro) or maximum frequency (Hand/Auto macro).	0 = 0% 10000 = 100% ***
01.13	CTRL LOCATION **	Active control location. (1,2) LOCAL; (3) EXT1; (4) EXT2. See the chapter *Program features*.	See Descr.
01.14	OP HOUR COUNTER	Elapsed time counter. Runs when the control board is powered.	1 = 1 h
01.15	KILOWATT HOURS	kWh counter.	1 = 100 kWh
01.16	APPL BLOCK OUTPUT	Application block output signal. E.g. PFC application output.	0 = 0% 10000 = 100%
01.17	DI6-1 STATUS	Status of digital inputs DI6-DI1 and the optional PFC extension module digital input 1 (DI7). Example: 0000001 = DI1 is on, DI2 to DI7 are off.	
01.18	AI1 [V]	Value of analogue input AI1.	1 = 0.001 V
01.19	AI2 [mA]	Value of analogue input AI2.	1 = 0.001 mA
01.20	AI3 [mA]	Value of analogue input AI3.	1 = 0.001 mA
01.21	RO3-1 STATUS	Status of relay outputs RO3-RO1. Example: 001 = RO1 is energised, RO2 and RO3 are de-energised.	
01.22	AO1 [mA]	Value of analogue output AO1.	1 = 0.001 mA
01.23	AO2 [mA]	Value of analogue output AO2.	1 = 0.001 mA
01.24	ACTUAL VALUE 1 *	Value of process feedback signal no. 1 received by the process PI controller. See par. 40.12.	0 = 0% 10000 = 100%
01.25	ACTUAL VALUE 2	Value of process feedback signal no. 2 received by the process PI controller. See par. 40.14.	0 = 0% 10000 = 100%

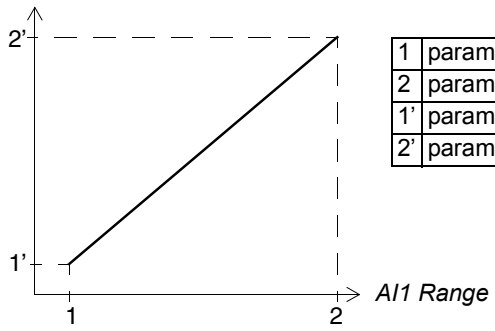
No.	Name/Value	Description	FbEq
01.26	CONTROL DEVIATION	Deviation of the PI controller, i.e. the difference between the process reference value and the process actual value.	-10000 = -100% 10000 = 100%
01.27	ACTUAL FUNC OUT	Result of the arithmetic operation selected with par. 40.04.	100 = 1
01.28	EXT AO1 [mA]	Value of output 1 of the analogue I/O extension module (optional).	1 = 0.001 mA
01.29	EXT AO2 [mA]	Value of output 2 of the analogue I/O extension module (optional).	1 = 0.001 mA
01.30	PP 1 TEMP	IGBT maximum temperature in inverter no. 1 (used only in high power units with parallel inverters).	1 = 1 °C
01.31	PP 2 TEMP	IGBT maximum temperature in inverter no. 2 (used only in high power units with parallel inverters).	1 = 1 °C
01.32	PP 3 TEMP	IGBT maximum temperature in inverter no. 3 (used only in high power units with parallel inverters).	1 = 1 °C
01.33	PP 4 TEMP	IGBT maximum temperature in inverter no. 4 (used only in high power units with parallel inverters).	1 = 1 °C
01.37	MOTOR TEMP EST	Estimated motor temperature.	1 = 1 °C
01.38	AI5 [mA]	Value of analogue input AI5 read from AI1 of the analogue I/O extension module (optional). A voltage signal is also displayed in mA (instead of V).	1 = 0.001 mA
01.39	AI6 [mA]	Value of analogue input AI6 read from AI2 of the analogue I/O extension module (optional). A voltage signal is also displayed in mA (instead of V).	1 = 0.001 mA
01.40	DI7-12 STATUS	Status of digital inputs DI7 to DI12 read from the digital I/O extension modules (optional). E.g. value 000001: DI7 is on, DI8 to DI12 are off.	1 = 1
01.41	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 energised. Other relay outputs are de-energised.	1 = 1
01.42	PFC OPERATION TIME	Time since the latest Autochange. See parameter group 42.	1 = 1 h
01.43	MOTOR RUN TIME	Motor run time counter. The counter runs when the inverter modulates.	1 = 10 h
01.44	FAN ON-TIME	Running time of the drive cooling fan. **Note:** The counter can be reset by the DriveWindow PC tool. Resetting is recommended when the fan is replaced.	1 = 10 h
01.45	CTRL BOARD TEMP	Control board temperature.	1 = 1 °C
*Default signal for PFC macro. **Default signal for Hand/Auto macro. ***Of max. process reference (PFC macro) or max. frequency (Hand/Auto macro).			

No.	Name/Value	Description	FbEq
02 ACTUAL SIGNALS		Speed and torque reference monitoring signals.	
02.01	SPEED REF 2	Limited speed reference.	0 = 0% 20000 = 100% of motor abs. max. frequency
02.02	SPEED REF 3	Ramped and shaped speed reference.	20000 = 100% of motor abs. max. frequency
02.09	TORQ REF 2	Speed controller output.	0 = 0% 10000 = 100% of motor nominal torque
02.10	TORQ REF 3	Torque reference.	10000 = 100% of motor nominal torque
02.13	TORQ USED REF	Torque reference after frequency, voltage and torque limiters. 100% corresponds to the motor nominal torque.	10000 = 100%
02.17	SPEED ESTIMATED	Estimated motor speed. 100% corresponds to the Absolute Maximum Frequency of the motor.	20000 = 100%

No.	Name/Value	Description	FbEq
03 ACTUAL SIGNALS		Data words for monitoring of fieldbus communication (each signal is a 16-bit data word).	
03.01	MAIN CTRL WORD	A 16-bit data word. See the chapter *Fieldbus control*.	
03.02	MAIN STATUS WORD	A 16-bit data word. See the chapter *Fieldbus control*.	
03.03	AUX STATUS WORD	A 16-bit data word. See the chapter *Fieldbus control*.	
03.04	LIMIT WORD 1	A 16-bit data word. See the chapter *Fieldbus control*.	
03.05	FAULT WORD 1	A 16-bit data word. See the chapter *Fieldbus control*.	
03.06	FAULT WORD 2	A 16-bit data word. See the chapter *Fieldbus control*.	
03.07	SYSTEM FAULT	A 16-bit data word. See the chapter *Fieldbus control*.	
03.08	ALARM WORD 1	A 16-bit data word. See the chapter *Fieldbus control*.	
03.09	ALARM WORD 2	A 16-bit data word. See the chapter *Fieldbus control*.	
03.10	ALARM WORD 3	A 16-bit data word. See the chapter *Fieldbus control*.	
03.20	LATEST FAULT	Fieldbus code of the latest fault. See chapter *Fault tracing* for the codes.	
03.21	2. LATEST FAULT	Fieldbus code of the 2nd latest fault.	
03.22	3. LATEST FAULT	Fieldbus code of the 3rd latest fault.	
03.23	4. LATEST FAULT	Fieldbus code of the 4th latest fault.	
03.24	5. LATEST FAULT	Fieldbus code of the 5th latest fault.	
03.25	LATEST WARNING	Fieldbus code of the latest warning.	
03.26	2. LATEST WARNING	Fieldbus code of the 2nd latest warning.	
03.27	3. LATEST WARNING	Fieldbus code of the 3rd latest warning.	
03.28	4. LATEST WARNING	Fieldbus code of the 4th latest warning.	
03.29	5. LATEST WARNING	Fieldbus code of the 5th latest warning.	

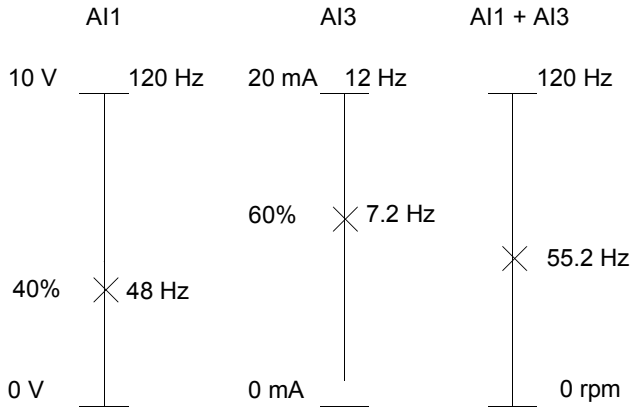
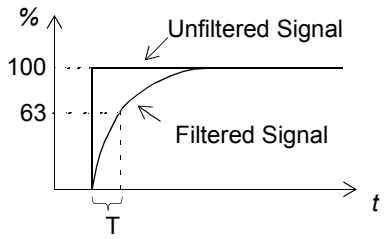
Index	Name/Selection	Description	FbEq
10 START/STOP/DIR		The sources for external start, stop and direction control	
10.01	EXT1 STRT/STP/DIR	Defines the connections and the source of the start, stop and direction commands for external control location 1 (EXT1). **Note:** The pulse (P) start/stop commands are not available if motor interlocks (parameter 42.04) are ON.	
	NOT SEL	No start, stop and direction command source.	1
	DI1	Start and stop through digital input DI1. 0 = stop; 1 = start. Direction is fixed according to parameter 10.03. **WARNING!** After a fault reset, the drive will start if the start signal is on.	2
	DI1,2	Start and stop through digital input DI1. 0 = stop, 1 = start. Direction through digital input DI2. 0 = forward, 1 = reverse. To control direction, parameter 10.03 DIRECTION must be REQUEST. **WARNING!** After a fault reset, the drive will start if the start signal is on.	3
	DI1P,2P	Pulse start through digital input DI1. 0 -> 1: Start. Pulse stop through digital input DI2. 1 -> 0: Stop. Direction of rotation is fixed according to parameter 10.03 DIRECTION.	4
	DI1P,2P,3	Pulse start through digital input DI1. 0 -> 1: Start. Pulse stop through digital input DI2. 1 -> 0: Stop. Direction through digital input DI3. 0 = forward, 1 = reverse. To control direction, parameter 10.03 DIRECTION must be REQUEST.	5
	DI1P,2P,3P	Pulse start forward through digital input DI1. 0 -> 1: Start forward. Pulse start reverse through digital input DI2. 0 -> 1: Start reverse. Pulse stop through digital input DI3. 1 -> ”0”: stop. To control the direction, parameter 10.03 DIRECTION must be REQUEST.	6
	DI6	See selection DI1.	7
	DI6,5	See selection DI1,2. DI6: Start/stop, DI5: direction.	8
	KEYPAD	Control panel. To control the direction, parameter 10.03 DIRECTION must be REQUEST.	9
	COMM. MODULE	Fieldbus Control Word.	10
	DI7	See selection DI1.	11
	DI7,8	See selection DI1,2.	12
	DI7P,8P	See selection DI1P,2P.	13
	DI7P,8P,9	See selection DI1P,2P,3.	14
	DI7P,8P,9P	See selection DI1P,2P,3P.	15
10.02	EXT2 STRT/STP/DIR	Defines the connections and the source of the start, stop and direction commands for external control location 2 (EXT2). **Note:** The pulse (P) start/stop commands are not available if motor interlocks (parameter 42.04) are ON.	
	NOT SEL	See parameter 10.01.	1
	DI1	See parameter 10.01.	2
	DI1,2	See parameter 10.01.	3
	DI1P,2P	See parameter 10.01.	4
	DI1P,2P,3	See parameter 10.01.	5

Index	Name/Selection	Description	FbEq
	DI1P,2P,3P	See parameter 10.01.	6
	DI6	See parameter 10.01.	7
	DI6,5	See parameter 10.01.	8
	KEYPAD	See parameter 10.01.	9
	COMM. MODULE	See parameter 10.01.	10
	DI7	See parameter 10.01.	11
	DI7,8	See parameter 10.01.	12
	DI7P,8P	See parameter 10.01.	13
	DI7P,8P,9	See parameter 10.01.	14
	DI7P,8P,9P	See parameter 10.01.	15
10.03	DIRECTION	Enables the control of direction of rotation of the motor, or fixes the direction. **Note:** With the PFC macro, if external reference 2 (EXT2) is the active reference, this parameter is fixed to FORWARD. The same restriction applies in local control when parameter 11.01 is set to REF2(%).	
	FORWARD	Fixed to forward	1
	REVERSE	Fixed to reverse	2
	REQUEST	Direction of rotation control allowed	3
11 REFERENCE SELECT		Panel reference type, external control location selection and external reference sources and limits	
11.01	KEYPAD REF SEL	Selects the type of the reference given from panel.	
	REF1(Hz)	Frequency reference in Hz.	1
	REF2(%)	%-reference. The use of REF2 vary depending on the application macro. If the PFC macro is selected, REF2 is the process reference; with the Hand/Auto macro, REF2 is a relative frequency reference.	2
11.02	EXT1/EXT2 SELECT	Defines the source from which the drive reads the signal that selects between the two external control locations, EXT1 or EXT2.	
	EXT1	EXT1 active. The control signal sources are defined by parameter 10.01 and 11.03.	1
	EXT2	EXT2 active. The control signal sources are defined by parameter 10.02 and 11.06.	2
	DI1	Digital input DI1. 0 = EXT1, 1 = EXT2.	3
	DI2	See selection DI1.	4
	DI3	See selection DI1.	5
	DI4	See selection DI1.	6
	DI5	See selection DI1.	7
	DI6	See selection DI1.	8
	DI7	See selection DI1.	9
	DI8	See selection DI1.	10
	DI9	See selection DI1.	11
	DI10	See selection DI1.	12
	DI11	See selection DI1.	13
	DI12	See selection DI1.	14
	COMM. MODULE	Fieldbus Control Word, bit 11.	15
11.03	EXT REF1 SELECT	Selects the signal source for external reference REF1	

Index	Name/Selection	Description	FbEq
	KEYPAD	Control panel. The first line on the display shows the reference value.	1
	AI1	Analogue input AI1. **Note:** If the signal is bipolar (±10 VDC), use the selection AI1 BIPOLAR. (The selection AI1 ignores the negative signal range.)	2
	AI2	Analogue input AI2.	3
	AI3	Analogue input AI3.	4
	AI1+AI3	Summation of analogue input AI1 and AI3	5
	AI2+AI3	Summation of analogue input AI2 and AI3	6
	AI1-AI3	Subtraction of analogue input AI1 and AI3	7
	AI2-AI3	Subtraction of analogue input AI2 and AI3	8
	AI1*AI3	Multiplication of analogue input AI1 and AI3	9
	AI2*AI3	Multiplication of analogue input AI2 and AI3	10
	MIN(AI1,AI3)	Minimum of analogue input AI1 and AI3	11
	MIN(AI2,AI3)	Minimum of analogue input AI2 and AI3	12
	MAX(AI1,AI3)	Maximum of analogue input AI1 and AI3	13
	MAX(AI2,AI3)	Maximum of analogue input AI2 and AI3	14
	COMM. MODULE	Fieldbus reference REF1	15
11.04	EXT REF1 MINIMUM	Defines the minimum value for external reference REF1 (absolute value). Corresponds to the minimum setting of the source signal used.	
	0 … 120 Hz	***Example:*** Analogue input AI1 is selected as the reference source (value of parameter 11.03 is AI1). The reference minimum and maximum correspond the AI minimum and maximum settings as follows: *EXT REF1 Range*  1 parameter 13.01 2 parameter 13.02 1' parameter 11.04 2' parameter 11.05 **Note:** If the reference is given through fieldbus, the scaling differs from that of an analogue signal. See the chapter *Fieldbus control* for more information.	0 … 120
11.05	EXT REF1 MAXIMUM	Defines the maximum value for external reference REF1 (absolute value). Corresponds to the maximum setting of the used source signal.	
	0 … 120 Hz	See parameter 11.04.	0 … 120
11.06	EXT REF2 SELECT	Selects the signal source for external reference REF2.	
	KEYPAD	See parameter 11.03.	1
	AI1	See parameter 11.03.	2
	AI2	See parameter 11.03.	3
	AI3	See parameter 11.03.	4
	AI1+AI3	See parameter 11.03.	5

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td>AI2+AI3</td><td>See parameter 11.03.</td><td>6</td></tr>
<tr><td></td><td>AI1-AI3</td><td>See parameter 11.03.</td><td>7</td></tr>
<tr><td></td><td>AI2-AI3</td><td>See parameter 11.03.</td><td>8</td></tr>
<tr><td></td><td>AI1*AI3</td><td>See parameter 11.03.</td><td>9</td></tr>
<tr><td></td><td>AI2*AI3</td><td>See parameter 11.03.</td><td>10</td></tr>
<tr><td></td><td>MIN(AI1,AI3)</td><td>See parameter 11.03.</td><td>11</td></tr>
<tr><td></td><td>MIN(AI2,AI3)</td><td>See parameter 11.03.</td><td>12</td></tr>
<tr><td></td><td>MAX(AI1,AI3)</td><td>See parameter 11.03.</td><td>13</td></tr>
<tr><td></td><td>MAX(AI2,AI3)</td><td>See parameter 11.03.</td><td>14</td></tr>
<tr><td></td><td>COMM. MODULE</td><td>See parameter 11.03.</td><td>15</td></tr>
<tr><td>11.07</td><td>EXT REF2 MINIMUM</td><td>Defines the minimum value for external reference REF2 (absolute value). Corresponds to the minimum setting of the source signal used.</td><td></td></tr>
<tr><td></td><td>0 … 100%</td><td>With PFC macro, sets the minimum process reference in percent of the maximum process quantity (PFC macro). With Hand/Auto macro, sets the minimum frequency reference in percent of the Absolute Maximum Frequency.
- Source is an analogue input: See example at parameter 11.04.
- Source is a serial link: See the chapter Fieldbus control.</td><td>0 … 10000</td></tr>
<tr><td>11.08</td><td>EXT REF2 MAXIMUM</td><td>Defines the maximum value for external reference REF2 (absolute value). Corresponds to the maximum setting of the source signal used.</td><td></td></tr>
<tr><td></td><td>0 … 500%</td><td>Setting range. Correspondence to the source signal limits:
- Source is an analogue input: See parameter 11.04.
- Source is a serial link: See the chapter Fieldbus control.</td><td>0 … 50000</td></tr>
<tr><td colspan="2">12 CONSTANT FREQ</td><td>Constant frequency selection and values. An active constant frequency overrides the drive frequency reference.
Note: If the PFC macro is selected, parameter 12.01 is set to a value other than NOT SEL, and one of the selected digital inputs is ON, the PFC logic is bypassed, i.e. no process PI controller is in use and the direct-on-line motors are not started.</td><td></td></tr>
<tr><td>12.01</td><td>CONST FREQ SEL</td><td>Activates the constant frequencies or selects the activation signal.</td><td></td></tr>
<tr><td></td><td>NOT SEL</td><td>No constant frequencies in use.</td><td>1</td></tr>
<tr><td></td><td>DI4 (FREQ1)</td><td>Frequency defined by parameter 12.02 is activated through digital input DI4. 1 = active, 0 = inactive.</td><td>2</td></tr>
<tr><td></td><td>DI5 (FREQ2)</td><td>Frequency defined by parameter 12.03 is activated through digital input DI5. 1 = active, 0 = inactive.</td><td>3</td></tr>
<tr><td></td><td>DI4,5</td><td>Constant frequency selection through digital input DI4 and DI5.
<table><tr><th>DI4</th><th>DI5</th><th>Constant speed in use</th></tr><tr><td>0</td><td>0</td><td>No constant frequency</td></tr><tr><td>1</td><td>0</td><td>Frequency defined by parameter 12.02</td></tr><tr><td>0</td><td>1</td><td>Frequency defined by parameter 12.03</td></tr><tr><td>1</td><td>1</td><td>Frequency defined by parameter 12.04</td></tr></table></td><td>4</td></tr>
<tr><td></td><td>DI11 (FREQ1)</td><td>Frequency defined by parameter 12.02 is activated through digital input DI11. 1 = active, 0 = inactive.</td><td>5</td></tr>
<tr><td></td><td>DI12 (FREQ2)</td><td>Frequency defined by parameter 12.03 is activated through digital input DI12. 1 = active, 0 = inactive.</td><td>6</td></tr>
<tr><td></td><td>DI11,12</td><td>See selection DI4,5.</td><td>7</td></tr>
</table>

Index	Name/Selection	Description	FbEq
12.02	CONST FREQ 1	Defines frequency 1. An absolute value. Does not include the direction information.	
	0 … 120 Hz	Setting range	0 … 120
12.03	CONST FREQ 2	Defines frequency 2. An absolute value. Does not include the direction information.	
	0 … 120 Hz	Setting range	0 … 120
12.04	CONST FREQ 3	Defines frequency 3. An absolute value. Does not include the direction information.	
	0 … 120 Hz	Setting range	0 … 120
13 ANALOGUE INPUTS		Analogue input signal processing.	
13.01	MINIMUM AI1	Defines the minimum value for analogue input AI1. When used as a reference, the value corresponds to the reference minimum setting. ***Example:*** If AI1 is selected as the source for external reference REF1, this value corresponds to the value of parameter 11.04.	
	0 V	Zero volts. **Note:** The program cannot detect a loss of analogue input signal.	1
	2 V	Two volts.	2
	TUNED VALUE	The value measured by the tuning function. See the selection TUNE.	3
	TUNE	Triggering of the value measurement. Procedure: - Connect the minimum signal to input. - Set the parameter to TUNE. **Note:** The readable range in tuning is 0 … 10 V.	4
13.02	MAXIMUM AI1	Defines the maximum value for analogue input AI1. When used as a reference, the value corresponds to the reference maximum setting. ***Example:*** If AI1 is selected as the source for external reference REF1, this value corresponds to the value of parameter 11.05.	
	10 V	Ten volts (DC).	1
	TUNED VALUE	The value measured by the tuning function. See the selection TUNE.	2
	TUNE	Triggering of the value measurement. Procedure: - Connect the maximum signal to input. - Set the parameter to TUNE. **Note:** The readable range in tuning is 0 … 10 V.	3

Index	Name/Selection	Description	FbEq
13.03	SCALE AI1	Scales analogue input AI1. ***Example:*** The effect on frequency reference REF1 when: - REF1 source selection (Parameter 11.03) = AI1+AI3 - REF1 maximum value setting (Parameter 11.05) = 120 Hz - Actual AI1 value = 4 V (40% of the full scale value) - Actual AI3 value = 12 mA (60% of the full scale value) - AI1 scaling = 100%, AI3 scaling = 10% 	
	0 … 100%	Scaling range	0 … 10000
13.04	FILTER AI1	Defines the filter time constant for analogue input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware (10 ms time constant). This cannot be changed by any parameter.	
	0.00 … 10.00 s	Filter time constant	0 … 1000
13.05	INVERT AI1	Activates/deactivates the inversion of analogue input AI1.	
	NO	No inversion	0
	YES	Inversion active. The maximum value of the analogue input signal corresponds to the minimum reference and vice versa.	65535
13.06	MINIMUM AI2	See parameter 13.01.	
	0 mA	See parameter 13.01.	1
	4 mA	See parameter 13.01.	2
	TUNED VALUE	See parameter 13.01.	3
	TUNE	See parameter 13.01.	4
13.07	MAXIMUM AI2	See parameter 13.02.	
	20 mA	See parameter 13.02.	1
	TUNED VALUE	See parameter 13.02.	2

Index	Name/Selection	Description	FbEq
	TUNE	See parameter 13.02.	3
13.08	SCALE AI2	See parameter 13.03.	
	0 … 100%	See parameter 13.03.	0 … 10000
13.09	FILTER AI2	See parameter 13.04.	
	0.00 … 10.00 s	See parameter 13.04.	0 … 1000
13.10	INVERT AI2	See parameter 13.05.	
	NO	See parameter 13.05.	0
	YES	See parameter 13.05.	65535
13.11	MINIMUM AI3	See parameter 13.01.	
	0 mA	See parameter 13.01.	1
	4 mA	See parameter 13.01.	2
	TUNED VALUE	See parameter 13.01.	3
	TUNE	See parameter 13.01.	4
13.12	MAXIMUM AI3	See parameter 13.02.	
	20 mA	See parameter 13.02.	1
	TUNED VALUE	See parameter 13.02.	2
	TUNE	See parameter 13.02.	3
13.13	SCALE AI3	See parameter 13.03.	
	0 … 100%	See parameter 13.03.	0 … 10000
13.14	FILTER AI3	See parameter 13.04.	
	0.00 … 10.00 s	See parameter 13.04.	0 … 1000
13.15	INVERT AI3	See parameter 13.05.	
	NO	See parameter 13.05.	0
	YES	See parameter 13.05.	65535
14 RELAY OUTPUTS		Status information indicated through the relay outputs, and the relay operating delays	
14.01	RELAY RO1 OUTPUT	Selects a drive status indicated through relay output RO1. The relay energises when the status meets the setting.	
	M1 START	Start/stop control for motor 1 (Interlocks enabled) or auxiliary motor 1 (Interlocks OFF). Should be selected only with the PFC macro active. See also parameter 42.04. **Note:** The parameter (or parameter 14.04) must be set to this value if either of the following conditions is valid: - (External control) External reference 2 is active and par. 42.06 is greater than zero. - (Local control) Par. 11.01 is set to REF2(%) and par. 42.06 is greater than zero. - Par. 42.01 is 1 or greater.	1
	NOT USED	Not used.	2
	READY	Ready to function: Run Enable signal on, no fault.	3
	RUNNING	Running: Start signal on, Run Enable signal on, no active fault.	4
	FAULT	Fault	5
	FAULT(-1)	Inverted fault. Relay is de-energised on a fault trip.	6

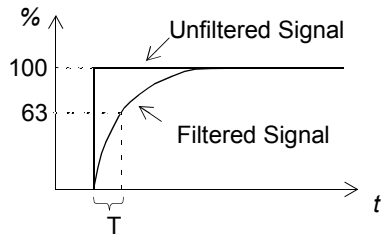
Index	Name/Selection	Description	FbEq
	FAULT(RST)	Fault. Automatic reset after the autoreset delay. See parameter group 31 AUTOMATIC RESET.	7
	STALL WARN	Warning by the stall protection function. See parameter 30.10.	8
	STALL FLT	Fault trip by the stall protection function. See parameter 30.10.	9
	MOT TEMP WRN	Warning trip of the motor temperature supervision function. See parameter 30.04.	10
	MOT TEMP FLT	Fault trip of the motor temperature supervision function. See parameter 30.04.	11
	ACS TEMP WRN	Warning by the drive temperature supervision function: 115 °C (239 °F).	12
	ACS TEMP FLT	Fault trip by the drive temperature supervision function: 125 °C (257 °F).	13
	FAULT/WARN	Fault or warning active	14
	WARNING	Warning active	15
	REVERSED	Motor rotates in reverse direction.	16
	EXT CTRL	Drive is under external control.	17
	REF 2 SEL	External reference REF 2 is in use.	18
	DC OVERVOLT	The intermediate circuit DC voltage has exceeded the overvoltage limit.	19
	DC UNDERVOL	The intermediate circuit DC voltage has fallen below the undervoltage limit.	20
	FREQ 1 LIM	Motor frequency at supervision limit 1. See parameters 32.01 and 32.02.	21
	FREQ 2 LIM	Motor speed at supervision limit 2. See parameters 32.03 and 32.04.	22
	CURRENT LIM	Motor current at the supervision limit. See parameters 32.05 and 32.06.	23
	REF 1 LIM	External reference REF1 at the supervision limit. See parameters 32.07 and 32.08.	24
	REF 2 LIM	External reference REF2 at the supervision limit. See parameters 32.09 and 32.10.	25
	STARTED	The drive has received a start command.	26
	LOSS OF REF	The drive has no reference.	27
	AT SPEED	The actual value has reached the reference value. In speed control, the speed error is less or equal to 10% of the nominal motor speed.	28
	ACT 1 LIM	Actual value ACT1 at a supervision limit. See parameters 32.11 and 32.12.	29
	ACT 2 LIM	Actual value ACT2 at a supervision limit. See parameters 32.13 and 32.14.	30
	COMM. MODULE	The relay is controlled by fieldbus reference REF3. See the chapter *Fieldbus control*.	31
	INLET LOW	Pressure at the pump/fan inlet has fallen below the set supervision limit (and remained so longer than the set delay time). Refer to parameter group 44.	32
	OUTLET HIGH	Pressure at the pump/fan outlet has exceeded the set supervision limit (and remained so longer than the set delay time). Refer to parameter group 44.	33
	PROFILE HIGH	Actual signal 01.16 APPL BLOCK OUTPUT or 01.26 CONTROL DEVIATION has remained above the set supervision limit longer than the set delay time. See parameter group 44.	34
14.02	RELAY RO2 OUTPUT	Selects the drive status to be indicated through relay output RO2. The relay energises when the status meets the setting.	

Index	Name/Selection	Description	FbEq
	M2 START	Start/stop control for motor 2 (Interlocks enabled) or auxiliary motor 2 (Interlocks OFF). Should be selected only with the PFC macro active. See also parameter 42.04. **Note:** The parameter (or parameter 14.05) must be set to this value if any of the following conditions apply: - (External control) External reference 2 is active, par. 42.06 is greater than zero, and par. 42.01 is 1 or greater. - (Local control) Par. 11.01 is set to REF2(%), par. 42.06 is greater than zero, and par. 42.01 is 1 or greater. - Par. 42.01 is 1 or greater.	1
	NOT USED	See parameter 14.01.	2
	READY	See parameter 14.01.	3
	RUNNING	See parameter 14.01.	4
	FAULT	See parameter 14.01.	5
	FAULT(-1)	See parameter 14.01.	6
	FAULT(RST)	See parameter 14.01.	7
	STALL WARN	See parameter 14.01.	8
	STALL FLT	See parameter 14.01.	9
	MOT TEMP WRN	See parameter 14.01.	10
	MOT TEMP FLT	See parameter 14.01.	11
	ACS TEMP WRN	See parameter 14.01.	12
	ACS TEMP FLT	See parameter 14.01.	13
	FAULT/WARN	See parameter 14.01.	14
	WARNING	See parameter 14.01.	15
	REVERSED	See parameter 14.01.	16
	EXT CTRL	See parameter 14.01.	17
	REF2 SEL	See parameter 14.01.	18
	DC OVERVOLT	See parameter 14.01.	19
	DC UNDERVOL	See parameter 14.01.	20
	FREQ 1 LIM	See parameter 14.01.	21
	FREQ 2 LIM	See parameter 14.01.	22
	CURRENT LIM	See parameter 14.01.	23
	REF 1 LIM	See parameter 14.01.	24
	REF 2 LIM	See parameter 14.01.	25
	STARTED	See parameter 14.01.	26
	LOSS OF REF	See parameter 14.01.	27
	AT SPEED	See parameter 14.01.	28
	ACT 1 LIM	See parameter 14.01.	29
	ACT 2 LIM	See parameter 14.01.	30
	COMM. MODULE	See parameter 14.01.	31
	INLET LOW	See parameter 14.01.	32
	OUTLET HIGH	See parameter 14.01.	33
	PROFILE HIGH	See parameter 14.01.	34

Index	Name/Selection	Description	FbEq
14.03	RELAY RO3 OUTPUT	Selects the drive status to be indicated through relay output RO3. The relay energises when the status meets the setting.	
	M3 START	Start/stop control for motor 3 (Interlocks enabled) or auxiliary motor 3 (Interlocks OFF). Should be selected only with the PFC macro active. See also parameter 42.04. **Note:** The parameter (or parameter 14.06) must be set to this value if any of the following conditions apply: - (External control) External reference 2 is active, par. 42.06 is greater than zero, and par. 42.01 is 2 or greater. - (Local control) Par. 11.01 is set to REF2(%), par. 42.06 is greater than zero, and par. 42.01 is 2 or greater. - Par. 42.01 is 2 or greater.	1
	NOT USED	See parameter 14.01.	2
	READY	See parameter 14.01.	3
	RUNNING	See parameter 14.01.	4
	FAULT	See parameter 14.01.	5
	FAULT(-1)	See parameter 14.01.	6
	FAULT(RST)	See parameter 14.01.	7
	STALL WARN	See parameter 14.01.	8
	STALL FLT	See parameter 14.01.	9
	MOT TEMP WRN	See parameter 14.01.	10
	MOT TEMP FLT	See parameter 14.01.	11
	ACS TEMP WRN	See parameter 14.01.	12
	ACS TEMP FLT	See parameter 14.01.	13
	FAULT/WARN	See parameter 14.01.	14
	WARNING	See parameter 14.01.	15
	REVERSED	See parameter 14.01.	16
	EXT CTRL	See parameter 14.01.	17
	REF2 SEL	See parameter 14.01.	18
	DC OVERVOLT	See parameter 14.01.	19
	DC UNDERVOL	See parameter 14.01.	20
	FREQ 1 LIM	See parameter 14.01.	21
	FREQ 2 LIM	See parameter 14.01.	22
	CURRENT LIM	See parameter 14.01.	23
	REF 1 LIM	See parameter 14.01.	24
	REF 2 LIM	See parameter 14.01.	25
	STARTED	See parameter 14.01.	26
	LOSS OF REF	See parameter 14.01.	27
	AT SPEED	See parameter 14.01.	28
	MAGN READY	The motor is magnetised and ready to give nominal torque (nominal magnetising of the motor has been reached).	29
	USER 2 SEL	User Macro 2 is in use.	30
	COMM. MODULE	See parameter 14.01.	31
	INLET LOW	See parameter 14.01.	32

Index	Name/Selection	Description	FbEq
	OUTLET HIGH	See parameter 14.01.	33
	PROFILE HIGH	See parameter 14.01.	34
14.04	RDIO MOD1 RO1	Selects the drive status indicated through relay output RO1 of digital I/O extension module 1 (optional, see parameter 98.03).	
	M4 START	Start/stop control for motor 4 (Interlocks enabled) or auxiliary motor 4 (Interlocks OFF). Should be selected only with the PFC macro active. See also parameter 42.04. **Note:** The parameter (or parameter 14.07) must be set to this value if any of the following conditions apply: - (External control) External reference 2 is active, par. 42.06 is greater than zero, and par. 42.01 is 3 or greater. - (Local control) Par. 11.01 is set to REF2(%), par. 42.06 is greater than zero, and par. 42.01 is 3 or greater. - Par. 42.01 is 3 or greater.	1
	READY	See parameter 14.01.	2
	RUNNING	See parameter 14.01.	3
	FAULT	See parameter 14.01.	4
	FAULT(-1)	See parameter 14.01.	5
	FREQ 1 LIM	See parameter 14.01.	6
	ACT 1 LIM	See parameter 14.01.	7
	INLET LOW	See parameter 14.01.	8
	OUTLET HIGH	See parameter 14.01.	9
	PROFILE HIGH	See parameter 14.01.	10
	M1 START	See parameter 14.01.	11
14.05	RDIO MOD1 RO2	Selects the drive status indicated through relay output RO2 of digital I/O extension module 1 (optional, see parameter 98.03).	
	M5 START	Start/stop control for motor 5 when the Interlocks function is in use. Should be selected only with the PFC macro active. See also parameter 42.04. **Note:** The parameter must be set to this value if any of the following conditions apply: - (External control) External reference 2 is active, par. 42.06 is greater than zero, and par. 42.01 is 4. - (Local control) Par. 11.01 is set to REF2(%), par. 42.06 is greater than zero, and par. 42.01 is 4. - Par. 42.01 is 4.	1
	READY	See parameter 14.01.	2
	RUNNING	See parameter 14.01.	3
	FAULT	See parameter 14.01.	4
	FAULT(-1)	See parameter 14.01.	5
	FREQ 2 LIM	See parameter 14.01.	6
	ACT 2 LIM	See parameter 14.01.	7
	INLET LOW	See parameter 14.01.	8
	OUTLET HIGH	See parameter 14.01.	9
	PROFILE HIGH	See parameter 14.01.	10
	M2 START	See parameter 14.02.	11

Index	Name/Selection	Description	FbEq
14.06	RDIO MOD2 RO1	Selects the drive status indicated through relay output RO1 of digital I/O extension module 2 (optional, see parameter 98.03).	
	READY	See parameter 14.01.	1
	RUNNING	See parameter 14.01.	2
	FAULT	See parameter 14.01.	3
	FAULT(-1)	See parameter 14.01.	4
	FREQ 1 LIM	See parameter 14.01.	5
	ACT 1 LIM	See parameter 14.01.	6
	INLET LOW	See parameter 14.01.	7
	OUTLET HIGH	See parameter 14.01.	8
	PROFILE HIGH	See parameter 14.01.	9
	M3 START	See parameter 14.03.	10
14.07	RDIO MOD2 RO2	Selects the drive status indicated through relay output RO2 of digital I/O extension module 2 (optional, see parameter 98.03).	
	READY	See parameter 14.01.	1
	RUNNING	See parameter 14.01.	2
	FAULT	See parameter 14.01.	3
	FAULT(-1)	See parameter 14.01.	4
	FREQ 2 LIM	See parameter 14.01.	5
	ACT 2 LIM	See parameter 14.01.	6
	INLET LOW	See parameter 14.01.	7
	OUTLET HIGH	See parameter 14.01.	8
	PROFILE HIGH	See parameter 14.01.	9
	M4 START	See parameter 14.04.	10
15 ANALOGUE OUTPUTS		Selection of the actual signals to be indicated through the analogue outputs. Output signal processing.	
15.01	ANALOGUE OUTPUT1	Connects a drive signal to analogue output AO1.	
	NOT USED	Not in use	1
	SPEED	Motor speed. 20 mA = motor nominal speed. The updating interval is 24 ms.	2
	FREQUENCY	Output frequency. 20 mA = motor nominal frequency. The updating interval is 24 ms.	3
	CURRENT	Output current. 20 mA = motor nominal current. The updating interval is 24 ms.	4
	TORQUE	Motor torque. 20 mA = 100% of motor nominal rating. The updating interval is 24 ms.	5
	POWER	Motor power. 20 mA = 100% of motor nominal rating. The updating interval is 100 ms.	6
	DC BUS VOLT	DC bus voltage. 20 mA = 100% of the reference value. The reference value is 540 VDC. (= 1.35 × 400 V) for 380 ... 415 VAC supply voltage rating and 675 VDC (= 1.35 × 500 V) for 380 ... 500 VAC supply. The updating interval is 24 ms.	7
	OUTPUT VOLT	Motor voltage. 20 mA = motor rated voltage. The updating interval is 100 ms.	8
	REFERENCE	Active reference that the drive is currently following. 20 mA = 100 % of the active reference. The updating interval is 24 ms.	9

Index	Name/Selection	Description	FbEq
	CONTROL DEV	The difference between the reference and the actual value of the process PI controller. 0/4 mA = -100%, 10/12 mA = 0%, 20 mA = 100%. The updating interval is 24 ms.	10
	ACTUAL 1	Value of variable ACT1 used in the process PID control. 20 mA = value of parameter 40.06. The updating interval is 24 ms.	11
	ACTUAL 2	Value of variable ACT2 used in the process PID control. 20 mA = value of parameter 40.10. The updating interval is 24 ms.	12
	PICON OUTP	The reference as taken from the output of the PI controller. The updating interval is 24 ms.	13
	PICON REF	The reference as taken from the input of the PI controller. The updating interval is 24 ms.	14
	ACTUAL FUNC	Result of the arithmetic operation selected by parameter 40.04 scaled by parameter 40.15.	15
	COMM. MODULE	The value is read from fieldbus reference REF4. See *Fieldbus control*.	16
15.02	INVERT AO1	Inverts the analogue output AO1 signal. The analogue signal is at the minimum level when the indicated drive signal is at its maximum level and vice versa.	
	NO	Inversion off	0
	YES	Inversion on	65535
15.03	MINIMUM AO1	Defines the minimum value of the analogue output signal AO1.	
	0 mA	Zero mA	1
	4 mA	Four mA	2
15.04	FILTER AO1	Defines the filtering time constant for analogue output AO1.	
	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 you select 0 s as the minimum value, the signal is still filtered with a time constant of 10 ms due to the signal interface hardware. This cannot be changed by any parameters.	0 … 1000
15.05	SCALE AO1	Scales the analogue output AO1 signal.	

Index	Name/Selection	Description	FbEq
	10 … 1000%	Scaling factor. If the value is 100%, the reference value of the drive signal corresponds to 20 mA. ***Example:*** The nominal motor current is 7.5 A and the measured maximum current at maximum load 5 A. The motor current 0 to 5 A needs to be read as 0 to 20 mA analogue signal through AO1. The required settings are: 1. AO1 is set to CURRENT by parameter 15.01. 2. AO1 minimum is set to 0 mA by parameter 15.03. 3. The measured maximum motor current is scaled to correspond to a 20 mA analogue output signal by setting the scaling factor (k) to 150%. The value is defined as follows: The reference value of the output signal CURRENT is the motor nominal current i.e. 7.5 A (see parameter 15.01). To make the measured maximum motor current correspond to 20 mA, it should be scaled equally to the reference value before it is converted to an analogue output signal. Equation: $k \cdot 5\ A = 7.5\ A \Rightarrow k = 1.5 = 150\%$	100 … 10000
15.06	ANALOGUE OUTPUT2	See parameter 15.01.	
	NOT USED	See parameter 15.01.	1
	SPEED	See parameter 15.01.	2
	FREQUENCY	See parameter 15.01.	3
	CURRENT	See parameter 15.01.	4
	TORQUE	See parameter 15.01.	5
	POWER	See parameter 15.01.	6
	DC BUS VOLT	See parameter 15.01.	7
	OUTPUT VOLT	See parameter 15.01.	8
	REFERENCE	See parameter 15.01.	9
	CONTROL DEV	See parameter 15.01.	10
	ACTUAL 1	See parameter 15.01.	11
	ACTUAL 2	See parameter 15.01.	12
	PICON OUTP	See parameter 15.01.	13
	PICON REF	See parameter 15.01.	14
	ACTUAL FUNC	See parameter 15.01.	15
	COMM. MODULE	The value is read from fieldbus reference REF5. See *Fieldbus control*.	16
15.07	INVERT AO2	See parameter 15.02.	
	NO	See parameter 15.02.	0
	YES	See parameter 15.02.	65535
15.08	MINIMUM AO2	See parameter 15.03.	
	0 mA	See parameter 15.03.	1
	4 mA	See parameter 15.03.	2
15.09	FILTER AO2	See parameter 15.04.	
	0.00 … 10.00 s	See parameter 15.04.	0 … 1000
15.10	SCALE AO2	See parameter 15.05.	
	10 … 1000%	See parameter 15.05.	100 … 10000

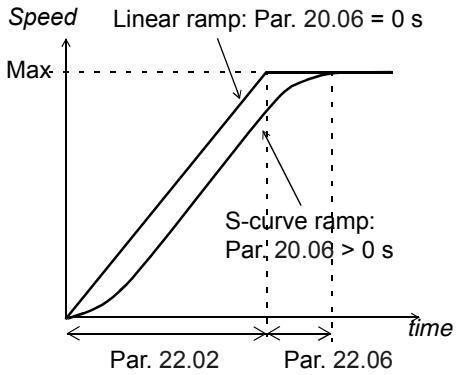
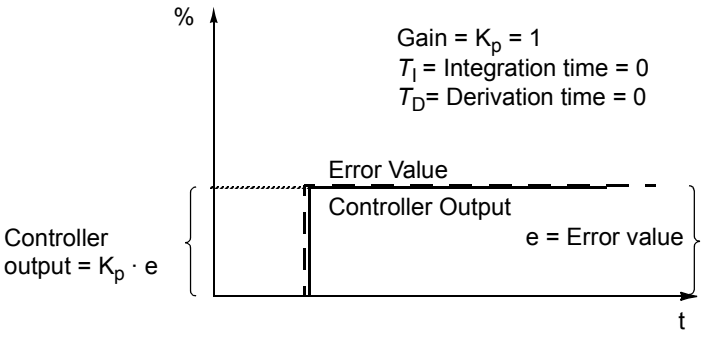
Index	Name/Selection	Description	FbEq
16 SYSTEM CTRL INPUTS		Run Enable, parameter lock etc.	
16.01	RUN ENABLE	Sets the Run Enable signal on, or selects a source for the external Run Enable signal. If Run Enable signal is switched off, the drive will not start or stops if it is running.	
	YES	Run Enable signal is on.	1
	DI1	External signal required through digital input DI1. 1 = Run Enable.	2
	DI2	See selection DI1.	3
	DI3	See selection DI1.	4
	DI4	See selection DI1.	5
	DI5	See selection DI1.	6
	DI6	See selection DI1.	7
	DI7	See selection DI1.	8
	DI8	See selection DI1.	9
	DI9	See selection DI1.	10
	DI10	See selection DI1.	11
	DI11	See selection DI1.	12
	DI12	See selection DI1.	13
	COMM. MODULE	External signal required through the Fieldbus Control Word (bit 3).	14
16.02	PARAMETER LOCK	Selects the state of the parameter lock. The lock prevents parameter changing.	
	OPEN	The lock is open. Parameter values can be changed.	0
	LOCKED	Locked. Parameter values cannot be changed from the control panel. The lock can be opened by entering the valid code at parameter 16.03.	65535
16.03	PASS CODE	Selects the pass code for the parameter lock (see parameter 16.02).	
	0 … 30000	Setting 358 opens the lock. The value will automatically revert to 0.	0 … 30000
16.04	FAULT RESET SEL	Selects the source for the fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists.	
	NOT SEL	Fault reset only from the control panel keypad (RESET key).	1
	DI1	Reset through digital input DI1 or by control panel: - If the drive is in external control mode: Reset by a rising edge of DI1. - If the drive is in local control mode: Reset by the RESET key of the control panel.	2
	DI2	See selection DI1.	3
	DI3	See selection DI1.	4
	DI4	See selection DI1.	5
	DI5	See selection DI1.	6
	DI6	See selection DI1.	7
	DI7	See selection DI1.	8
	DI8	See selection DI1.	9
	DI9	See selection DI1.	10
	DI10	See selection DI1.	11
	DI11	See selection DI1.	12
	DI12	See selection DI1.	13

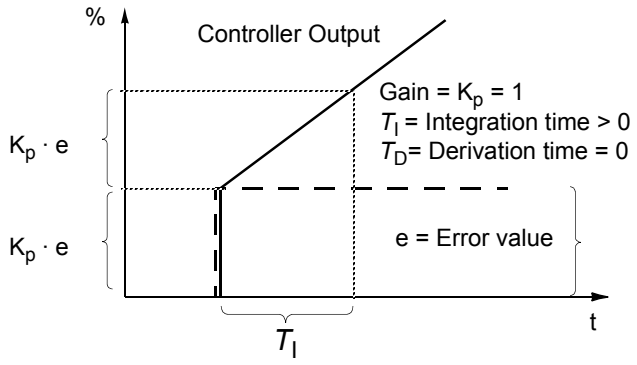
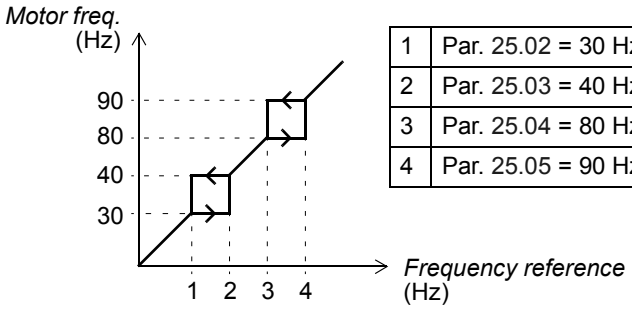
Index	Name/Selection	Description	FbEq
	ON STOP	Reset along with the stop signal received through a digital input, or by the RESET key of the control panel.	14
	COMM. MODULE	Reset through the fieldbus Control Word (bit 7), or by the RESET key of the control panel.	15
16.05	USER MACRO IO CHG	Enables the change of the User Macro through a digital input. See parameter 99.02. The change is only allowed when the drive is stopped. During the change, the drive will not start. **Note:** Always save the User Macro by parameter 99.02 after changing any parameter settings, or reperforming 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. **Note:** Selection of User Macro 2 can be supervised via relay output RO3. See parameter 14.03 for more information.	
	NOT SEL	User macro change is not possible through a digital input.	1
	DI1	Falling edge of digital input DI1: User Macro 1 is loaded into use. Rising edge of digital input DI1: User Macro 2 is loaded into use.	2
	DI2	See selection DI1.	3
	DI3	See selection DI1.	4
	DI4	See selection DI1.	5
	DI5	See selection DI1.	6
	DI6	See selection DI1.	7
	DI7	See selection DI1.	8
	DI8	See selection DI1.	9
	DI9	See selection DI1.	10
	DI10	See selection DI1.	11
	DI11	See selection DI1.	12
	DI12	See selection DI1.	13
16.06	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!	
	OFF	Local control allowed.	0
	ON	Local control disabled.	65535
16.07	PARAMETER 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	Save completed	0
	SAVE..	Save in progress	1
20 LIMITS		Drive operation limits.	
20.01	MINIMUM FREQ	Defines the allowed minimum frequency. If the value is positive, the motor will not run in the reverse direction. **Note:** With the PFC macro, negative values must not be used. **Note:** The limit is linked to the motor nominal frequency setting i.e. parameter 99.07. If 99.07 is changed, the default frequency limit will also change.	

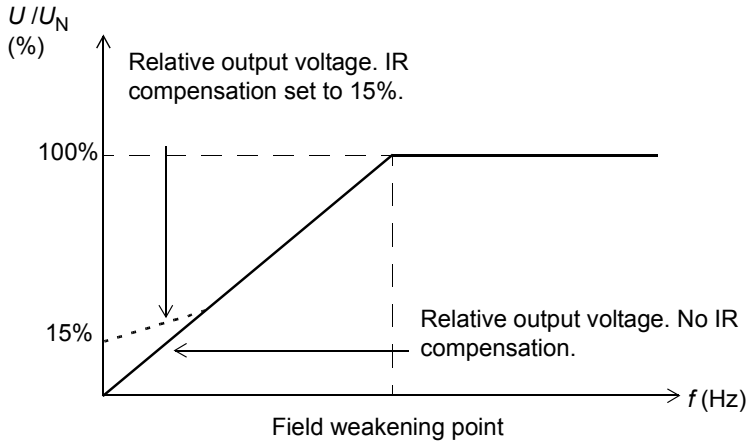
Index	Name/Selection	Description	FbEq
	-120 Hz … 120 Hz	Minimum frequency limit	-12000 … 12000
20.02	MAXIMUM FREQ	Defines the allowed maximum frequency. **Note:** With the PFC macro, negative values must not be used. **Note:** The limit is linked to the motor nominal speed setting i.e. parameter 99.08. If 99.08 is changed, the default speed limit will also change.	
	-120 Hz … 120 Hz	Maximum frequency limit	-12000 … 12000
20.03	MAXIMUM CURRENT	Defines the allowed maximum motor current in amperes.	
	0.0 … (depends on drive type)	Current limit	10 = 1 A
20.04	MAXIMUM TORQUE	Defines the maximum torque limit for the drive.	
	0.0 … 600.0%	Value of limit in percent of motor nominal torque.	0 … 60000
20.05	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:** The controller must be OFF to allow chopper operation.	
	OFF	Overvoltage control deactivated.	0
	ON	Overvoltage control activated.	65535
20.06	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.	
	OFF	Undervoltage control deactivated.	0
	ON	Undervoltage control activated.	65535
20.11	P MOTORING LIM	Defines the allowed maximum power fed by the inverter to the motor.	
	0 … 600%	Power limit in percent of the motor nominal power	0 … 60000
20.12	P GENERATING LIM	Defines the allowed maximum power fed by the motor to the inverter.	
	-600 … 0%	Power limit in percent of the motor nominal power	-60000 … 0
21 START/STOP		Start and stop modes of the motor.	
21.01	START FUNCTION	Selects the motor starting method.	
	AUTO	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. **Note:** If parameter 99.04 = SCALAR, no flying start or automatic restart is possible by default. The flying start feature needs to be activated separately by parameter 21.08.	1

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></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.
Note: DC magnetising cannot be selected if parameter 99.04 = SCALAR.</td><td>2</td></tr>
<tr><td></td><td>CNST 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 21.02.
Note: Starting to a rotating machine is not possible when DC magnetising is selected.
Note: DC magnetising cannot be selected if parameter 99.04 = SCALAR.
  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>21.02</td><td>CONST MAGN TIME</td><td>Defines the magnetising time in the constant magnetising mode. See parameter 21.01. After the start command, the drive automatically pre-magnetises the motor the set time.</td><td></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>
<tr><td>21.03</td><td>STOP FUNCTION</td><td>Selects the motor stop function.</td><td></td></tr>
<tr><td></td><td>COAST</td><td>Stop by cutting off the motor power supply. The motor coasts to a stop.</td><td>1</td></tr>
<tr><td></td><td>RAMP</td><td>Stop along a ramp. See parameter group 22 ACCEL/DECEL.</td><td>2</td></tr>
<tr><td>21.08</td><td>SCALAR FLY START</td><td>Activates the flying start feature in scalar control mode. See parameters 21.01 and 99.04.</td><td></td></tr>
<tr><td></td><td>NO</td><td>Inactive.</td><td>0</td></tr>
<tr><td></td><td>YES</td><td>Active.</td><td>1</td></tr>
<tr><td>21.09</td><td>START INTRL FUNC</td><td>Defines how the Start Interlock input on RMIO board affects the drive operation.</td><td></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: Input is back to 1 and the drive receives rising edge of the Start signal.</td><td>1</td></tr>
</table>

Index	Name/Selection	Description	FbEq
	OFF3 STOP	Drive running: 1 = Normal operation. 0 = Stop by ramp. The ramp time is defined by parameter 22.07 EM STOP RAMP. 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.	2
22 ACCEL/DECEL		Acceleration and deceleration times.	
22.01	ACC/DEC SEL	Selects the active pair of acceleration/deceleration times.	
	ACC/DEC 1	Acceleration time 1 and deceleration time 1 are used. See parameters 22.02 and 22.03.	1
	ACC/DEC 2	Acceleration time 2 and deceleration time 2 are used. See parameters 22.04 and 22.05.	2
	DI1	Acceleration/deceleration time pair selection through digital input DI1. 0 = Acceleration time 1 and deceleration time 1 are in use. 1 = Acceleration time 2 and deceleration time 2 are in use.	3
	DI2	See selection DI1.	4
	DI3	See selection DI1.	5
	DI4	See selection DI1.	6
	DI5	See selection DI1.	7
	DI6	See selection DI1.	8
	DI7	See selection DI1.	9
	DI8	See selection DI1.	10
	DI9	See selection DI1.	11
	DI10	See selection DI1.	12
	DI11	See selection DI1.	13
	DI12	See selection DI1.	14
22.02	ACCEL TIME 1	Defines acceleration time 1, i.e. the time required for the frequency to change from zero to the maximum frequency. - If the reference increases faster than the set acceleration rate, the motor frequency will follow the acceleration rate. - If the reference increases slower than the set acceleration rate, the motor frequency 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.	
	0.00 … 1800.00 s	Acceleration time	0 … 18000
22.03	DECEL TIME 1	Defines deceleration time 1, i.e. the time required for the frequency to change from the maximum (see parameter 20.02) to zero. - If the reference decreases slower than the set deceleration rate, the motor frequency will follow the reference signal. - If the reference changes faster than the set deceleration rate, the motor frequency 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 20.05). **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.	

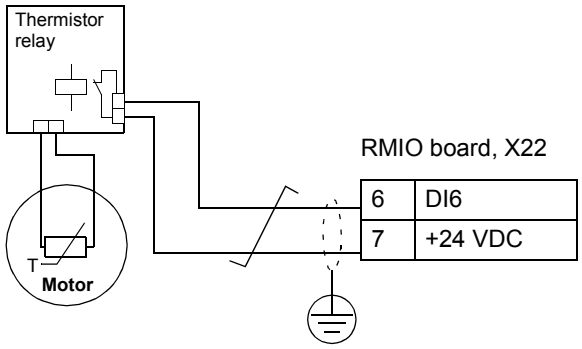
Index	Name/Selection	Description	FbEq
	0.00 … 1800.00 s	Deceleration time	0 … 18000
22.04	ACCEL TIME 2	See parameter 22.02.	
	0.00 … 1800.00 s	See parameter 22.02.	0 … 18000
22.05	DECEL TIME 2	See parameter 22.02.	
	0.00 … 1800.00 s	See parameter 22.02.	0 … 18000
22.06	ACC/DEC RAMP SHPE	Selects the shape of the acceleration/deceleration ramp.	
	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
22.07	EM STOP RAMP TIME	Defines the time inside which the drive is stopped after an emergency stop command. The emergency stop command can be given through a fieldbus or an Emergency Stop module (optional). Consult the local ABB representative for more information on the optional module and the related parameter settings.	
	0.00 … 2000.00 s	Deceleration time	0 … 200000
23 SPEED CTRL		Speed controller variables. The parameters are not visible if parameter 99.04 = SCALAR.	
23.01	GAIN	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. 	

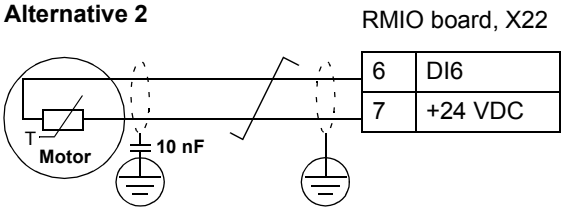
Index	Name/Selection	Description	FbEq
	0.0 … 250.0	Gain	0 … 25000
23.02	INTEGRATION TIME	Defines an integration time for the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant. The shorter the integration time, the faster the 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. 	
	0.01 … 999.97 s	Integration time	10 … 999970
23.03	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:*** A 1000 rpm constant speed reference is given to the drive. Despite full slip compensation (SLIP GAIN = 100%), a manual tachometer measurement from the motor shaft 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. With a gain value of 106%, no static speed error exists.	
	0.0 … 400.0%	Slip gain value.	0 … 400
25 CRITICAL FREQ		Frequency bands within which the drive is not allowed to operate.	
25.01	CRIT FREQ SELECT	Activates/deactivates the critical frequencies function. ***Example:*** A fan has vibration in the ranges of 30 to 40 Hz and 80 to 90 Hz. To make the drive skip the vibration ranges, - activate the critical speeds function, - set the critical speed ranges as in the figure below.  1 Par. 25.02 = 30 Hz 2 Par. 25.03 = 40 Hz 3 Par. 25.04 = 80 Hz 4 Par. 25.05 = 90 Hz	

Index	Name/Selection	Description	FbEq
	OFF	Inactive	0
	ON	Active.	65535
25.02	CRIT FREQ 1 LOW	Defines the minimum limit for critical frequency range 1.	
	0 … 120 Hz	Minimum limit. The value cannot be above the maximum (parameter 25.03).	0 … 120
25.03	CRIT FREQ 1 HIGH	Defines the maximum limit for critical frequency range 1.	
	0 … 120 Hz	Maximum limit. The value cannot be below the minimum (parameter 25.02).	0 … 120
25.04	CRIT FREQ 2 LOW	See parameter 25.02.	
	0 … 120 Hz	See parameter 25.02.	0 … 120
25.05	CRIT FREQ 2 HIGH	See parameter 25.03.	
	0 … 120 Hz	See parameter 25.03.	0 … 120
26 MOTOR CONTROL			
26.01	FLUX OPTIMIZATION	Activates/deactivates the flux optimisation function. **Note:** The function cannot be used if parameter 99.04 = SCALAR.	
	NO	Inactive	0
	YES	Active	65535
26.02	FLUX BRAKING	Activates/deactivates the flux braking function. **Note:** The function cannot be used if parameter 99.04 = SCALAR.	
	NO	Inactive	0
	YES	Active	65535
26.03	IR COMPENSATION	Defines the relative output voltage boost at zero speed (IR compensation). The function is useful in applications with high break-away torque, but no DTC motor control cannot be applied. The figure below illustrates the IR compensation. **Note:** The function can be used only if parameter 99.04 is SCALAR.  Field weakening point	
	0 … 30%	Voltage boost at zero speed in percent of the motor nominal voltage	0 … 3000
26.05	HEX FIELD WEAKEN	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).	
	NO	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

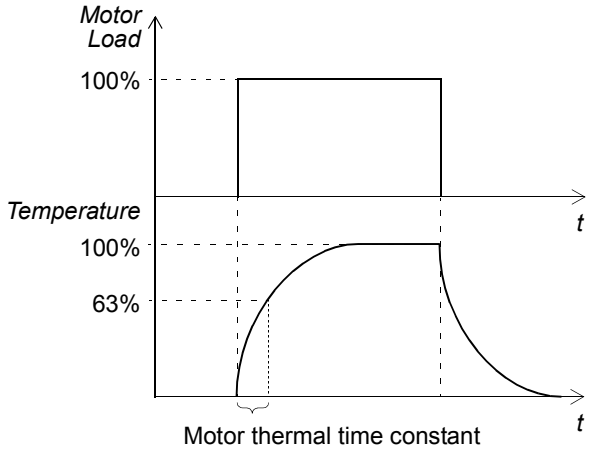
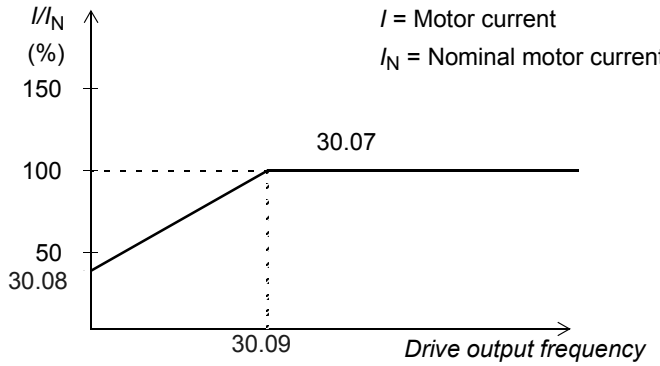
Index	Name/Selection	Description	FbEq
	YES	Motor flux follows a circular pattern below the field weakening point (typically 50 or 60 Hz) and a hexagonal pattern in the field weakening range. Optimal selection in the applications that require maximal instantaneous torque in the field weakening range of the speed. The losses at constant operation are higher than with the selection NO.	1
30 FAULT FUNCTIONS		Programmable protection functions	
30.01	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 (see parameter group 13 ANALOGUE INPUTS).	
	FAULT	The drive trips on a fault and the motor coasts to stop.	1
	NO	Inactive	2
	PRESET FREQ	The drive generates a warning AI < MIN FUNC (8110) and sets the frequency to the value defined by parameter 30.18. **WARNING!** Make sure that it is safe to continue operation in case the analogue input signal is lost.	3
	LAST FREQ	The drive generates a warning AI < MIN FUNC (8110) and freezes the frequency to the level the drive was operating at. The value is determined by the average frequency over the previous 10 seconds. **WARNING!** Make sure that it is safe to continue operation in case the analogue input signal is lost.	4
30.02	PANEL LOSS	Selects how the drive reacts to a control panel communication break.	
	FAULT	Drive trips on a fault and the motor stops as defined by parameter 21.03.	1
	PRESET FREQ	The drive generates a warning and sets the frequency to the value defined by parameter 30.18. **WARNING!** Make sure that it is safe to continue operation in case the analogue input signal is lost.	2
	LAST SPEED	The drive generates a warning and freezes the frequency to the level the drive was operating at. The value is determined by the average frequency over the previous 10 seconds. **WARNING!** Make sure that it is safe to continue operation in case the analogue input signal is lost.	3
30.03	EXTERNAL FAULT	Selects an interface for an external fault signal.	
	NOT SEL	Inactive	1
	DI1	External fault indication is given through digital input DI1. 0: Fault trip. Motor coasts to stop. 1: No external fault.	2
	DI2	See selection DI1.	3
	DI3	See selection DI1.	4
	DI4	See selection DI1.	5
	DI5	See selection DI1.	6
	DI6	See selection DI1.	7
	DI7	See selection DI1.	8
	DI8	See selection DI1.	9
	DI9	See selection DI1.	10

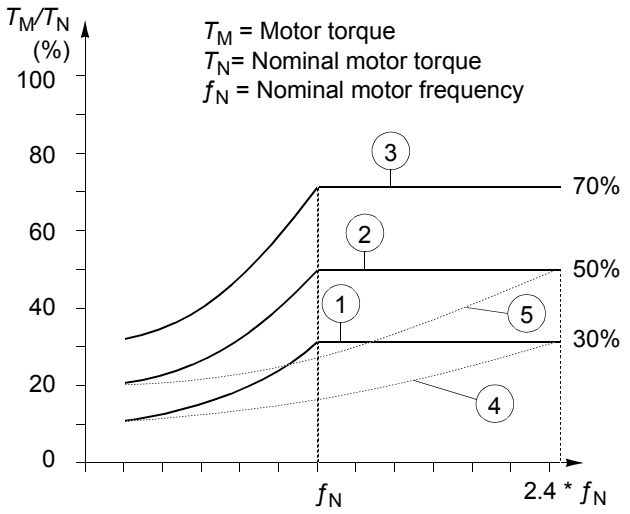
Index	Name/Selection	Description	FbEq
	DI10	See selection DI1.	11
	DI11	See selection DI1.	12
	DI12	See selection DI1.	13
30.04	MOTOR THERM PROT	Selects how the drive reacts when the motor overtemperature is detected by the function defined by Parameter 30.05.	
	FAULT	The drive generates a warning when 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
30.05	MOT THERM P MODE	Selects the thermal protection mode of the motor. When overtemperature is detected, the drive reacts as defined by parameter 30.04.	
	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 30.07. **Note:** The model cannot be used with high power motors (parameter 99.06 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 30.06) and the motor load curve (parameters 30.07, 30.08 and 30.09). 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>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


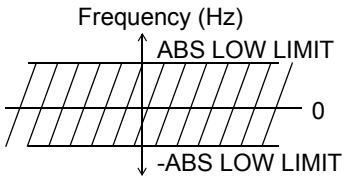
Alternative 2


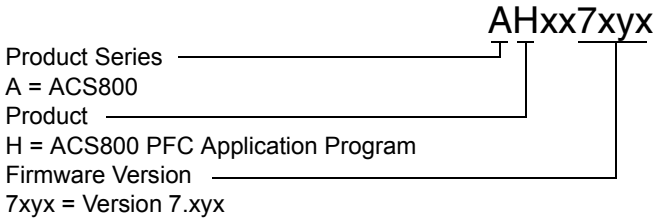
</td><td>3</td></tr>
</table>

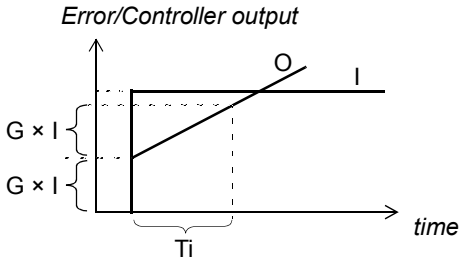
Index	Name/Selection	Description	FbEq
30.06	MOTOR THERM TIME	Defines the thermal time constant for the user-defined thermal model (see the selection USER MODE of parameter 30.05).  	
	256.0 … 9999.8 s	Time constant	256 … 9999
30.07	MOTOR LOAD CURVE	Defines the load curve together with parameters 30.08 and 30.09. The load curve is used in the user-defined thermal model (see the selection USER MODE at parameter 30.05).  	
	50.0 … 150.0%	Allowed continuous motor load in percent of the nominal motor current.	50 … 150
30.08	ZERO SPEED LOAD	Defines the load curve together with parameters 30.07 and 30.09.	
	25.0 … 150.0%	Allowed continuous motor load at zero speed in percent of the nominal motor current.	25 … 150
30.09	BREAK POINT	Defines the load curve together with parameters 30.07 and 30.08.	
	1.0 … 300.0 Hz	Drive output frequency at 100% load.	100 … 30000
30.10	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 30.11 and - the conditions above have been valid longer than the time set by parameter 30.12.	
	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 30.12.	2

Index	Name/Selection	Description	FbEq
	NO	Protection is inactive.	3
30.11	STALL FREQ HI	Defines the frequency limit for the stall function. See parameter 30.10.	
	0.5 … 50.0 Hz	Stall frequency	50 … 5000
30.12	STALL TIME	Defines the time for the stall function. See parameter 30.10.	
	10.00 … 400.00 s	Stall time	10 … 400
30.13	UNDERLOAD FUNC	Selects how the drive reacts to underload. The protection wakes up if: - the motor torque falls below the curve selected by parameter 30.15, - 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 30.14.	
	NO	Protection is inactive.	1
	WARNING	The drive generates a warning.	2
	FAULT	The drive trips on a fault.	3
30.14	UNDERLOAD TIME	Time limit for the underload function. See parameter 30.13.	
	0 … 600 s	Underload time	0 … 600
30.15	UNDERLOAD CURVE	Selects the load curve for the underload function. See parameter 30.13. 	
	1 … 5	Number of the load curve	1 … 5
30.16	MOTOR PHASE LOSS	Activates the motor phase loss supervision function.	
	NO	Inactive	0
	FAULT	Active. The drive trips on a fault.	65535
30.17	EARTH FAULT	Selects how the drive reacts when an earth fault is detected in the motor or the motor cable.	
	WARNING	The drive generates a warning.	0
	FAULT	The drive trips on a fault.	65535
30.18	PRESET FREQ	Used as a reference when a fault occurs and the fault function is set to preset frequency.	
	0.00 … 120.00 Hz	Preset frequency.	0 … 120

Index	Name/Selection	Description	FbEq
30.19	COMM 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. The time delays are given by parameters 30.20 and 30.21.	
	FAULT	Protection is active. The drive trips on a fault and stops the motor as defined by parameter 21.03.	1
	NO	Protection is inactive.	2
	PRESET FREQ	Protection is active. The drive generates a warning and sets the frequency to the value defined by parameter 30.18.  **WARNING**! Make sure that it is safe to continue operation in case of a communication break.	3
	LAST FREQ	Protection is active. The drive generates a warning and freezes the frequency to the level the drive was operating at. The value is determined by the average frequency over the previous 10 seconds.  **WARNING**! Make sure that it is safe to continue operation in case of a communication break.	4
30.20	MAIN REF DS T-OUT	Defines the time delay for the Main Reference Dataset supervision. See parameter 30.19.	
	0.10 … 60.00 s	Time delay	10 … 6000
30.21	COMM FLT RO/AO	Selects the operation of the fieldbus controlled relay output and analogue output in a communication break. See groups 14 RELAY OUTPUTS and 15 ANALOGUE OUTPUTS and the chapter *Fieldbus control*. The delay for the supervision function is given by parameter 30.22.	
	ZERO	Relay output is de-energised. Analogue output is set to zero.	0
	LAST VALUE	The relay output keeps the last state before the communication loss. The analogue output gives the last value before the communication loss.  **WARNING**! After the communication recovers, the update of the relay and the analogue outputs starts immediately without fault message resetting.	65535
30.22	AUX REF DS T-OUT	Defines the delay time for the Auxiliary Reference Dataset supervision. See parameter 30.19. The drive automatically activates the supervision 60 seconds after power switch-on if the value is other than zero. **Note:** The delay also applies for the function defined by parameter 30.21.	
	0.00 … 60.00 s	Time delay. 0.00 s = The function is inactive.	0 … 6000
31 AUTOMATIC RESET		Automatic fault reset. Automatic resets are possible only for certain fault types and when the automatic reset function is activated for that fault type. The automatic reset function is not operational if the drive is in local control (L visible on the first row of the panel display).	
31.01	NUMBER OF TRIALS	Defines the number of automatic fault resets the drive performs within the time defined by parameter 31.02.	
	0 … 5	Number of the automatic resets	0 … 5
31.02	TRIAL TIME	Defines the time for the automatic fault reset function. See parameter 31.01.	
	1.0 … 180.0 s	Allowed resetting time	100 … 18000
31.03	DELAY TIME	Defines the time that the drive will wait after a fault before attempting an automatic reset. See parameter 31.01.	
	0.0 … 3.0 s	Resetting delay	0 … 300

Index	Name/Selection	Description	FbEq
31.04	OVERCURRENT	Activates/deactivates the automatic reset for the overcurrent fault.	
	NO	Inactive	0
	YES	Active	65535
31.05	OVERVOLTAGE	Activates/deactivates the automatic reset for the intermediate link overvoltage fault.	
	NO	Inactive	0
	YES	Active	65535
31.06	UNDERVOLTAGE	Activates/deactivates the automatic reset for the intermediate link undervoltage fault.	
	NO	Inactive	0
	YES	Active	65535
31.07	AI SIGNAL<MIN	Activates/deactivates the automatic reset for the fault AI SIGNAL<MIN (analogue input signal under the allowed minimum level).	
	NO	Inactive	0
	YES	Active. **WARNING!** The drive may restart even after a long stop if the analogue input signal is restored. Ensure that the use of this feature will not cause danger.	65535
32 SUPERVISION		Supervision limits. A relay output can be used to indicate when the value is above/below the limit.	
32.01	FREQ1 FUNCTION	Activates/deactivates the frequency supervision function and selects the type of the supervision limit.	
	NO	Supervision is not used.	1
	LOW LIMIT	Supervision wakes up if the value is below the limit.	2
	HIGH LIMIT	Supervision wakes up if the value is above the limit.	3
	ABS LOW LIMIT	Supervision wakes up if the value is below the set limit. The limit is supervised in both rotating directions. The figure below illustrates the principle.  	4
32.02	FREQ1 LIMIT	Defines the frequency supervision limit. See parameter 32.01.	
	- 120 … 120 Hz	Value of the limit	-120 … 120
32.03	FREQ2 FUNCTION	See parameter 32.01.	
	NO	See parameter 32.01.	1
	LOW LIMIT	See parameter 32.01.	2
	HIGH LIMIT	See parameter 32.01.	3
	ABS LOW LIMIT	See parameter 32.01.	4
32.04	FREQ2 LIMIT	See parameter 32.01.	
	-120 … 120 Hz	See parameter 32.01.	-120 … 120
32.05	CURRENT FUNCTION	Activates/deactivates the motor current supervision function and selects the type of the supervision limit.	
	NO	See parameter 32.01.	1

Index	Name/Selection	Description	FbEq
	LOW LIMIT	See parameter 32.01.	2
	HIGH LIMIT	See parameter 32.01.	3
32.06	CURRENT LIMIT	Defines the limit for the motor current supervision (see parameter 32.05).	
	0 … 1000 A	Value of the limit	0 … 1000
32.07	REF1 FUNCTION	Activates/deactivates the reference REF1 supervision function and selects the type of the supervision limit.	
	NO	See parameter 32.01.	1
	LOW LIMIT	See parameter 32.01.	2
	HIGH LIMIT	See parameter 32.01.	3
32.08	REF1 LIMIT	Defines the limit for the reference REF1 supervision (see parameter 32.07).	
	0 … 120 Hz	Value of the limit	0 … 120
32.09	REF2 FUNCTION	Activates/deactivates the reference REF2 supervision function and selects the type of the supervision limit.	
	NO	See parameter 32.01.	1
	LOW LIMIT	See parameter 32.01.	2
	HIGH LIMIT	See parameter 32.01.	3
32.10	REF2 LIMIT	Defines the limit for the reference REF2 supervision (see parameter 32.09).	
	0 … 500%	Value of the limit in percent of motor nominal torque	0 … 5000
32.11	ACT1 FUNCTION	Activates/deactivates the supervision function for variable ACT1 of the process PI controller and selects the type of the supervision limit.	
	NO	See parameter 32.01.	1
	LOW LIMIT	See parameter 32.01.	2
	HIGH LIMIT	See parameter 32.01.	3
32.12	ACT1 LIMIT	Defines the limit for ACT1 supervision (see parameter 32.11).	
	0 … 200%	Value of the limit	0 … 2000
32.13	ACT2 FUNCTION	Activates/deactivates the supervision function for variable ACT2 of the process PI controller and selects the type of the supervision limit.	
	NO	See parameter 32.01.	1
	LOW LIMIT	See parameter 32.01.	2
	HIGH LIMIT	See parameter 32.01.	3
32.14	ACT2 LIMIT	Defines the limit for ACT2 supervision (see parameter 32.13).	
	0 … 200%	Value of the limit	0 … 2000
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	APPL SW VERSION	Displays the type and the version of the application program.	

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td></td><td>Decoding key:
AHAx7xyx
Product Series
A = ACS800
Product
S = ACS800 PFC Application Program
Firmware Type
A = Application Program
Firmware Version
7xyx = Version 7.xyx</td><td></td></tr>
<tr><td>33.03</td><td>TEST DATE</td><td>Displays the test date.</td><td></td></tr>
<tr><td></td><td></td><td>Date value in format DDMMYY (day, month, year)</td><td></td></tr>
<tr><td colspan="2">40 PI CONTROL</td><td>- process PI control (99.02 = PFC)</td><td></td></tr>
<tr><td>40.01</td><td>PI GAIN</td><td>Defines the gain of the process PI controller.</td><td></td></tr>
<tr><td></td><td>0.1 … 100.0</td><td>Gain value. The table below lists a few examples of the gain settings and the resulting PI controller output changes when
- a 10% or 50% error value is connected to the controller (error = process reference - process actual value).
- motor maximum frequency is 60 Hz (Parameter 20.02)
<table><tr><th>PI Gain</th><th>PI Output Change: 10% Error</th><th>PI Output Change: 50% Error</th></tr><tr><td>0.5</td><td>3 Hz (0.5 × 0.1 × 60 Hz)</td><td>15 Hz (0.5 × 0.5 × 60 Hz)</td></tr><tr><td>1.0</td><td>6 Hz (1.0 × 0.1 × 60 Hz)</td><td>30 Hz (1.0 × 0.5 × 60 Hz)</td></tr><tr><td>3.0</td><td>18 Hz (3.0 × 0.1 × 60 Hz)</td><td>60 Hz (> 3.0 × 0.5 × 60 Hz) (limited)</td></tr></table></td><td>10 … 10000</td></tr>
<tr><td>40.02</td><td>PI INTEG TIME</td><td>Defines the integration time for the process PI controller.
 

I = controller input (error)
O = controller output
G = gain
t = time
Ti = integration time</td><td></td></tr>
<tr><td></td><td>0.50 … 1000.00 s</td><td>Integration time</td><td>50 … 100000</td></tr>
<tr><td>40.03</td><td>ERROR VALUE INV</td><td>Inverts the error at the process PI controller input (error = process reference - process actual value).</td><td></td></tr>
<tr><td></td><td>NO</td><td>No inversion</td><td>0</td></tr>
<tr><td></td><td>YES</td><td>Inversion</td><td>65535</td></tr>
<tr><td>40.04</td><td>ACTUAL VALUE SEL</td><td>Selects the process actual value for the process PI controller: The sources for the variable ACT1 and ACT2 are further defined by parameters 40.05 and 40.06.
Use the sqrt(A1-A2) or sqA1+sqA2 function if the PI controller controls flow with a pressure transducer measuring the pressure difference over a flow meter.</td><td></td></tr>
</table>

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td>ACT1</td><td>ACT1</td><td>1</td></tr>
<tr><td></td><td>ACT1-ACT2</td><td>Subtraction of ACT1 and ACT 2.</td><td>2</td></tr>
<tr><td></td><td>ACT1+ACT2</td><td>Addition of ACT1 and ACT2</td><td>3</td></tr>
<tr><td></td><td>ACT1*ACT2</td><td>Multiplication of ACT1 and ACT2</td><td>4</td></tr>
<tr><td></td><td>ACT1/ACT2</td><td>Division of ACT1 and ACT2</td><td>5</td></tr>
<tr><td></td><td>MIN(A1,A2)</td><td>Selects the smaller of ACT1 and ACT2</td><td>6</td></tr>
<tr><td></td><td>MAX(A1,A2)</td><td>Selects the greater of ACT1 and ACT2</td><td>7</td></tr>
<tr><td></td><td>sqrt(A1-A2)</td><td>Square root of the subtraction of ACT1 and ACT2</td><td>8</td></tr>
<tr><td></td><td>sqA1+sqA2</td><td>Addition of the square root of ACT1 and the square root of ACT2</td><td>9</td></tr>
<tr><td>40.05</td><td>ACTUAL1 INPUT SEL</td><td>Selects the source for the variable ACT1. See parameter 40.04.</td><td></td></tr>
<tr><td></td><td>NO</td><td>No source selected</td><td>1</td></tr>
<tr><td></td><td>AI1</td><td>Analogue input AI1</td><td>2</td></tr>
<tr><td></td><td>AI2</td><td>Analogue input AI2</td><td>3</td></tr>
<tr><td></td><td>AI3</td><td>Analogue input AI3</td><td>4</td></tr>
<tr><td>40.06</td><td>ACTUAL2 INPUT SEL</td><td>Selects the source for the variable ACT2. See parameter 40.04.</td><td></td></tr>
<tr><td></td><td>NO</td><td>No source selected</td><td>1</td></tr>
<tr><td></td><td>AI1</td><td>Analogue input AI1</td><td>2</td></tr>
<tr><td></td><td>AI2</td><td>Analogue input AI2</td><td>3</td></tr>
<tr><td></td><td>AI3</td><td>Analogue input AI3</td><td>4</td></tr>
<tr><td>40.07</td><td>ACT1 MINIMUM</td><td>Defines the minimum value for the variable ACT1 if an analogue input is selected as a source for ACT1. See parameter 40.05. The minimum and maximum (40.08) settings of ACT1 define how the voltage/current signal received from the measuring device is converted to a percentage value used by the process PI controller.</td><td></td></tr>
<tr><td></td><td>-1000 … 1000%</td><td>Minimum value in percent of the set analogue input range. The equation below shows how to calculate the value when analogue input AI1 is used as a variable ACT1.

$\text{ACT1 MINIMUM} = \frac{\text{AI1min - 13.01}}{\text{13.02 - 13.01}} \times 100\%$

<table><tr><td>AI1min</td><td>The voltage value received from the measuring device when the measured process actual value is at the desired minimum level.</td></tr><tr><td>13.01</td><td>AI1 minimum (parameter setting)</td></tr><tr><td>13.02</td><td>AI1 maximum (parameter setting)</td></tr></table>
Example: The pressure of a pipe system is to be controlled between 0 and 10 bar. The pressure transducer has an output range of 4 to 8 V, corresponding to pressure between 0 and 10 bar. The minimum output voltage of the transducer is 2 V and the maximum is 10 V, so the minimum and the maximum of the analogue input is set to 2 V and 10 V. ACT1 MINIMUM is calculated as follows:

$\text{ACT1 MINIMUM} = \frac{\text{4 V - 2 V}}{\text{10 V - 2 V}} \times 100\% = 25\%$</td><td>-1000 … 1000</td></tr>
</table>

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td>40.08</td><td>ACT1 MAXIMUM</td><td>Defines the maximum value for the variable ACT1 if an analogue input is selected as a source for ACT1. See parameter 40.07. The minimum (40.09) and maximum settings of ACT1 define how the voltage/current signal received from the measuring device is converted to a percentage value used by the process PI controller.</td><td></td></tr>
<tr><td></td><td>-1000 … 1000%</td><td>Maximum value in percent of the set analogue input signal range. The equation below instructs how to calculate the value when analogue input AI1 is used as a variable ACT1.

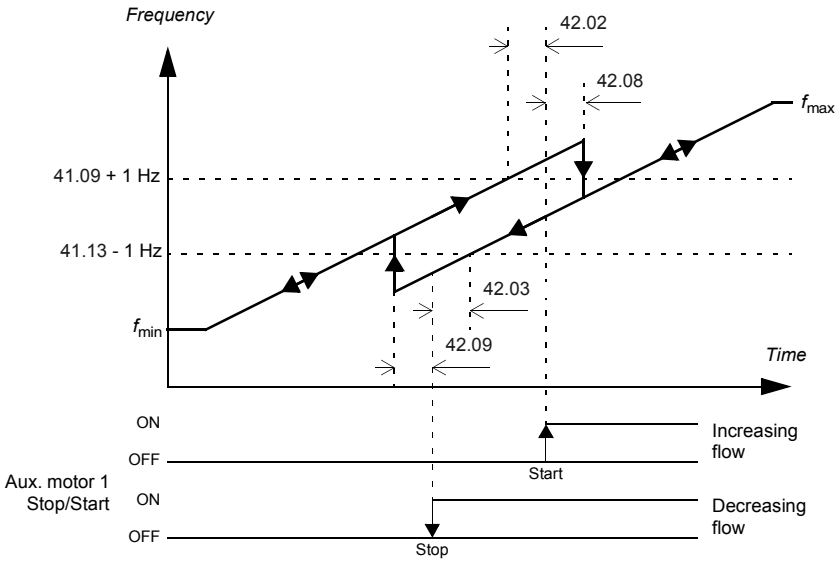
$\text{ACT1 MAXIMUM} = \frac{\text{AI1max - 13.01}}{\text{13.02 - 13.01}} \times 100\%$

<table><tr><td>AI1max</td><td>The voltage value received from the measuring device when the measured process actual value is at the desired maximum level.</td></tr><tr><td>13.01</td><td>AI1 minimum (parameter setting)</td></tr><tr><td>13.02</td><td>AI1 maximum (parameter setting)</td></tr></table>
Example: See parameter 40.07. ACT1 MAXIMUM is calculated as follows:

$\text{ACT1 MAXIMUM} = \frac{\text{8 V - 2 V}}{\text{10 V - 2 V}} \times 100\% = 75\%$</td><td>-1000 … 1000</td></tr>
<tr><td>40.09</td><td>ACT2 MINIMUM</td><td>See parameter 40.07.</td><td></td></tr>
<tr><td></td><td>-1000 … 1000%</td><td>See parameter 40.07.</td><td>-1000 … 1000</td></tr>
<tr><td>40.10</td><td>ACT2 MAXIMUM</td><td>See parameter 40.08.</td><td></td></tr>
<tr><td></td><td>-1000 … 1000%</td><td>See parameter 40.08.</td><td>-1000 … 1000</td></tr>
<tr><td>40.11</td><td>ACT1 UNIT SCALE</td><td>Matches actual value 1 displayed on the control panel and the unit defined by parameter 40.12.</td><td></td></tr>
<tr><td></td><td>-100000.00 … 100000.00</td><td>Actual value 1 scaling.</td><td>-1000000 … 1000000</td></tr>
<tr><td>40.12</td><td>ACTUAL 1 UNIT</td><td>Selects the unit of actual value 1.</td><td></td></tr>
<tr><td></td><td>NO</td><td></td><td>1</td></tr>
<tr><td></td><td>bar</td><td></td><td>2</td></tr>
<tr><td></td><td>%</td><td></td><td>3</td></tr>
<tr><td></td><td>C</td><td></td><td>4</td></tr>
<tr><td></td><td>mg/l</td><td></td><td>5</td></tr>
<tr><td></td><td>kPa</td><td></td><td>6</td></tr>
<tr><td>40.13</td><td>ACT2 UNIT SCALE</td><td>Matches actual value 2 displayed on the control panel and the unit defined by parameter 40.14.</td><td></td></tr>
<tr><td></td><td>-100000.00 … 100000.00</td><td>Actual value 2 scaling.</td><td>-1000000 … 1000000</td></tr>
<tr><td>40.14</td><td>ACTUAL 2 UNIT</td><td>Selects the unit of actual value 2.</td><td></td></tr>
<tr><td></td><td>NO</td><td></td><td>1</td></tr>
</table>

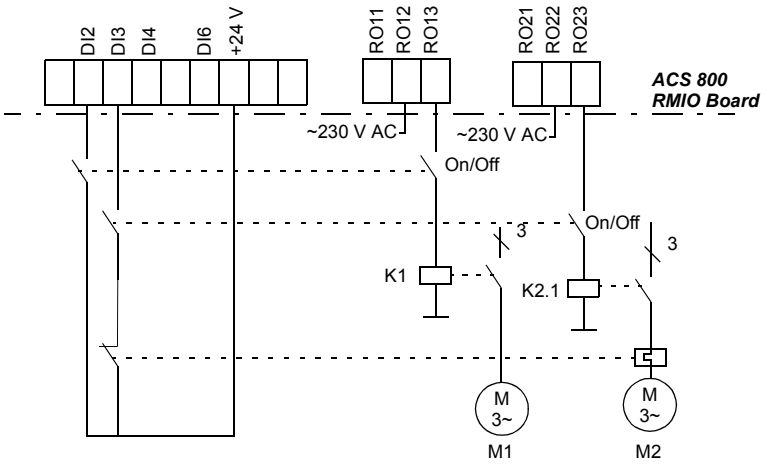
Index	Name/Selection	Description	FbEq
	bar		2
	%		3
	C		4
	mg/l		5
	kPa		6
40.15	ACTUAL FUNC SCALE	Scales the result of the arithmetic operation selected by parameter 40.04. The scaled value can be read through an analogue output (see parameter 15.01).	
	-100000.00 … 100000.00	Scaling for the ACTUAL FUNC signal.	-1000000 … 1000000
41 PFC CONTROL 1		Process references, start/stop frequencies for auxiliary motors. Only visible and effective when the PFC macro is selected.	
41.01	SET POINT 1/2 SEL	Defines the source from which the drive reads the signal that selects between the two process references. See also parameters 41.02, 41.03 and 41.04.	
	SET POINT 1	Process reference 1 selected.	1
	SET POINT 2	Process reference 2 selected.	2
	DI1	Digital input DI1. 0 = Process reference 1, 1 = Process reference 2.	3
	DI2	See selection DI1.	4
	DI3	See selection DI1.	5
	DI4	See selection DI1.	6
	DI5	See selection DI1.	7
	DI6	See selection DI1.	8
	DI7	See selection DI1.	9
	DI8	See selection DI1.	10
	DI9	See selection DI1.	11
	DI10	See selection DI1.	12
	DI11	See selection DI1.	13
	DI12	See selection DI1.	14
41.02	SET POINT 1 SRCE	Selects the source of process reference 1.	
	EXTERNAL	Process reference 1 is read from the source defined with parameter 11.06. The control panel must be in external control mode (an “R” displayed). If the control panel is in local mode (an “L” displayed), the panel gives a direct frequency reference and the PFC logic is bypassed. **Note:** The process reference can be read from the control panel in local mode only if the type of keypad reference is changed to REF2(%) (see parameter 11.01.)	0
	INTERNAL	Process reference 1 is a constant value set by parameter 41.03.	65535
41.03	SPOINT1 INTERNAL	Defines process reference 1 when parameter 41.02 is set to INTERNAL.	
	0.0 … 100.0%	Internal process reference 1.	0 … 10000
41.04	SPOINT2 INTERNAL	Defines process reference 2.	
	0.0 … 100.0%	Process reference 2.	0 … 10000

Index	Name/Selection	Description	FbEq
41.05	REFERENCE STEP 1	Sets a percentage that is added to the process reference when one auxiliary (direct-on-line) motor is running. **Example:** The drive operates three parallel pumps that pump water into a pipe. The pressure in the pipe is controlled. The constant pressure reference is set by parameter 41.03. During low water consumption, only the speed-regulated pump is run. When water consumption increases, constant-speed (direct-on-line) pumps are started: first one pump, and if the demand grows further, also the other pump. As water flow increases, the pressure loss between the beginning (point of measurement) and the end of the pipe increases. By setting suitable reference steps the process reference is increased along the increasing pumping capacity. The reference steps compensate the growing pressure loss and prevent the pressure fall at the end of the pipe.	
	0.0 … 100.0%	Reference step 1.	0 … 10000
41.06	REFERENCE STEP 2	Sets a percentage that is added to the process reference when two auxiliary (direct-on-line) motors are running. See parameter 41.05.	
	0.0 … 100.0%	Reference step 2.	0 … 10000
41.07	REFERENCE STEP 3	Sets a percentage that is added to the process reference when three auxiliary (direct-on-line) motors are running. See parameter 41.05.	
	0.0 … 100.0%	Reference step 3.	0 … 10000
41.08	REFERENCE STEP 4	Sets a percentage that is added to the process reference when four auxiliary (direct-on-line) motors are running. See parameter 41.05.	
	0.0 … 100.0%	Reference step 4.	0 … 10000
41.09	START FREQ 1	Defines the start frequency for auxiliary motor 1. When the output frequency of the drive exceeds this value + 1 Hz and no auxiliary motors are running, the start delay counter (see parameter 42.02) is started. If the frequency is still at the same level or higher when the delay elapses, the first auxiliary pump starts. After the motor is started, the output frequency is decreased by Start frequency 1 - Low frequency 1 (41.09-41.13).	
	0.0 … 120.0 Hz	Start frequency 1.	0 … 120
41.10	START FREQ 2	Defines the start frequency for auxiliary motor 2. See parameter 41.09.	
	0.0 … 120.0 Hz	Start frequency 2.	0 … 120
41.11	START FREQ 3	Defines the start frequency for auxiliary motor 3. See parameter 41.09.	
	0.0 … 120.0 Hz	Start frequency 3.	0 … 120
41.12	START FREQ 4	Defines the start frequency for auxiliary motor 4. See parameter 41.09.	
	0.0 … 120.0 Hz	Start frequency 4.	0 … 120
41.13	LOW FREQ 1	Defines the low (stop) frequency for auxiliary motor 1. When the output frequency of the drive falls below this value - 1 Hz and one auxiliary motor is running, the stop delay counter is started. If the frequency is still at the same level or lower when the delay elapses, the first auxiliary pump stops. After the motor is stopped, the output frequency is increased by Start frequency 1 - Low frequency 1 (41.09-41.13).	
	0.0 … 120.0 Hz	Low frequency 1.	0 … 120
41.14	LOW FREQ 2	Defines the low (stop) frequency for auxiliary motor 2. See parameter 41.13.	
	0.0 … 120.0 Hz	Low frequency 2.	0 … 120
41.15	LOW FREQ 3	Defines the low (stop) frequency for auxiliary motor 3. See parameter 41.13.	
	0.0 … 120.0 Hz	Low frequency 3.	0 … 120

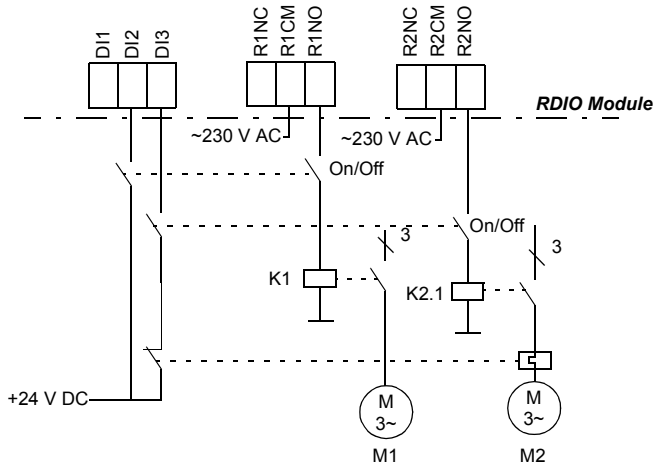
Index	Name/Selection	Description	FbEq
41.16	LOW FREQ 4	Defines the low (stop) frequency for auxiliary motor 4. See parameter 41.13.	
	0.0 … 120.0 Hz	Low frequency 4.	0 … 120
42 PFC CONTROL 2		Auxiliary motor set-up (start/stop delays, autochange). Only visible when the PFC macro is selected.	
42.01	NBR OF AUX MOTORS	Defines the number of auxiliary motors, i.e. motors in excess of 1. **Note:** After changing the value of this parameter, check the settings of the relay outputs in parameter group 14. **Note:** Without additional hardware, the drive supports the use of up to two auxiliary motors*. An optional digital input/output extension module (RDIO) is required for the use of three to four auxiliary motors. See parameter group 98. *Three auxiliary motors can be used without additional hardware if the Interlocks and Autochange functions are not used (see below). **WARNING!** Use of the Autochange function also requires the use of the Interlocks function.	
	ZERO	No auxiliary motors used (a one-pump/fan station).	1
	ONE	One auxiliary motor used (two-pump/fan station).	2
	TWO	Two auxiliary motors used (three-pump/fan station).	3
	THREE	Three auxiliary motors used (four-pump/fan station).	4
	FOUR	Four auxiliary motors used (five-pump/fan station).	5
42.02	AUX MOT START DLY	Start delay for auxiliary motors. 	
	0.0 … 3600.0 s	Auxiliary motor start delay.	0 … 3600
42.03	AUX MOT STOP DLY	Stop delay for auxiliary motors. See parameter 42.02.	
	0.0 … 3600.0 s	Auxiliary motor start delay.	0 … 3600

Index	Name/Selection	Description	FbEq
42.04	INTERLOCKS	Defines the use of the Interlocks function.  **WARNING!** Use of the Autochange function (parameter 42.06) also requires the use of the Interlocks function. The Interlocks function is used with multimotor applications where one motor at a time is connected to the output of the drive. The remaining motors are powered from the supply line and started and stopped by the relay outputs of the drive. A contact of the manual on/off switch (or protective device, such as a thermal relay, etc.) of each motor is wired to the interlock circuit. The logic will detect if a motor is unavailable and start the next available motor instead. If the interlock circuit of the speed-regulated motor is switched off, the motor is stopped and all relay outputs are de-energised. Then the drive will restart. The next available motor in the Autochange sequence will be started as regulated. If the interlock circuit of a direct-on-line motor is switched off, the drive will not try to start the motor until the interlock circuit is switched on again. The other motors will operate normally. The selection SET1 uses predominantly the standard inputs and outputs of the drive, while SET2 uses those of optional digital I/O extension modules (type RDIO).	

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td>OFF</td><td>The Interlocks function is not in use; digital inputs DI2, DI3 and DI4 are available for other purposes. The speed-regulated motor is directly connected to the drive; auxiliary (direct-on-line) motors are started and stopped whenever necessary. The auxiliary motors can be controlled primarily through the standard relay outputs or optional digital I/O extension modules (type RDIO). The selection between the desired relay outputs is made by the parameters in Group 14.
Depending on the number of auxiliary motors (parameter 42.01), the standard relay outputs are used as follows:
<table>
<tr><th rowspan="2">42.01</th><th colspan="2">Usage of standard relay outputs</th></tr>
<tr><th>Output</th><th>Assignment/Note</th></tr>
<tr><td>0</td><td>–</td><td>N/A</td></tr>
<tr><td>1</td><td>RO1</td><td>Controls the start/stop contactor of auxiliary motor no. 1.</td></tr>
<tr><td rowspan="2">2</td><td>RO1</td><td>Controls the start/stop contactor of auxiliary motor no. 1.</td></tr>
<tr><td>RO2</td><td>Controls the start/stop contactor of auxiliary motor no. 2.</td></tr>
<tr><td rowspan="3">3</td><td>RO1</td><td>Controls the start/stop contactor of auxiliary motor no. 1.</td></tr>
<tr><td>RO2</td><td>Controls the start/stop contactor of auxiliary motor no. 2.</td></tr>
<tr><td>RO3</td><td>Controls the start/stop contactor of auxiliary motor no. 3.</td></tr>
<tr><td rowspan="4">4</td><td>RO1</td><td>Controls the start/stop contactor of auxiliary motor no. 1.</td></tr>
<tr><td>RO2</td><td>Controls the start/stop contactor of auxiliary motor no. 2.</td></tr>
<tr><td>RO3</td><td>Controls the start/stop contactor of auxiliary motor no. 3.</td></tr>
<tr><td>RDIO1 RO1</td><td>Relay output RO1 of the first RDIO module controls the start/stop contactor of auxiliary motor no. 4.
Note: The module must be enabled by parameter 98.03.</td></tr>
</table>
Alternatively, optional digital I/O extension modules can be used:
<table>
<tr><th rowspan="2">42.01</th><th colspan="2">Usage of relay outputs of digital I/O extension modules</th></tr>
<tr><th>Output</th><th>Assignment/Note</th></tr>
<tr><td>0</td><td>–</td><td>N/A</td></tr>
<tr><td>1</td><td>RDIO1 RO1</td><td>Relay output RO1 of the first RDIO module controls the start/stop contactor of auxiliary motor no. 1.</td></tr>
<tr><td rowspan="2">2</td><td>RDIO1 RO1</td><td>Relay output RO1 of the first RDIO module controls the start/stop contactor of auxiliary motor no. 1.</td></tr>
<tr><td>RDIO1 RO2</td><td>Relay output RO2 of the first RDIO module controls the start/stop contactor of auxiliary motor no. 2.</td></tr>
<tr><td rowspan="3">3</td><td>RDIO1 RO1</td><td>Relay output RO1 of the first RDIO module controls the start/stop contactor of auxiliary motor no. 1.</td></tr>
<tr><td>RDIO1 RO2</td><td>Relay output RO2 of the first RDIO module controls the start/stop contactor of auxiliary motor no. 2.</td></tr>
<tr><td>RDIO2 RO1</td><td>Relay output RO1 of the second RDIO module controls the start/stop contactor of auxiliary motor no. 3.</td></tr>
<tr><td rowspan="4">4</td><td>RDIO1 RO1</td><td>Relay output RO1 of the first RDIO module controls the start/stop contactor of auxiliary motor no. 1.</td></tr>
<tr><td>RDIO1 RO2</td><td>Relay output RO2 of the first RDIO module controls the start/stop contactor of auxiliary motor no. 2.</td></tr>
<tr><td>RDIO2 RO1</td><td>Relay output RO1 of the second RDIO module controls the start/stop contactor of auxiliary motor no. 3.</td></tr>
<tr><td>RDIO2 RO2</td><td>Relay output RO2 of the second RDIO module controls the start/stop contactor of auxiliary motor no. 4.</td></tr>
</table>
Note: The RDIO modules must be enabled by parameters 98.03 and 98.04.</td><td>1</td></tr>
</table>

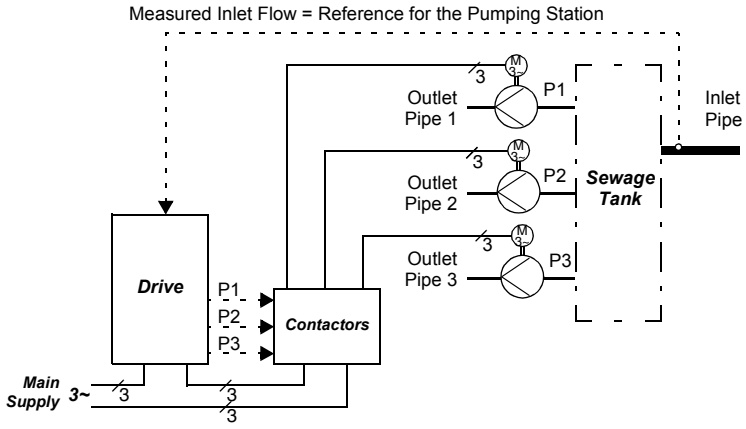
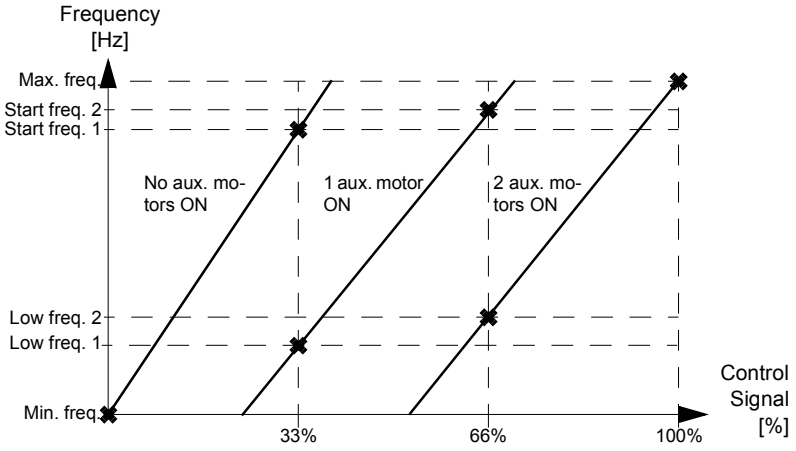
<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td>SET1</td><td>The Interlocks function is in use. Depending on the number of auxiliary motors, the relay outputs and digital inputs are used as follows:
<table>
<tr><th rowspan="2">42.01</th><th colspan="2">Usage of relay outputs and digital inputs</th></tr>
<tr><th>I/O</th><th>Assignment/Note</th></tr>
<tr><td rowspan="2">0</td><td>DI2</td><td>Monitors the status of motor no. 1.</td></tr>
<tr><td>RO1</td><td>Controls the start/stop contactor of motor no. 1.</td></tr>
<tr><td rowspan="2">1</td><td>DI2/3</td><td>Monitor the status of motors no. 1 and 2 respectively.</td></tr>
<tr><td>RO1/2</td><td>Control the start/stop contactors of motors no. 1 and 2 respectively.</td></tr>
<tr><td rowspan="2">2</td><td>DI2/3/4</td><td>Monitor the status of motors no. 1, 2 and 3 respectively.</td></tr>
<tr><td>RO1/2/3</td><td>Control the start/stop contactors of motors 1, 2 and 3 respectively.</td></tr>
<tr><td rowspan="4">3</td><td>DI2/3/4</td><td>Monitor the status of motors no. 1, 2 and 3 respectively.</td></tr>
<tr><td>RDIO1 DI1 (DI7)</td><td>Digital input DI1 of the first RDIO module (DI7) monitors the status of motor 4.</td></tr>
<tr><td>RO1/2/3</td><td>Control the start/stop contactors of motors 1, 2 and 3 respectively.</td></tr>
<tr><td>RDIO1 RO1</td><td>Relay output RO1 of the first RDIO module controls the start/stop contactor of motor no. 4.</td></tr>
<tr><td rowspan="4">4</td><td>DI2/3/4</td><td>Monitor the status of motors no. 1, 2 and 3 respectively.</td></tr>
<tr><td>RDIO1 DI1/2 (DI7/DI8)</td><td>Digital inputs DI1 and DI2 of the first RDIO module (DI7 and DI8) monitor the status of motors 4 and 5 respectively.</td></tr>
<tr><td>RO1/2/3</td><td>Control the start/stop contactors of motors 1, 2 and 3 respectively.</td></tr>
<tr><td>RDIO1 RO1/2</td><td>Relay outputs RO1 and RO2 of the first RDIO module control the start/stop contactors of motors no. 4 and 5 respectively.</td></tr>
</table>
Below is an example of two motors connected to the drive with SET1 selected.


Note: Any RDIO modules present must be enabled by parameters 98.03 and 98.04.</td><td>2</td></tr>
</table>

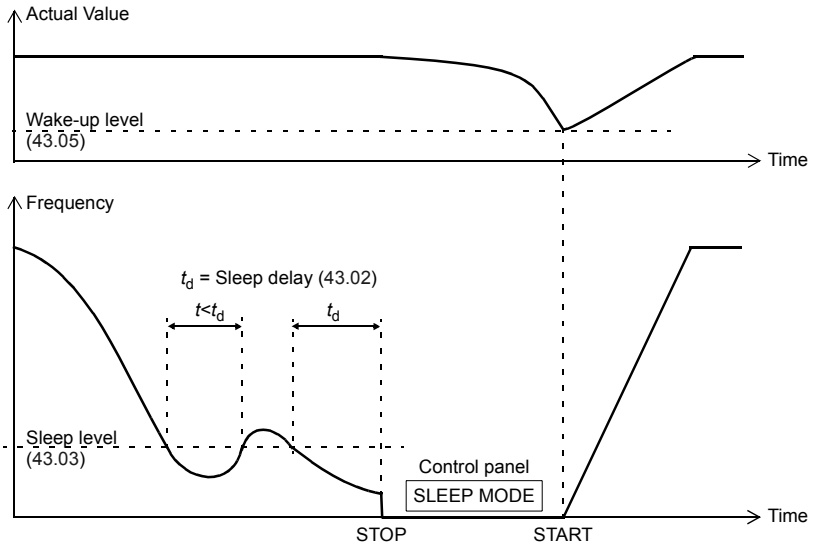
<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td>SET2</td><td>The Interlocks function is in use. Depending on the number of auxiliary motors, the relay outputs and digital inputs are used as follows:
<table>
<tr><th rowspan="2">42.01</th><th colspan="2">Usage of relay outputs and digital inputs</th></tr>
<tr><th>I/O</th><th>Assignment/Note</th></tr>
<tr><td rowspan="2">0</td><td>RDIO1 DI2 (DI8)</td><td>Digital input DI2 of the first RDIO module (DI8) monitors the status of motor no. 1.</td></tr>
<tr><td>RDIO1 RO1</td><td>Relay output RO1 of the first RDIO module controls the start/stop contactor of motor no. 1.</td></tr>
<tr><td rowspan="2">1</td><td>RDIO1 DI2/3</td><td>Digital inputs DI2 and DI3 of the first RDIO module (DI8 and DI9) monitor the status of motors no. 1 and 2 respectively.</td></tr>
<tr><td>RDIO1 RO1/2</td><td>Relay outputs RO1 and RO2 of the first RDIO module control the start/stop contactors of motors no. 1 and 2 respectively.</td></tr>
<tr><td rowspan="4">2</td><td>RDIO1 DI2/3</td><td>Digital inputs DI2 and DI3 of the first RDIO module (DI8 and DI9) monitor the status of motors no. 1 and 2 respectively.</td></tr>
<tr><td>RDIO2 DI1</td><td>Digital input DI1 of the second RDIO module (DI10) monitors the status of motor 3.</td></tr>
<tr><td>RDIO1 RO1/2</td><td>Relay outputs RO1 and RO2 of the first RDIO module control the start/stop contactors of motors 1 and 2 respectively.</td></tr>
<tr><td>RDIO2 RO1</td><td>Relay output RO1 of the second RDIO module controls the start/stop contactor of motor 3.</td></tr>
<tr><td rowspan="4">3</td><td>RDIO1 DI2/3</td><td>Digital inputs DI2 and DI3 of the first RDIO module (DI8 and DI9) monitor the status of motors no. 1 and 2 respectively.</td></tr>
<tr><td>RDIO2 DI1/2</td><td>Digital inputs DI1 and DI2 of the second RDIO module (DI10 and DI11) monitor the status of motors 3 and 4 respectively.</td></tr>
<tr><td>RDIO1 RO1/2</td><td>Relay outputs RO1 and RO2 of the first RDIO module control the start/stop contactors of motors 1 and 2 respectively.</td></tr>
<tr><td>RDIO2 RO1/2</td><td>Relay outputs RO1 and RO2 of the second RDIO module control the start/stop contactors of motors 3 and 4 respectively.</td></tr>
<tr><td>4</td><td colspan="2">Not applicable.</td></tr>
</table>
Below is an example of two motors connected to the drive with SET2 selected.


Note: The RDIO modules must be enabled by parameters 98.03 and 98.04.</td><td>3</td></tr>
<tr><td>42.06</td><td>AUTOCHANGE INTERV</td><td>Switches on the Autochange function, and specifies the Autochange interval. See parameter 42.07.</td><td></td></tr>
</table>

Index	Name/Selection	Description	FbEq
	0 h 00 min … 336 h (14 days)	Autochange interval. 0 h 00 min = Autochange function disabled. **Note:** The counter runs only when the start signal of the drive is on. **WARNING!** If the Autochange function is used, also the Interlocks function must be used, and parameter 21.03 set to COAST. In an Autochange system, there is a contactor between the drive output and the speed-controlled motor. The contactor will be damaged if opened without first interrupting the power stage switching of the drive. The switching is interrupted when the interlock is switched off and the selected stop mode is COAST.	0 … 20160 (min)
42.07	AUTOCHANGE LEVEL	Percentage from which the output frequency limit for the Autochange function is calculated. $f_{ac} = \frac{\text{Par. 42.07}}{\left(\frac{100\%}{1 + \text{Par 42.01}}\right)} \times \text{Par. 20.02}$ f_{ac} = Output frequency below which Autochange is allowed. The motor starting sequence is changed when the Autochange interval has elapsed and the output frequency is below f_{ac}. Autochanging is indicated by a warning on the control panel display. **Note:** After adjusting this parameter, check using the formula above that the corresponding output frequency is within allowed range (eg. between minimum and maximum limits). Otherwise no Autochanging is possible. **Note:** When the drive power is switched off, the values of the starting sequence counter and the Autochange interval counter are stored. The counters will continue using these values after the power is switched on again. **Example:** There are three motors in a system (parameter 42.01 is set to 2). Autochange level is set to 25%. The maximum frequency is set to 52 Hz by parameter 20.02. An Autochange occurs when the output frequency is below 39 Hz = (25%/(100%/(1+2)) × 52 Hz, and Autochange interval from the previous Autochange has elapsed. Upon an Autochange, 1) All motors are stopped. 2) The starting sequence is incremented (from 1-2-3 to 2-3-1, etc.). 3) The contactor that controls the speed-regulated motor is closed. 4) The delay set by parameter 42.10 is waited. 5) The speed-regulated motor is energised and normal PFC operation starts. If the Autochange level is 0 and the interval has elapsed, Autochange will occur during a stop, eg. when the Sleep function is active.	
	0.0 … 100.0%	Autochange level.	0 … 10000
42.08	FREQ TIME ON DLY	See diagram at parameter 42.02.	
	0.0 … 3600.0 s		0 … 3600
42.09	FREQ TIME OFF DLY	See diagram at parameter 42.02.	
	0.0 … 3600.0 s		0 … 3600

Index	Name/Selection	Description	FbEq
42.10	PFC START DELAY	Start delay for the speed-regulated motor. Does not affect the starting of the direct-on-line motors. See parameter 42.07. **WARNING!** There must always be a delay set if the motors are equipped with star-delta starters. The delay must be set longer than the time setting of the starter. After the motor is switched on by the relay output of the drive, there must be enough time for the star-delta starter to first switch to star and then back to delta before the motor is connected to the drive.	
	0 … 10000 ms	PFC start delay.	0 … 10000
42.11	REGUL BYPASS CTRL	Selects whether the process PI controller is bypassed. This parameter can be used in applications with a low number of sensors and low accuracy requirements. **Example:** The capacity of the pumping station (outlet flow) follows the measured inlet flow.  In the diagram below, the slopes of the lines describe the relation between the control signal (selected by parameter 40.04) and the frequency of the controlled motor (i.e. drive output frequency) in a three-motor system. At full control signal level, all pumps are operating at maximum frequency.  	
	NO	Process PI controller is in use.	0

Index	Name/Selection	Description	FbEq
	YES	Process PI controller is bypassed. The signal selected by parameter 40.04 is used as the frequency reference. The automatic start/stop of direct-on-line motors is related to this actual value signal instead of the output of the PI controller.	65535
43 SLEEP FUNCTION		Sleep function set-up.	
43.01	SLEEP SELECTION	Controls the Sleep function.	
	OFF	The Sleep function is disabled.	1
	INTERNAL	The Sleep function is activated and deactivated as defined by parameters 43.02, 43.03 and 43.05.	2
	DI1	If the digital input is OFF, the Sleep function is activated and deactivated as defined by parameters 43.02, 43.03 and 43.05. When the digital input is switched ON, the reference is set to 0%. As the output frequency falls below the value of parameter 43.03, the drive enters the Sleep mode. As long as the digital input stays ON, the drive will not wake up. When the digital input is switched OFF, the drive continues to operate according to the Sleep function set-up parameters.	3
	DI2	See selection DI1.	4
	DI3	See selection DI1.	5
	DI4	See selection DI1.	6
	DI5	See selection DI1.	7
	DI6	See selection DI1.	8
	DI7	See selection DI1.	9
	DI8	See selection DI1.	10
	DI9	See selection DI1.	11
	DI10	See selection DI1.	12
	DI11	See selection DI1.	13
	DI12	See selection DI1.	14
43.02	SLEEP DELAY	Sets the Sleep delay for the Sleep function. If the output frequency of the drive is below the value set by parameter 43.03, longer than the Sleep delay, the drive is stopped, and the control panel displays the warning “SLEEP MODE”.	
	0.0 … 3600.0 s		0 … 3600

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td>43.03</td><td>SLEEP LEVEL</td><td>Sets the frequency limit for the Sleep function. When the output frequency of the drive drops below this limit, the sleep delay counter is started. When the output frequency exceeds this limit, the sleep delay counter is reset.
 

Note: The Sleep level setting should be greater than the minimum frequency setting (parameter 20.01). Otherwise the output frequency of the drive will never fall below the Sleep level.</td><td></td></tr>
<tr><td></td><td>0.0 … 120.0 Hz</td><td>Sleep level in Hz.
Setting the parameter to 0 disables the Sleep function.</td><td>0 … 120</td></tr>
<tr><td>43.05</td><td>WAKE UP LEVEL</td><td>Sets the process actual value limit for the Sleep function. When the process actual value falls below the limit, the Sleep function is interrupted.
The wake-up level is given in percent of the used process reference value.
Example: The PFC application program follows a process reference set by parameter 41.03 SPOINT1 INTERNAL. The table below shows the wake-up level with two process reference settings, and two wake-up level settings.
<table>
<tr><th>Value of 41.03</th><th>Value of 43.05</th><th>Wake-up level</th></tr>
<tr><td>100%</td><td>50%</td><td>50% of 100% = 50%</td></tr>
<tr><td>80%</td><td>40%</td><td>40% of 80% = 32%</td></tr>
</table>
Note: If the PI controller is bypassed (parameter 42.11) or inverted (40.03), the Sleep function is interrupted whenever the actual value exceeds the wake-up level. In this case, the wake-up level is taken as an absolute percentage value (of 100%).</td><td></td></tr>
<tr><td></td><td>0.0 … 100.0%</td><td>Wake-up level.</td><td>0 … 10000</td></tr>
<tr><td colspan="2">44 PFC PROTECTION</td><td>Set-up of PFC protections.</td><td></td></tr>
<tr><td>44.01</td><td>INPUT PROT CTRL</td><td>Enables, and selects the mode of, the primary supervision of pump/fan inlet pressure.</td><td></td></tr>
<tr><td></td><td>NOT SEL</td><td>Primary inlet pressure supervision not used.</td><td>1</td></tr>
<tr><td></td><td>WARNING</td><td>Detection of low inlet pressure produces a warning on the control panel display.</td><td>2</td></tr>
</table>

Index	Name/Selection	Description	FbEq
	PROTECT	Detection of low inlet pressure produces a warning on the control panel display. The output of the PI controller is ramped down (according to par. 44.17) to the forced reference (set by parameter 44.08). The drive will revert to the original reference if the pressure subsequently exceeds the supervision level.	3
	FAULT	Detection of low inlet pressure trips the drive on a fault.	4
44.02	AI MEASURE INLET	Selects the analogue input for pump/fan inlet pressure supervision.	
	NOT USED	No analogue input selected.	1
	AI1	Pump/fan inlet pressure monitored through selected input.	2
	AI2	Pump/fan inlet pressure monitored through selected input.	3
	AI3	Pump/fan inlet pressure monitored through selected input.	4
	EXT AI1	Pump/fan inlet pressure monitored through selected input.	5
	EXT AI2	Pump/fan inlet pressure monitored through selected input.	6
44.03	AI IN LOW LEVEL	Sets the supervision limit for the primary inlet pressure measurement. If the value of the selected input falls below this limit, the action defined by parameter 44.01 is taken after a delay set by parameter 44.07 expires.	
	0.0 … 100.0%	The range corresponds to 0 … 10 V or 0 …20 mA on the analogue input. With a bipolar input, the absolute input value is considered.	0 … 100
44.04	VERY LOW CTRL	Enables, and selects the mode of, the secondary inlet pressure supervision function. The function uses the analogue input selected by parameter 44.02.	
	NOT SEL	Secondary inlet pressure supervision not used.	1
	STOP	Detection of very low inlet pressure stops the drive. The drive will start again if the pressure exceeds the supervision level.	2
	FAULT	Detection of very low inlet pressure trips the drive on a fault.	3
44.05	AI IN VERY LOW	Supervision level for the secondary inlet pressure monitoring function. See parameter 44.04.	
	0.0 … 100.0%		
44.06	DI STATUS INLET	Selects the digital input for connection of a pressure switch at the pump/fan inlet. The “normal” state is 1 (on). If the selected input switches to 0 (off), the action defined by parameter 44.01 is executed after a delay set by parameter 44.07 expires.	
	NOT USED	No digital input selected.	1
	DI1	Pump/fan inlet pressure monitored through selected input.	2
	DI2	Pump/fan inlet pressure monitored through selected input.	3
	DI3	Pump/fan inlet pressure monitored through selected input.	4
	DI4	Pump/fan inlet pressure monitored through selected input.	5
	DI5	Pump/fan inlet pressure monitored through selected input.	6
	DI6	Pump/fan inlet pressure monitored through selected input.	7
	DI7	Pump/fan inlet pressure monitored through selected input.	8
	DI8	Pump/fan inlet pressure monitored through selected input.	9
	DI9	Pump/fan inlet pressure monitored through selected input.	10
	DI10	Pump/fan inlet pressure monitored through selected input.	11
	DI11	Pump/fan inlet pressure monitored through selected input.	12
	DI12	Pump/fan inlet pressure monitored through selected input.	13
44.07	INPUT CTRL DLY	Sets the delay after which the action defined by parameter 44.01 is taken upon detection of low inlet pressure.	

Index	Name/Selection	Description	FbEq
	0 … 60 s		0 … 60
44.08	INLET FORCED REF	This reference is used after detection of low inlet pressure. See par. 44.01. **WARNING!** Make sure that it is safe to continue operation using this reference.	
	0 … 100%		0 … 100
44.09	OUTPUT PROT CTRL	Enables, and selects the mode of, the primary supervision of pump/fan outlet pressure.	
	NOT SEL	Primary outlet pressure supervision not used.	1
	WARNING	Detection of high outlet pressure produces a warning on the control panel display.	2
	PROTECT	Detection of high outlet pressure produces a warning on the control panel display. The output of the PI controller is ramped down (according to par. 44.17) to the forced reference (set by parameter 44.16). The drive will revert to the original reference if the pressure subsequently falls below the supervision level.	3
	FAULT	Detection of high outlet pressure trips the drive on a fault.	4
44.10	AI MEASURE OUTLET	Selects the analogue input for pump/fan outlet pressure supervision.	
	NOT USED	No analogue input selected.	1
	AI1	Pump/fan outlet pressure monitored through selected input.	2
	AI2	Pump/fan outlet pressure monitored through selected input.	3
	AI3	Pump/fan outlet pressure monitored through selected input.	4
	EXT AI1	Pump/fan outlet pressure monitored through selected input.	5
	EXT AI2	Pump/fan outlet pressure monitored through selected input.	6
44.11	AI OUT HIGH LEVEL	Sets the supervision limit for the primary outlet pressure measurement. If the value of the selected analogue input exceeds this limit, the action defined by parameter 44.09 is taken after a delay set with parameter 44.15 expires.	
	0.0 … 100.0%	The range corresponds to 0 … 10 V or 0 …20 mA on the analogue input. With a bipolar input, the absolute input value counts.	0 … 100
44.12	VERY HIGH CTRL	Enables, and selects the mode of, the secondary outlet pressure supervision function. The function uses the analogue input selected by parameter 44.10.	
	NOT SEL	Secondary outlet pressure monitoring not used.	1
	STOP	Detection of very high outlet pressure stops the drive. The drive will start again if the pressure falls below the supervision level.	2
	FAULT	Detection of very high outlet pressure trips the drive on a fault.	3
44.13	AI OUT VERY HIGH	Supervision level for secondary outlet pressure monitoring function. See parameter 44.09.	
	0 … 500%		0 … 500
44.14	DI STATUS OUTLET	Selects the digital input for connection of a pressure switch at the pump/fan outlet. The “normal” state is 1 (on). If the selected input switches to 0 (off), the action defined by parameter 44.09 is taken after a delay set by parameter 44.15 expires.	
	NOT USED	No digital input selected.	1
	DI1	Pump/fan outlet pressure monitored through selected input.	2
	DI2	Pump/fan outlet pressure monitored through selected input.	3
	DI3	Pump/fan outlet pressure monitored through selected input.	4

Index	Name/Selection	Description	FbEq
	DI4	Pump/fan outlet pressure monitored through selected input.	5
	DI5	Pump/fan outlet pressure monitored through selected input.	6
	DI6	Pump/fan outlet pressure monitored through selected input.	7
	DI7	Pump/fan outlet pressure monitored through selected input.	8
	DI8	Pump/fan outlet pressure monitored through selected input.	9
	DI9	Pump/fan outlet pressure monitored through selected input.	10
	DI10	Pump/fan outlet pressure monitored through selected input.	11
	DI11	Pump/fan outlet pressure monitored through selected input.	12
	DI12	Pump/fan outlet pressure monitored through selected input.	13
44.15	OUTPUT CTRL DLY	Sets the delay after which the action defined by parameter 44.09 is taken upon detection of high outlet pressure.	
	0 … 60 s		0 … 60
44.16	OUTLET FORCED REF	This reference is used after detection of high outlet pressure. See par. 44.09. **WARNING!** Make sure that it is safe to continue operation using this reference.	
	0 … 100%		0 … 100
44.17	PI REF DEC TIME	PI controller ramp-down time. See selection PROTECT at parameters 44.01 and 44.09.	
	0.01 … 3600.00 s		0 … 3600
44.18	APPL PROFILE CTRL	Parameters 44.16 to 44.18 provide the Application Profile protection feature, based on long-term monitoring of an internal status signal. If the selected signal exceeds (and remains above) the supervision limit for a longer time than the set delay, the internal status signal “PROFILE HIGH” is set to 1. The signal can be selected to control a relay output (see parameter group 14 RELAY OUTPUTS).	
	CONTROL DEV	Signal 01.25 is monitored and compared to parameter 44.19.	0
	APPL OUTPUT	Signal 01.15 is monitored and compared to parameter 44.19.	65535
44.19	PROFILE OUTP LIM	Supervision limit for the Application Profile protection.	
	0 … 500%		0 … 500
44.20	PROF LIMIT ON DLY	Delay time for the Application Profile protection.	
	0.0 … 100.0 h		0 … 100
51 COMM MOD DATA		The parameters are visible and need to be adjusted, only when a fieldbus adapter module (optional) is installed and activated by parameter 98.02. For details on the parameters, refer to the manual of the fieldbus module and the chapter *Fieldbus control*. These parameter settings will remain the same even though the macro is changed.	
52 STANDARD MODBUS		The settings for the Standard Modbus Link. See the 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 … 247	Address	1 … 247
52.02	BAUDRATE	Defines the transfer rate of the link.	
	600	600 bit/s	1
	1200	1200 bit/s	2

Index	Name/Selection	Description	FbEq
	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.	
	NONE1STOPBIT	No parity bit, one stop bit	1
	NONE2STOPBIT	No parity bit, two stop bits	2
	ODD	Odd parity indication bit, one stopbit	3
	EVEN	Even parity indication bit, one stopbit	4
70 DDCS CONTROL		Settings for the fibre optic channels 0, 1 and 3.	
70.01	CHANNEL 0 ADDR	Defines the node address for channel 0. No two nodes on-line may have the same address. The setting needs to be changed when a master station is connected to channel 0 and it does not automatically change the address of the slave. Examples of such masters are an ABB Advant Controller or another drive.	
	1 … 254	Address.	1 … 125
70.02	CHANNEL 3 ADDR	Node address for channel 3. 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 Drive*Window*® program running.	
	1 … 254	Address.	1 … 254
90 D SET 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 98.02. For more information, see the chapter *Fieldbus control.*	
90.01	AUX DS REF3	Selects the address into which the value of fieldbus reference REF3 is written.	
	0 … 8999	Parameter index.	0 … 8999
90.02	AUX DS REF4	Selects the address into which the value of fieldbus reference REF4 is written.	
	0 … 8999	Parameter index.	0 … 8999
90.03	AUX DS REF5	Selects the address into which the value of fieldbus reference REF5 is written.	
	0 … 8999	Parameter index.	0 … 8999
90.04	MAIN DS SOURCE	Defines the data set from which the drive reads the Control Word, Reference REF1 and Reference REF2.	
	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.	
	1 … 255	Data set number.	1 … 255
92 D SET 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 98.02. For more information, see the chapter *Fieldbus control.*	
92.01	MAIN DS STATUS WORD	Stores the address from which the Main Status Word is read from. Fixed value, not visible.	
	302 (fixed)	Parameter index	302

Index	Name/Selection	Description	FbEq
92.02	MAIN DS ACT1	Selects the address from which the Actual Signal 1 is read to the Main Data Set.	
	0 … 9999	Parameter index	0 … 9999
92.03	MAIN DS ACT2	Selects the address from which the Actual Signal 2 is read to the Main Data Set.	
	0 … 9999	Parameter index	0 … 9999
92.04	AUX DS ACT3	Selects the address from which the Actual Signal 3 is read to the Auxiliary Data Set.	
	0 … 9999	Parameter index	0 … 9999
92.05	AUX DS ACT4	Selects the address from which the Actual Signal 4 is read to the Auxiliary Data Set.	
	0 … 9999	Parameter index	0 … 9999
92.06	AUX DS ACT5	Selects the address from which the Actual Signal 5 is read to the Auxiliary Data Set.	
	0 … 9999	Parameter index	0 … 9999
98 OPTION MODULES		Activation of the option modules. The parameter settings will remain the same even though the application macro is changed (parameter 99.02).	
98.02	COMM. MODULE LINK	Activates the external serial communication and selects the interface. See the chapter *Fieldbus control.*	
	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 MOD DATA.	2
	ADVANT	The drive communicates with an ABB Advant OCS system via CH0 on the RDCO board (optional). See also parameter group 70 DDCS CONTROL.	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 group 52 STANDARD MODBUS.	4
	CUSTOMISED	The drive communicates via a customer specified link. The control sources are defined by parameters 90.04 and 90.05.	5
98.03	DI/O EXT MODULE 1	Activates the communication to the digital I/O extension module 1 (optional) and defines the type and connection interface of the module. See parameters 14.04 and 14.05 for selecting the drive states that are indicated through the relay outputs.	
	NO	Inactive	1 or 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* (Code: 3AFE 64485733 [English]).	5

Index	Name/Selection	Description	FbEq
98.04	DI/O EXT MODULE 2	Activates the communication to the digital I/O extension module 2 (optional) and defines the type and connection interface of the module. See parameters 14.06 and 14.07 for selecting the drive states that are indicated through the relay outputs.	
	NO	Inactive	1 or 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 3. For directions, see *User's Manual for RDIO Module* (Code: 3AFE 64485733 [English]).	5
98.06	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. Module inputs: Module input AI1 replaces standard input AI2. Module input AI2 replaces standard input AI3. Module outputs: Module output AO1 replaces standard output AO1. Module output AO2 replaces standard output AO2. See parameters 98.08 and 98.09 for the signal type definitions.	
	NO	Communication inactive	1 or 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 *User's Manual for RAIO Module* (Code: 3AFE 64484567 [English]).	5
98.07	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 98.02.	
	ABB DRIVES	ABB Drives communication profile.	0
	CSA 2.8/3.0	Communication profile used by application program versions 2.8 and 3.0.	65535
98.08	AI/O EXT AI1 FUNC	Defines the signal type for input 1 of the analogue I/O extension module (AI5 in the drive application program). The setting must match the signal connected to the module. **Note:** The communication must be activated by parameter 98.06.	
	UNIPOLAR AI5	Unipolar	1
	BIPOLAR AI5	Bipolar	2
98.09	AI/O EXT AI2 FUNC	Defines the signal type for input 2 of the analogue I/O extension module (AI6 in the drive application program). The setting must match the signal connected to the module. **Note:** The communication must be activated by parameter 98.06.	

Index	Name/Selection	Description	FbEq
	UNIPOLAR AI6	Unipolar	1
	BIPOLAR AI6	Bipolar	2
99 START-UP DATA		Language selection. Definition of motor set-up data.	
99.01	LANGUAGE	Selects the display language.	
	ENGLISH	International English	0
	ENGLISH(AM)	American English. If selected, the unit of power used is HP instead of kW.	1
	DEUTSCH	German	2
	ITALIANO	Italian	3
	ESPANOL	Spanish	4
	PORTUGUES	Portuguese	5
	NEDERLANDS	Dutch	6
	FRANCAIS	French	7
	DANSK	Danish	8
	SUOMI	Finnish	9
	SVENSKA	Swedish	10
	CESKY	Czech (Not supported at the time of publishing.)	11
	POLSKI	Polish	12
	PO-RUSSKI	Russian (Not supported at the time of publishing.)	12
99.02	APPLICATION MACRO	Selects the application macro. See the chapter *Application macros* for more information. **Note:** When you change the default parameter values of a macro, the new settings become valid immediately and stay valid even if the power of the drive is switched off and on. However, backup of the default parameter settings (factory settings) of each standard macro is still available. See parameter 99.03.	
	PFC	PFC macro in use.	1
	HAND/AUTO	Hand/Auto macro in use.	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.	3
	USER 1 SAVE	Save User 1 macro. Stores the current parameter settings and the motor model. **Note:** There are parameters that are not included in the macros. See parameter 99.03.	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.	5
	USER 2 SAVE	Save User 2 macro. Stores the current parameter settings and the motor model. **Note:** There are parameters that are not included in the macros. See parameter 99.03.	6

Index	Name/Selection	Description	FbEq
99.03	APPLIC RESTORE	Restores the original settings of the active application macro (99.02). - If a standard macro is active, the parameter values are restored to the default settings (factory settings). Exceptions: parameter settings in parameter group 99 remain unchanged. The motor model remains unchanged. - If User Macro 1 or 2 is active, the parameter values are restored to the last saved values. In addition, the last saved motor model are restored. Exceptions: Settings of parameters 16.05 and 99.02 remain unchanged. **Note:** The parameter settings and the motor model are restored according to the same principles when a macro is changed to another.	
	NO	No restoring	0
	YES	Restoring	65535
99.04	MOTOR CTRL MODE	Selects the motor control mode.	
	DTC	Direct Torque Control mode is suitable for most applications.	0
	SCALAR	Scalar control is suitable in special cases where the DTC cannot be applied. The scalar control mode is recommended: - for multimotor drives with variable number of motors - when the nominal current of the motor is less than 1/6 of the nominal output current of the drive (inverter) - the drive is used for test purposes with no motor connected. **Note:** The outstanding motor control accuracy of the DTC cannot be achieved in scalar control. The differences between the scalar and DTC control modes are pointed out in this manual in relevant parameter lists. There are some standard features that are disabled in the scalar control mode: Motor Identification Run (group 99 START-UP DATA), Speed Limits (group 20 LIMITS), Torque Limit (group 20 LIMITS), DC Hold (group 21 START/STOP), DC Magnetizing (group 21 START/STOP), Speed Controller Tuning (group 23 SPEED CTRL), Flux Optimization (group 26 MOTOR CONTROL), Flux Braking (group 26 MOTOR CONTROL), Underload Function (group 30 FAULT FUNCTIONS), Motor Phase Loss Protection (group 30 FAULT FUNCTIONS), Motor Stall Protection (group 30 FAULT FUNCTIONS).	65535
99.05	MOTOR NOM VOLTAGE	Defines the nominal motor voltage. Must be equal to the value on the motor rating plate.	
	1/2 … 2 · UN	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
99.06	MOTOR NOM CURRENT	Defines the nominal motor current. Must be equal to the value on the motor rating plate. **Note:** Correct motor run requires that the magnetizing current of the motor does not exceed 90 percent of the nominal current of the inverter.	
	0 … 2 · I_{2hd}	Allowed range: approx. 1/6 … 2 · I_{2hd} of ACS800 (parameter 99.04 = DTC). Allowed range: approx. 0 … 2 · I_{2hd} of ACS800 (parameter 99.04 = SCALAR).	1 = 0.1 A
99.07	MOTOR NOM FREQ	Defines the nominal motor frequency.	
	8 … 300 Hz	Nominal frequency (50 or 60 Hz typically)	800 … 30000

Index	Name/Selection	Description	FbEq
99.08	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 99.08 is changed, the speed limits in parameter group 20 LIMITS change automatically as well.	
	1 … 18000 rpm	Nominal motor speed	1 … 18000
99.09	MOTOR NOM POWER	Defines the nominal motor power. Set exactly as on the motor rating plate.	
	0 … 9000 kW	Nominal motor power	0 … 90000
99.10	MOTOR 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 the chapter *Start-up; and control through the I/O*. **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. **Note:** The ID Run (STANDARD or REDUCED) cannot be performed if parameter 99.04 = SCALAR.	
	NO	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 teminals). **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
99.11	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.	

Fault tracing

Chapter overview

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 with 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 the 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 the chapter *Control panel* for more information.

Warning messages generated by the drive

WARNING	CAUSE	WHAT TO DO
ACS 800 TEMP (4210)	The drive temperature is excessive. A warning is given if the inverter module temperature exceeds 115 °C.	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 30.01)	An analogue control signal is below minimum allowed value. This can be caused by incorrect signal level or a failure in the control wiring.	Check for proper analogue control signal levels. Check the control wiring. Check Fault Function parameters.
AUTOCHANGE	The autochange function is being performed.	Refer to the description of parameters 42.06 and 42.07.
BACKUP USED	A PC-stored backup of drive parameters is downloaded into use.	Wait until download is completed.
CALIBRA REQ	Calibration of output current transformers required. Displayed at start if drive is in scalar control (parameter 99.04) and scalar flystart feature is on (parameter 21.08).	Calibration starts automatically. Wait for a while.
CALIBRA DONE	Calibration of output current transformers completed.	Continue normal operation.
CHOKE OTEMP (ff82)	Excessive temperature of drive output filter. Supervision is in use in step-up drives.	Stop drive. Let it cool down. Check ambient temperature. Check filter fan rotates in correct direction and air flows freely.
COMM MODULE (7510) (programmable Fault Function)	Cyclical communication between the drive and the master is lost.	Check the status of fieldbus communication. See the chapter *Fieldbus control*, or appropriate fieldbus adapter manual. Check parameter settings: - group 51 (for fieldbus adapter) - group 52 (for Standard Modbus Link) Check cable connections. Check if the bus master is not configured, or does not send/receive messages.
EARTH FAULT (2330) (programmable Fault Function 30.17)	The load on the incoming mains system is out of balance. This can be caused by a fault in the motor, motor cable, or an internal malfunction.	Check motor. Check motor cable. Check there are no power factor correction capacitors or surge absorbers in the motor cable.
ENCODER A<>B (7302)	Pulse encoder phasing is wrong: Phase A is connected to terminal of phase B and vice versa.	Interchange the connection of pulse encoder phases A and B.
ENCODER ERR (7301)	Communication fault between the pulse encoder and the pulse encoder interface module and between the module and the drive.	Check the pulse encoder and its wiring, the pulse encoder interface module and its wiring, parameter group 50 settings.

WARNING	CAUSE	WHAT TO DO
ID DONE	The drive has performed the motor identification magnetisation and is ready for operation. This warning belongs to the normal start-up procedure.	Continue drive operation.
ID MAGN	Motor identification magnetisation is on. This warning belongs to the normal start-up procedure.	Wait until the drive indicates that motor identification is completed.
ID MAGN REQ	Motor identification is required. This warning belongs to the normal start-up procedure. The drive expects the user to select how the motor identification should be performed: By Identification Magnetisation or by ID Run.	Start the Identification Magnetisation by pressing the Start key, or select the ID Run and start (see parameter 99.10).
ID N CHANGED	The ID number of the drive has been changed from 1.	Change the ID number back to 1. See the chapter *Control panel.*
ID RUN SEL	Motor Identification Run is selected, and the drive is ready to start the ID Run. This warning belongs to the ID Run procedure.	Press Start key to start the Identification Run.
INLET LOW (programmable Fault Function 44.01 … 44.06)	Pressure at pump/fan inlet too low.	Check for a closed valve on the inlet side of the pump/fan. Check piping for leaks.
MACRO CHANGE	Macro is restoring or User macro is being saved.	Wait until the drive has finished the task.
MOTOR STALL (7121) (programmable Fault Function 30.10)	The motor is operating in the stall region. This can be caused by excessive load or insufficient motor power.	Check motor load and the ratings of the drive. Check Fault Function parameters.
MOTOR STARTS	Motor Identification Run starts. This warning belongs to the ID Run procedure.	Wait until the drive indicates that motor identification is completed.
MOTOR TEMP (4310) (programmable Fault Function 30.04 … 30.09)	The motor temperature is excessive. This can be caused by 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.
OUTLET HIGH (programmable Fault Function 44.08 … 44.14)	Pressure at pump/fan outlet too high.	Check piping for blocks.
PANEL LOSS (5300) (programmable Fault Function 30.02)	A control panel selected as the active control location for the drive has ceased communicating.	Check the panel connection (see the hardware manual). Check control panel connector. Replace control panel in the mounting platform. Check Fault Function parameters.

WARNING	CAUSE	WHAT TO DO
REPLACE FAN	Running time of the inverter cooling fan has exceeded its estimated life time.	Change the fan. Reset fan run time counter 01.44.
RUN DISABLE	No Run enable signal received.	Check the setting of parameter 16.01. Switch on the signal or check the wiring of the selected source.
SHORT CIRC (2340)	Short-circuit in the motor cable(s) or motor. Output bridge of the converter unit is faulty.	Check motor and motor cable. Check there are no power factor correction capacitors or surge absorbers in the motor cable. Consult ABB representative.
SLEEP MODE	The sleep function has entered the sleeping mode.	Refer to the description of parameter group 43.
START INTERLOCK	No Start Interlock signal received.	Check the circuit connected to the Start Interlock input on the RMIO board.
SYNCRO SPEED	The value of the motor nominal speed set to parameter 99.08 is not correct: The value is too near the synchronous speed of the motor. Tolerance is 0.1%.	Check nominal speed from motor rating plate and set parameter 99.08 exactly accordingly.
THERMISTOR (4311) (programmable Fault Function 30.04 … 30.05)	The 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.
UNDERLOAD (ff6a) (programmable Fault Function 30.13)	Motor load is too low. This can be caused by a release mechanism in the driven equipment.	Check for a problem in the driven equipment. Check Fault Function parameters.

Warning messages generated by the control panel

WARNING	CAUSE	WHAT TO DO
DOWNLOADING FAILED	Download function of the panel has failed. No data has been copied from panel to drive.	Make sure the panel is in local mode. Retry (there might be interference on the link). Contact ABB representative.
DRIVE INCOMPATIBLE DOWNLOADING NOT POSSIBLE	Program versions in the panel and drive do not match. It is not possible to copy data from panel to the drive.	Check program versions (see parameter group 33 INFORMATION).
DRIVE IS RUNNING DOWNLOADING NOT POSSIBLE	Downloading is not possible while the motor is running.	Stop motor. Perform downloading.
NO COMMUNICATION (X)	Cabling problem or a hardware malfunction on the Panel Link.	Check Panel Link connections. Press RESET key. The panel reset may take up to half a minute, please wait.
	(4) = Panel type not compatible with version of the drive application program.	Check panel type and version of the drive application program. The panel type is printed on the cover of the panel. The application program version is stored in parameter 33.02.
NO FREE ID NUMBERS ID NUMBER SETTING NOT POSSIBLE	The Panel Link already includes 31 stations.	Disconnect another station from the link to free an ID number.
NOT UPLOADED DOWNLOADING NOT POSSIBLE	No upload function has been performed.	Perform the upload function before downloading. See the chapter *Control panel*.
UPLOADING FAILED	Upload function of the panel has failed. No data has been copied from the drive to the panel.	Retry (there might be interference on the link). Contact 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 a warning is displayed. Parameter lock is on.	Stop motor, then change parameter value. Open the parameter lock (see parameter 16.02).

Fault messages generated by the drive

FAULT	CAUSE	WHAT TO DO
ACS 800 TEMP (4210)	Excessive internal temperature. Trip level of inverter module temperature is 125 °C.	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 30.01)	Analogue control signal is below minimum allowed value due to incorrect signal level or failure in the control wiring.	Check for proper analogue control signal levels. Check control wiring. Check Fault Function parameters.
BACKUP ERROR	Failure when restoring PC-stored backup of drive parameters.	Retry. Check connections. Check that parameters are compatible with drive.
CTRL B TEMP (4110)	Control board temperature is lower than -5 … 0 °C or exceeds +73 … 82 °C.	Check air flow and fan operation.
BR BROKEN (7111)	Brake resistor is not connected or it is damaged. The resistance rating of the brake resistor is too high.	Check the resistor and the resistor connection. Check that the resistance rating meets the specification.
BC SHORT CIR (7113)	Short circuit in brake chopper IGBT(s).	Replace brake chopper. Ensure brake resistor is connected and not damaged.
BR WIRING (7111)	Wrong connection of brake resistor.	Check resistor connection. Ensure brake resistor is not damaged.
COMM MODULE (7510) (programmable Fault Function)	Cyclical communication with drive and master station is lost.	Check status of fieldbus communication. See the chapter *Fieldbus control*, or appropriate fieldbus adapter manual. Check parameter settings: - group 51 (for fieldbus adapter), or - group 52 (for Standard Modbus Link) Check cable connections. Check if master can communicate.
CURR MEAS (2211)	Current transformer failure in output current measurement circuit.	Check current transformer connections to Main Circuit Interface Board, INT.
DC HIGH RUSH (FF80)	Drive supply voltage is excessive. When supply voltage is over 124% of the voltage rating of the unit (415, 500 or 690 V), motor speed rushes to trip level (40% of the nominal speed).	Check supply voltage level, rated voltage of the drive and allowed voltage range of the drive.

FAULT	CAUSE	WHAT TO DO
DC OVERVOLT (3210)	Excessive intermediate circuit DC voltage. DC overvoltage trip limit is $1.3 \cdot U_{1max,}$ 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. Actual voltage in the intermediate circuit corresponding to the mains voltage trip level is 728 VDC for 400 V units and 877 VDC for 500 V units.	Check that the overvoltage controller is on (Parameter 20.05). 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 the frequency converter with a brake chopper and a brake resistor.
DC UNDERVOLT (3220)	Intermediate circuit DC voltage is not sufficient due to missing mains phase, a blown fuse or a rectifier bridge internal fault. DC undervoltage trip limit is $0.65 \cdot U_{1min,}$ where U_{1min} is the minimum value of the mains voltage range. For 400 V and 500 V units, U_{1min} is 380 V. Actual voltage in the intermediate circuit corresponding to the mains voltage trip level is 334 VDC	Check mains supply and fuses.
ENCODER A<>B (7302)	Pulse encoder phasing is wrong: Phase A is connected to terminal of phase B and vice versa.	Interchange the connection of pulse encoder phases A and B.
ENCODER ERR (7301)	Communication fault between pulse encoder and pulse encoder interface module or between module and drive.	Check pulse encoder and its wiring, module and its wiring and parameter group 50 settings.
EARTH FAULT (2330) (programmable Fault Function 30.17	Load on the incoming mains system is out of balance due to fault in the motor, motor cable or an internal malfunction.	Check motor. Check motor cable. Check there are no power factor correction capacitors or surge absorbers in the motor cable.
EXTERNAL FLT (9000) (programmable Fault Function 30.03)	Fault in one of the external devices. (This information is configured through one of the programmable digital inputs.)	Check external devices for faults. Check parameter 30.03 EXTERNAL FAULT.
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.
ID RUN FAIL	Motor ID Run is not completed successfully.	Check maximum speed (Parameter 20.02). It should be at least 80% of the nominal speed of the motor (Parameter 99.08).
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.
INLET LOW (programmable Fault Function 44.01 … 44.06)	Pressure at pump/fan inlet too low.	Check for a closed valve on the inlet side of the pump/fan. Check piping for leaks.

FAULT	CAUSE	WHAT TO DO
I/O COMM ERR (7000)	Communication error on the control board, channel CH1. Electromagnetic interference.	Check connections of fibre optic cables on channel CH1. Check all I/O modules (if present) connected to channel CH1. Check for proper earthing of the equipment. Check for highly emissive components nearby.
LINE CONV (ff51)	Fault on the 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 30.16)	One of the motor phases is lost due to fault in the 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 TEMP (4310) (programmable Fault Function 30.04 … 30.09)	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 and load. Check start-up data. Check Fault Function parameters.
MOTOR STALL (7121) (programmable Fault Function 30.10 … 30.12)	Motor is operating in the stall region due to e.g. excessive load or insufficient motor power.	Check motor load and the drive ratings. Check Fault Function parameters.
NO MOT DATA (ff52)	Motor data is not given or motor data does not match with inverter data.	Check motor data given by parameters 99.04 … 99.09.
OUTLET HIGH (programmable Fault Function 44.08 … 44.14)	Pressure at pump/fan outlet too high.	Check piping for blocks.
OVERCURRENT (2310)	Output current is excessive. Overcurrent trip limit is 1.65 … 3.5 · I_{max} depending on drive type.	Check motor load. Check acceleration time. Check motor and motor cable (including phasing). Check there are no power factor correction capacitors or surge absorbers in the motor cable. Check encoder cable (including phasing).

FAULT	CAUSE	WHAT TO DO
OVERFREQ (7123)	Motor is turning faster than the highest allowed speed due to incorrectly set minimum/ maximum speed, insufficient braking torque or changes in the load when using torque reference. Trip level is 40 Hz over the operating range absolute maximum speed limit (Direct Torque Control mode active) or frequency limit (Scalar Control active). The operating range limits are set by parameters 20.01 and 20.02 (DTC mode active) or 20.07 and 20.08 (Scalar Control active).	Check minimum/maximum speed settings. Check adequacy of motor braking torque. Check applicability of torque control. Check need for a brake chopper and resistor(s).
PANEL LOSS (5300) (programmable Fault Function 30.02)	A control panel or Drive*Window* selected as active control location for the drive has ceased communicating.	Check panel connection (see appropriate hardware manual). Check control panel connector. Replace control panel in the mounting platform. Check Fault Function parameters. Check DrivesWindow connection.
PPCC LINK (5210)	Fibre optic link to the INT board is faulty.	Check fibre optic cables.
SC (INU 1) SC (INU 2) SC (INU 3) SC (INU 4)	Short circuit in inverter unit of several parallel inverter modules. The number refers to the faulty inverter module number. INT board fibre optic connection fault in inverter unit consisting of several parallel inverter modules. The number refers to the inverter module number.	Check motor and motor cable. Check power semiconductors (IGBT power plates) of inverter module. (INU 1 stands for inverter module 1 etc.). Check connection from inverter module Main Circuit Interface Board, INT to PPCC Branching Unit, PBU. (Inverter module 1 is connected to PBU CH1 etc.)
SLOT OVERLAP	Two option modules have the same connection interface selection.	Check connection interface selections in group *98 OPTION MODULES*.
START INHIBIT (ff7a)	Optional start inhibit hardware logic is activated.	Check start inhibit circuit (GPS board).
SUPPLY PHASE (3130)	Intermediate circuit DC voltage is oscillating due to missing mains phase, a blown fuse or a rectifier bridge internal fault. A trip occurs when the DC voltage ripple is 13 per cent of the DC voltage.	Check mains fuses. Check for mains supply imbalance.
THERMISTOR (4311) (programmable Fault Function 30.04 … 30.05)	Excessive motor temperature (detected by the motor thermal protection function, which has selection THERMISTOR active) .	Check motor ratings and load. Check start-up data. Check thermistor connections. Check thermistor cabling.

FAULT	CAUSE	WHAT TO DO
UNDERLOAD (ff6a) (programmable Fault Function 30.13 … 30.15)	Motor load is too low due to e.g. release mechanism in the driven equipment.	Check for a problem in the driven equipment. Check Fault Function parameters.
USER MACRO	No User Macro saved or the file is defective.	Create User Macro.
THERMAL MODE	Motor thermal protection mode is set to DTC for a high-power motor.	See parameter 30.05.

PFC Application Example

Overview

In this appendix, a two-pump PFC application is briefly presented by means of circuit diagrams:

- main circuit diagram (sheet 1)
- control circuit diagram (sheet 2)
- connection diagram (sheet 3).

The pumps are used for pressure boosting. Alternation and a sleep function are used. The application also includes the following additional features:

- Manual control switches for selection between conventional PFC control and direct-on-line connection of the motors (S1, S2). The switches are of the three-position type:
  A = PFC control in use.
  0 = Motor is off.
  V = PFC control is by-passed and motor is connected direct-on-line.
- Cooling air fan for the alternation switchgear cabinet which includes the ACS 600 and the contactor logic (fan motor = M10)
- Indicator lamps (H1, H2)
- Operating hour counters (P1, P2)

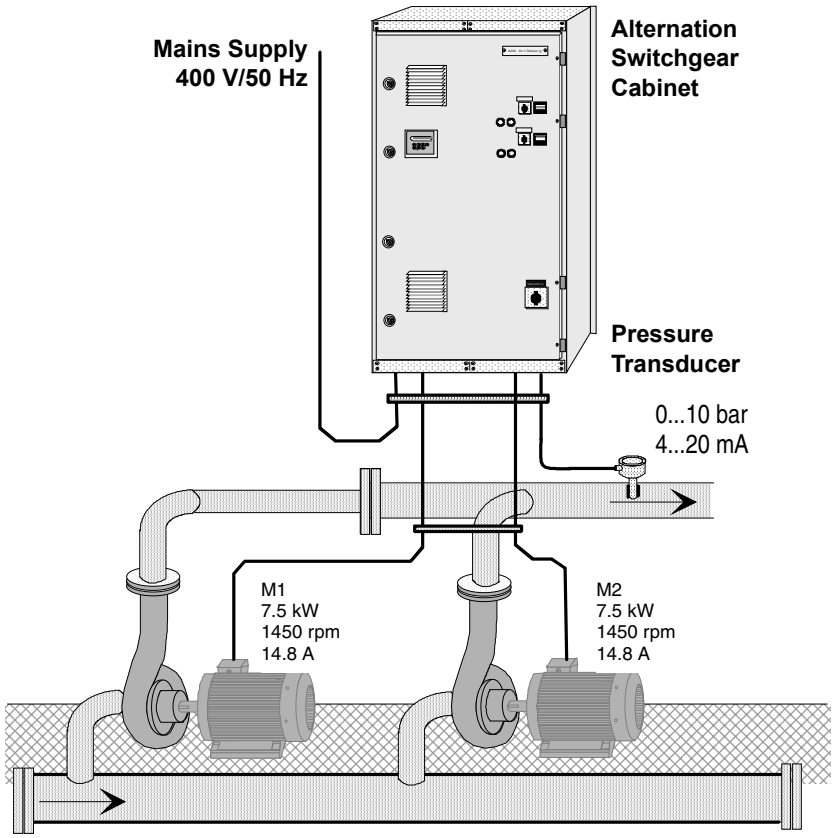
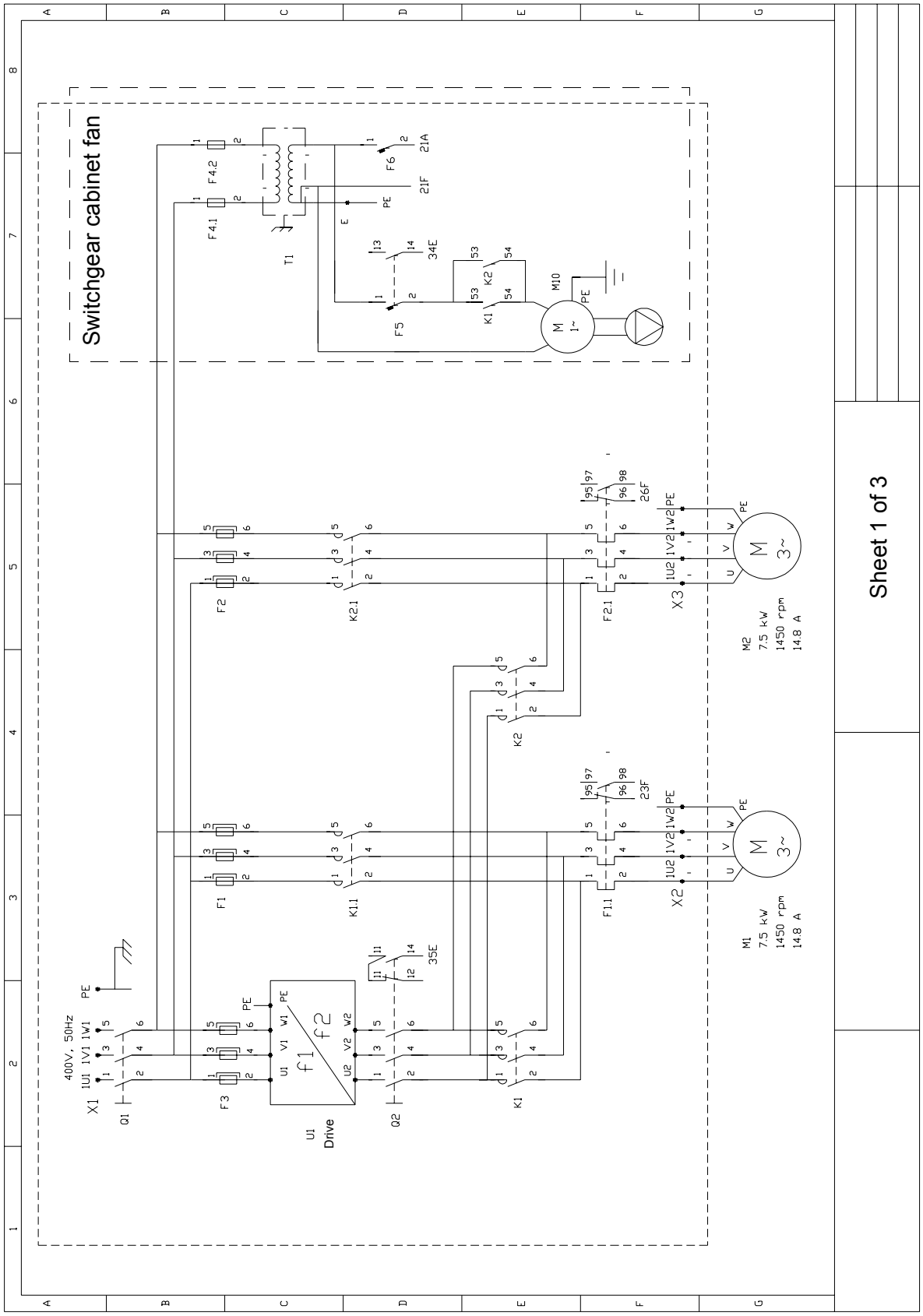
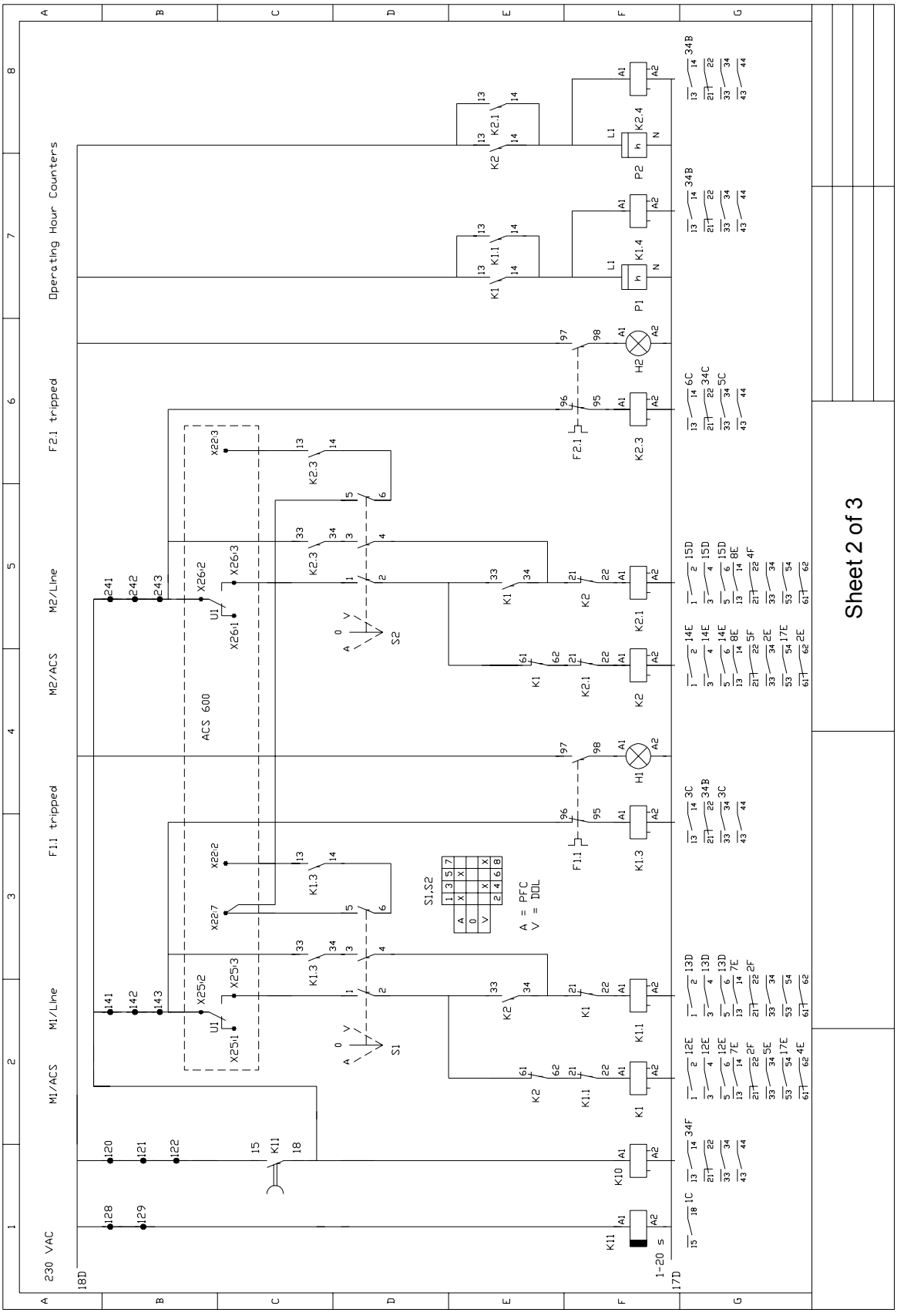
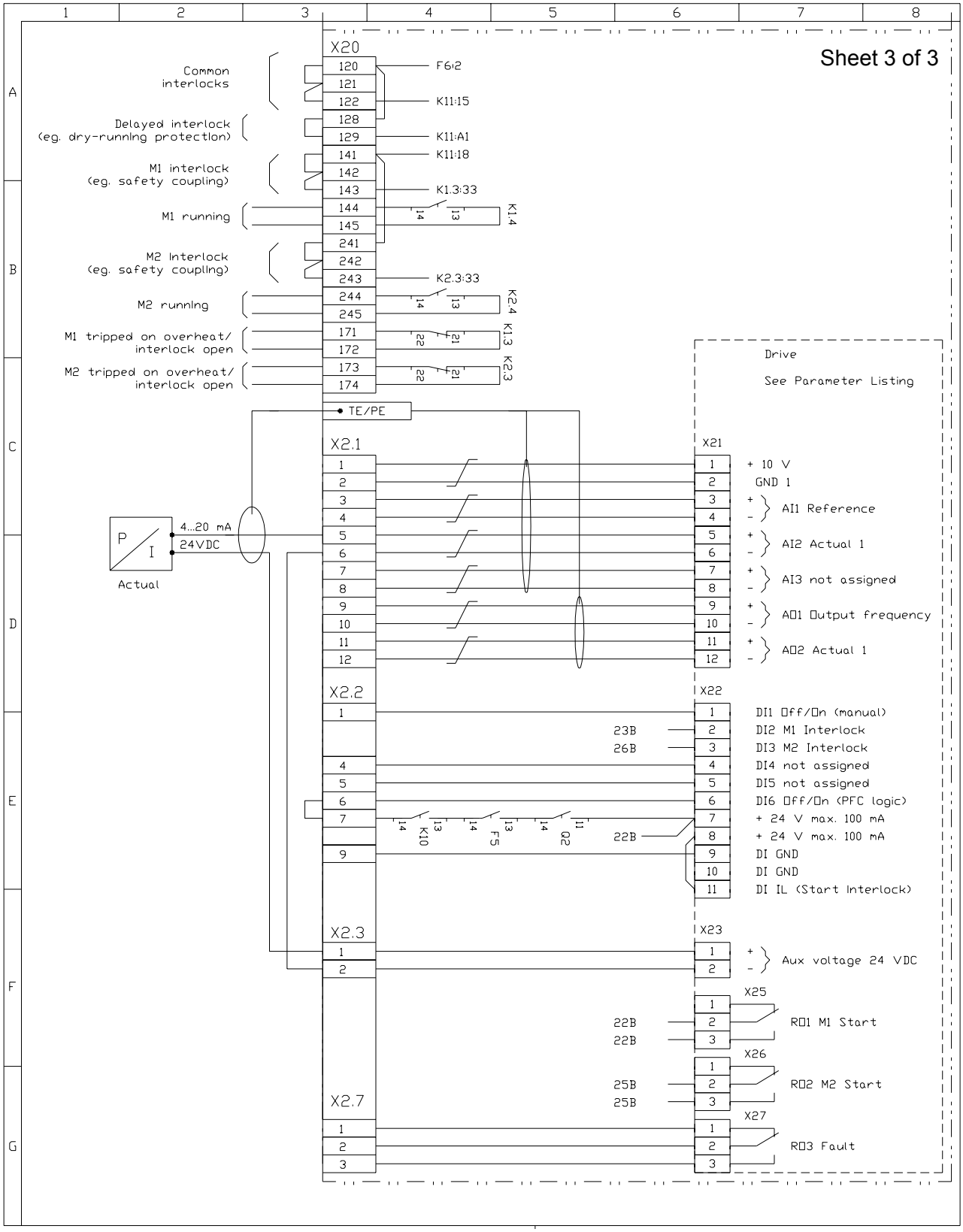


Figure 1 Pumping station, general view. The drive is installed inside the alternation switchgear cabinet.


Switchgear cabinet fan
Sheet 1 of 3
400V, 50Hz
PE
X1
Q1
F3
U1
Drive
Q2
K1
F1
K11
F11
X2
M1
7.5 kW
1450 rpm
14.8 A
F2
K2.1
F2.1
X3
M2
7.5 kW
1450 rpm
14.8 A
K2
F4.2
F4.1
T1
F6
21A
21F
34E
F5
K1
K2
M10
35E
23F
26F


Sheet 2 of 3
230 VAC
M1/ACS
M1/Line
F1.1 tripped
M2/ACS
M2/Line
F2.1 tripped
Operating Hour Counters
ACS 600
S1,S2
A = PFC
V = DOL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X20
Common interlocks
120
121
122
F6:2
K11:15
Delayed interlock (eg. dry-running protection)
128
129
K11:A1
M1 interlock (eg. safety coupling)
141
142
143
K11:18
K1.3:33
M1 running
144
145
K1.4
M2 interlock (eg. safety coupling)
241
242
243
K2.3:33
M2 running
244
245
K2.4
M1 tripped on overheat/ interlock open
171
172
K1.3
M2 tripped on overheat/ interlock open
173
174
K2.3
TE/PE
X2.1
X2.2
X2.3
X2.7
4...20 mA
24VDC
P
I
Actual
Drive
See Parameter Listing
X21
+ 10 V
GND 1
AI1 Reference
AI2 Actual 1
AI3 not assigned
AO1 Output frequency
AO2 Actual 1
X22
DI1 Off/On (manual)
DI2 M1 Interlock
DI3 M2 Interlock
DI4 not assigned
DI5 not assigned
DI6 Off/On (PFC logic)
+ 24 V max. 100 mA
+ 24 V max. 100 mA
DI GND
DI GND
DI IL (Start Interlock)
23B
26B
22B
K10
F5
Q2
X23
Aux voltage 24 VDC
X25
RO1 M1 Start
22B
22B
X26
RO2 M2 Start
25B
25B
X27
RO3 Fault

Fieldbus control

Chapter overview

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. (For connection to an Advant Fieldbus 100 system, an external AF 100 interface is used.)

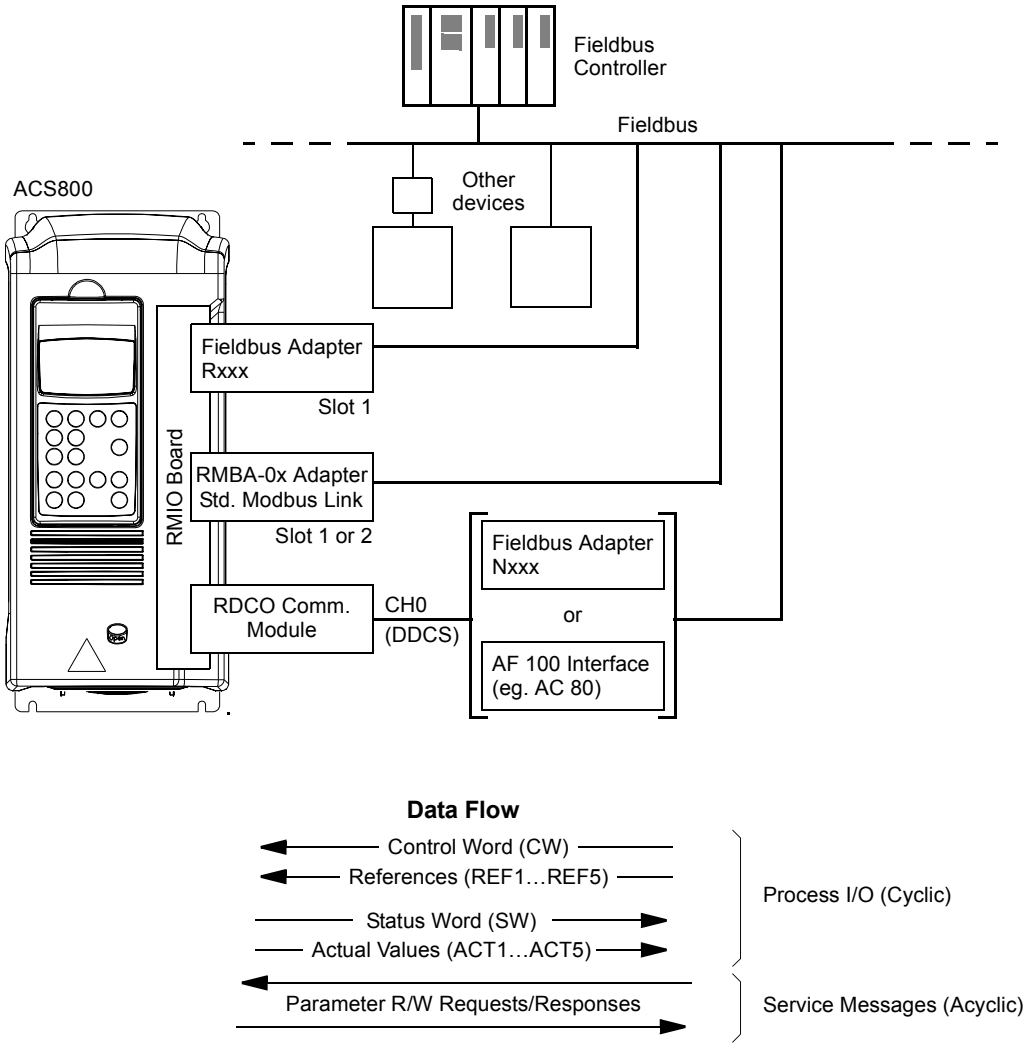


Figure 2 Fieldbus control.

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

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 98.02. After the communication is initialised, the configuration parameters of the module become available in the drive at parameter group 51.

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

Parameter	Alternative settings	Setting for fieldbus control	Function/Information
COMMUNICATION INITIALISATION			
98.02 COMM. MODULE LINK	NO; FIELDBUS; ADVANT; STD MODBUS; CUSTOMISED	FIELDBUS	Initialises communication between drive and fieldbus adapter module. Activates module set-up parameters (Group 51).
98.07 COMM PROFILE	ABB DRIVES; CSA 2.8/3.0	ABB DRIVES	Selects the communication profile used by the drive. See 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)			

After the parameters in group 51 have been set, the drive control parameters (shown in Table 4) must be checked and adjusted where necessary.

The new settings will take effect when the drive is next powered up.

Control 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.

Communication set-up

The communication through the Standard Modbus Link is initialised by setting parameter 98.02 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			
98.02 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.
98.07 COMM PROFILE	ABB DRIVES; CSA 2.8/3.0	ABB DRIVES	Selects the communication profile used by the drive. See section *Communication Profiles* below.
COMMUNICATION PARAMETERS			
52.01 STATION NUMBER	1 to 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	ODD; EVEN; NONE1STOPBIT; NONE2STOPBIT	–	Parity setting for the Standard Modbus Link.

After the parameters in group 52 have been set, the drive control parameters (shown in Table 4) 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:

- **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 communicate with 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 98.02 to ADVANT.

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

Parameter	Alternative Settings	Setting for Control through CH0	Function/Information
COMMUNICATION INITIALISATION			
98.02 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.
98.07 COMM PROFILE	ABB DRIVES; CSA 2.8/3.0	ABB DRIVES	Selects the communication profile used by the drive. See 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 (shown in Table 4) checked and adjusted where necessary.

In an Optical ModuleBus connection, the channel 0 address (parameter 70.01) 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 70.01) 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 Table 4 below 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***.

Table 4 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 STRT/STP/DIR	COMM. MODULE	Enables the fieldbus Control Word (except bit 11) when EXT1 is selected as the active control location.
10.02 EXT2 STRT/STP/DIR	COMM. MODULE	Enables the fieldbus Control Word (except bit 11) when EXT2 is selected as the active control location.
10.03 DIRECTION	FORWARD, REVERSE or REQUEST	Enables rotation direction control as defined by parameters 10.01 and 10.02.
11.02 EXT1/EXT2 SELECT	COMM. MODULE	Enables EXT1/EXT2 selection by fieldbus Control Word bit 11 EXT CTRL LOC.
11.03 EXT REF1 SELECT	COMM. MODULE	Fieldbus reference REF1 is used when EXT1 is selected as the active control location. See section *References* below for information on the alternative settings.
11.06 EXT REF2 SELECT	COMM. MODULE	Fieldbus reference REF2 is used when EXT2 is selected as the active control location. See section *References* below for information on the alternative settings.
OUTPUT SIGNAL SOURCE SELECTION		
14.01 RELAY RO1 OUTPUT	COMM. MODULE	Enables Relay output RO1 control by fieldbus reference REF3 bit 13.
14.02 RELAY RO2 OUTPUT	COMM. MODULE	Enables Relay output RO2 control by fieldbus reference REF3 bit 14.
14.03 RELAY RO3 OUTPUT	COMM. MODULE	Enables Relay output RO3 control by fieldbus reference REF3 bit 15.
15.01 ANALOGUE OUTPUT1	COMM. MODULE	Directs the contents of fieldbus reference REF4 to Analogue output AO1. **Scaling**: 20000 = 20 mA
15.06 ANALOGUE OUTPUT2	COMM. MODULE	Directs the contents of fieldbus reference REF5 to Analogue output AO2. **Scaling:** 20000 = 20 mA.

Parameter	Setting for fieldbus control	Function/Information
SYSTEM CONTROL INPUTS		
16.01 RUN ENABLE	COMM. MODULE	Enables the control of the Run Enable signal through fieldbus Control Word bit 3.
16.04 FAULT RESET SEL	COMM. MODULE	Enables fault reset through fieldbus Control Word bit 7.
16.07 PARAMETER SAVE	DONE; SAVE	Saves parameter value changes (including those made through fieldbus control) to permanent memory.
COMMUNICATION FAULT FUNCTIONS		
30.19 COMM FLT FUNC	FAULT; NO; PRESET FREQ; LAST FREQ	Determines drive action in case fieldbus communication is lost. **Note:** The communication loss detection is based on monitoring of received Main and Auxiliary data sets (whose sources are selected with parameters 90.04 and 90.05 respectively).
30.20 MAIN REF DS T-OUT	0.10 … 60.00 s	Defines the time between Main Reference data set loss detection and the action selected with parameter 30.19.
30.21 COMM FLT RO/AO	ZERO; LAST VALUE	Determines the state in which Relay outputs RO1 to RO3 and Analogue outputs AO1 and AO2 are left upon loss of the Auxiliary Reference data set.
30.22 AUX REF DS T-OUT	0.00 … 60.00 s	Defines the time between Auxiliary Reference data set loss detection and the action selected with parameter 30.19. **Note:** This supervision function is disabled if this parameter, or parameters 90.01, 90.02 and 90.03 are set to 0.
FIELDBUS REFERENCE TARGET SELECTION (Not visible when 98.02 is set to NO.)		
90.01 AUX DS REF3	0 … 8999	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 … 8999	Defines the drive parameter into which the value of fieldbus reference REF4 is written. **Format:** see parameter 90.01.
90.03 AUX DS REF5	0 … 8999	Defines the drive parameter into which the value of fieldbus reference REF5 is written. **Format:** see parameter 90.01.
90.04 MAIN DS SOURCE	1 (Fieldbus Control) or 81 (Standard Modbus Control)	If 98.02 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).

Parameter	Setting for fieldbus control	Function/Information
90.05 AUX DS SOURCE	3 (Fieldbus Control) or 83 (Standard Modbus Control)	If 98.02 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 (Not visible when 98.02 is set to NO.)		
92.01 MAIN DS STATUS WORD	302 (Fixed)	The Status Word is transmitted to as the first word of the Main Actual Signal data set.
92.02 MAIN DS ACT1	0 … 9999	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. **103** = actual signal 01.03 FREQUENCY; **2202** = parameter 22.02 ACCEL TIME 1.
92.03 MAIN DS ACT2	0 … 9999	Selects the Actual signal or parameter value to be transmitted as the third word (ACT2) of the Main Actual Signal data set. **Format:** see parameter 92.02.
92.04 AUX DS ACT3	0 … 9999	Selects the Actual signal or parameter value to be transmitted as the first word (ACT3) of the Auxiliary Actual Signal data set. **Format:** see parameter 92.02.
92.05 AUX DS ACT4	0 … 9999	Selects the Actual signal or parameter value to be transmitted as the second word (ACT4) of the Auxiliary Actual Signal data set. **Format:** see parameter 92.02.
92.06 AUX DS ACT5	0 … 9999	Selects the Actual signal or parameter value to be transmitted as the third word (ACT5) of the Auxiliary Actual Signal data set. **Format:** see parameter 92.02.

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 Standard 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 and 90.05 respectively. The contents of the Main Reference data set are fixed. The contents of the Auxiliary Reference data set can be selected using parameters 90.01, 90.02 and 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.

Data from fieldbus controller to drive		
Word	**Contents**	**Selector**
Main Reference data set		
1st word	Control Word	(Fixed)
2nd word	Reference 1	(Fixed)
3rd word	Reference 2	(Fixed)
Auxiliary Reference data set		
1st word	Reference 3	Par. 90.01
2nd word	Reference 4	Par. 90.02
3rd word	Reference 5	Par. 90.03

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

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 and 10.02) is set to COMM. MODULE.

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 text under *Communication profiles* below for information on the composition of the Control Word and the Status Word.

References

References (REF) 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.

Fieldbus reference selection

Fieldbus reference (sometimes called COM.REF in signal selection contexts) is selected by setting a Reference selection parameter – 11.03 or 11.06 – to COMM. MODULE.

The fieldbus reference is read every 6 milliseconds by the drive.

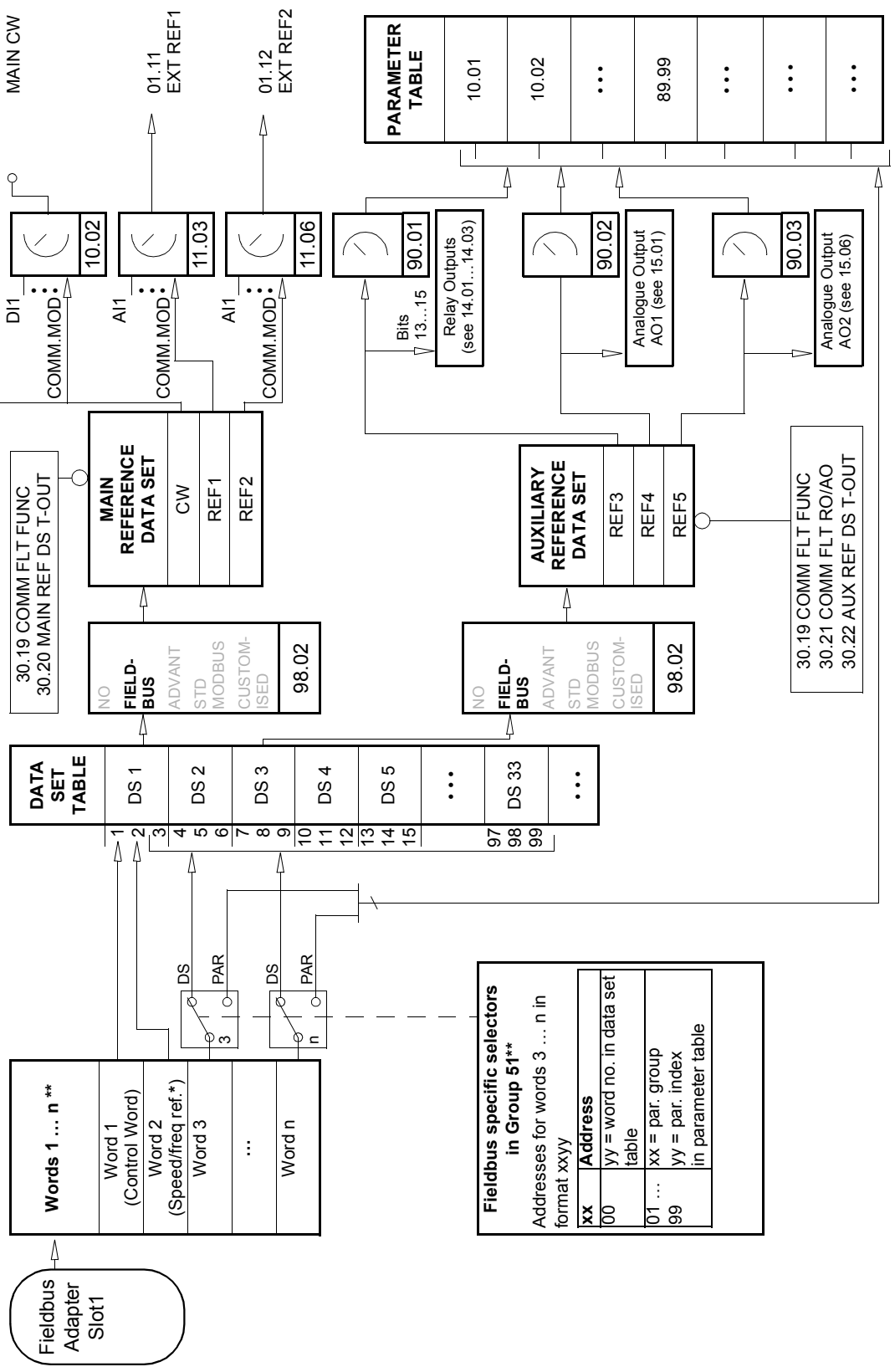
Fieldbus reference scaling

Refer-ence	Application Macro Used	Reference Type	Range	Scaling	Notes
REF1	(any)	Frequency	-32765 … 32765	-20000 = **-[Par. 11.05]** 0 = 0 20000 = **[Par. 11.05]**	Not limited by Pars. 11.04/11.05. (Final reference limited by 20.01/20.02.)
REF2	PFC	Controller Reference	-32765 … 32765	-10000 = **-[Par. 11.08]** 0 = 0 10000 = **[Par. 11.08]**	
	HAND/AUTO	Frequency	-32765 … 32765	-20000 = **-[Par. 11.05]** 0 = 0 20000 = **[Par. 11.05]**	Not limited by Pars. 11.07/11.08. (Final reference limited by 20.01/20.02.)

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. The scaling of the integers sent to the master as Actual Values depends on the selected function; please refer to the chapter *Actual signals and parameters*.

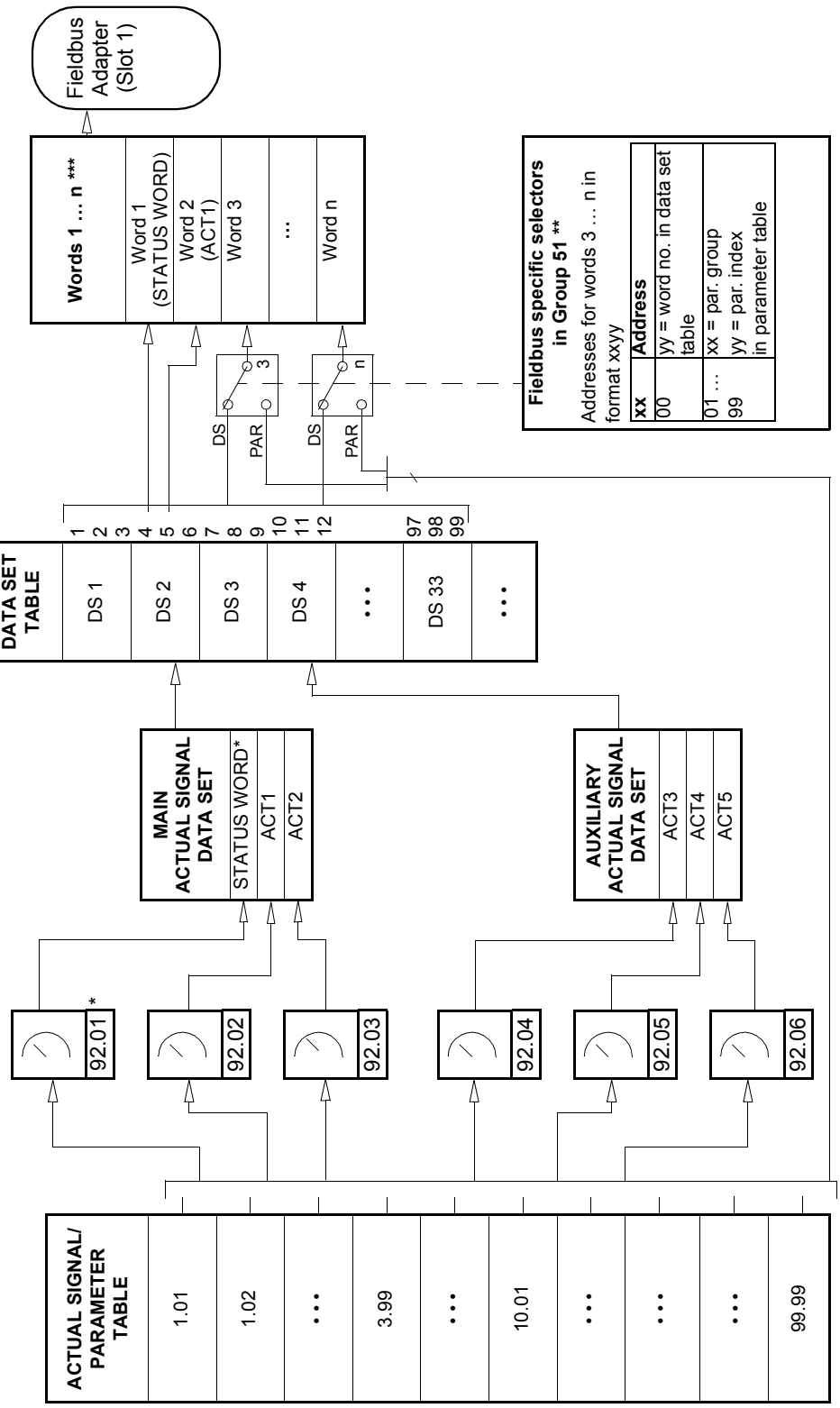
Block diagram: Control data input from fieldbus (for type Rxxx fieldbus adapters)



* Depends on the selected motor control mode (parameter 99.04).

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

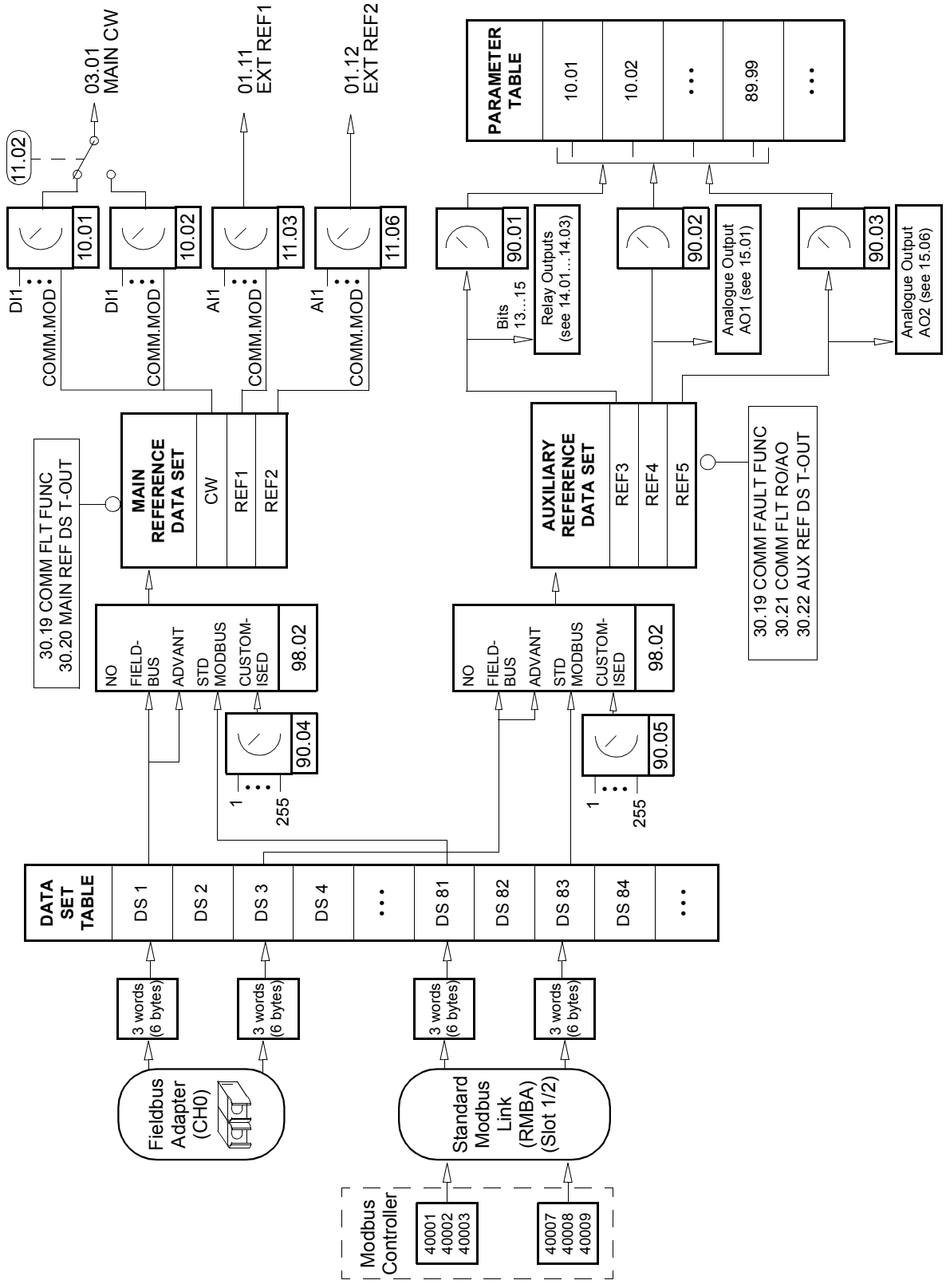
Block diagram: Actual value selection for fieldbus (for type Rxxx fieldbus adapters)



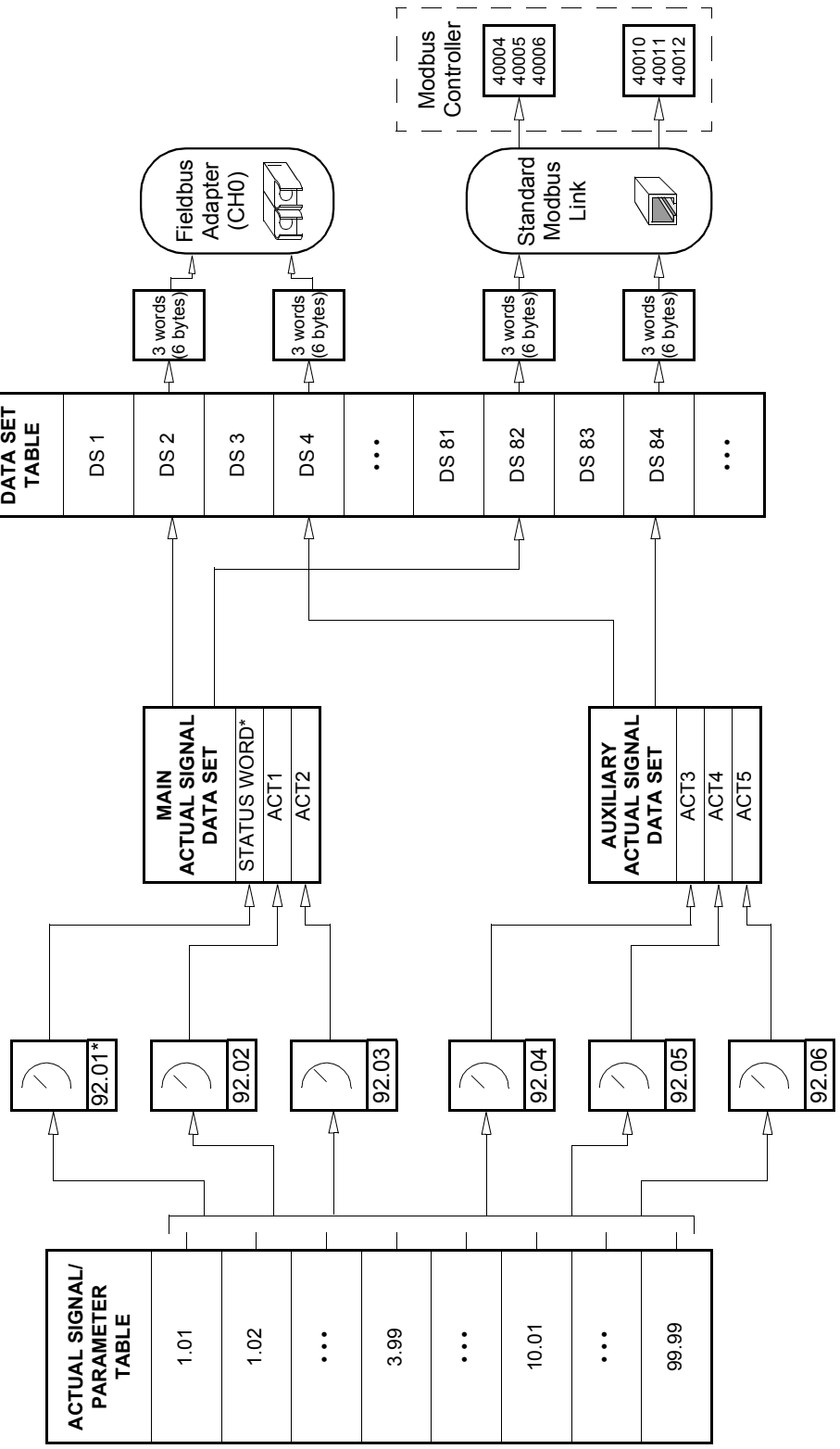
* Fixed to 03.02 MAIN STATUS WORD.

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

Block diagram: Control data input from fieldbus (for type Nxxx fieldbus adapters)



Block diagram: Actual value selection for fieldbus (for type Nxxx fieldbus adapters)



* Fixed to 03.02 MAIN STATUS WORD.

Communication profiles

The PFC Application Program supports two communication profiles:

- ABB Drives communication profile (default)
- CSA 2.8/3.0 communication profile.

The ABB Drives communication profile derives from the PROFIBUS control interface and provides a variety of control and diagnostic functions.

The CSA 2.8/3.0 communication profile can be selected for backward compatibility with PFC Application Program versions 2.8 and 3.0. This eliminates the need for reprogramming the PLC when drives with the above-mentioned program versions are replaced.

The Control Word and Status Word for the CSA 2.8/3.0 communication profile are detailed below.

Note: The communication profile selector parameter (98.05) affects both optical CH0 and the Standard Modbus channels.

ABB Drives communication profile

The ABB Drives communication profile is active when parameter 98.07 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 or 10.02 (whichever control location is active) is set to COMM. MODULE.

Table 5 The Control Word (Actual Signal 3.01) for the ABB Drives communication profile. The upper case boldface text refers to the states shown in Figure 3.

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 16.01. If par. 16.01 is set to COMM. MODULE, this bit also activates the Run Enable signal.)
		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.**
		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 par. 11.02 is set to COMM. MODULE.
		0	Select External Control Location EXT1. Effective if par. 11.02 is set to COMM. MODULE.
12 … 15	Reserved		

Table 6 The Status Word (Actual Signal 3.02) for the ABB Drives communication profile. The upper case boldface text refers to the states shown in Figure 3.

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 frequency or speed value equals or is greater than supervision limit (par. 32.02). Valid in both rotation directions regardless of value of par. 32.02.
		0	Actual frequency or speed value is within supervision limit.
11	EXT CTRL LOC	1	External Control Location EXT2 selected.
		0	External Control Location EXT1 selected.
12	RUN ENABLE	1	Run Enable signal received.
		0	No Run Enable received.
13, 14	Reserved		
15		1	Communication error detected by fieldbus adapter module (on fibre optic channel CH0).
		0	Fieldbus adapter (CH0) communication OK.

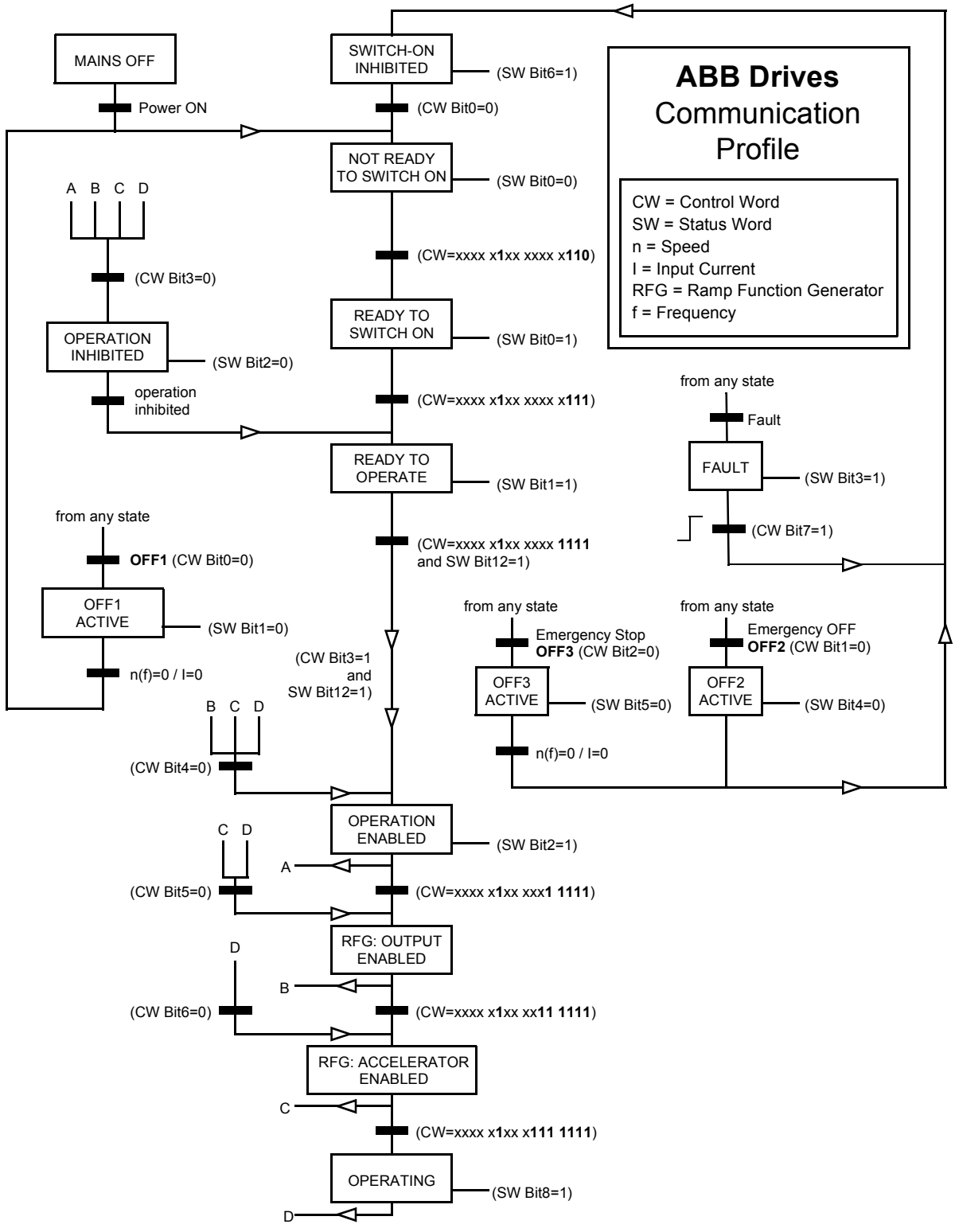


Figure 3 State Machine for the ABB Drives communication profile.

CSA 2.8/3.0 communication profile

The CSA 2.8/3.0 communication profile is active when parameter 98.07 is set to CSA 2.8/3.0. The Control Word and Status Word for the profile are described below.

Table 7 Control Word for the CSA 2.8/3.0 communication profile.

Bit	Name	Value	Description
0	Reserved		
1	ENABLE	1	Enabled
		0	Coast to stop
2	Reserved		
3	START/STOP	0 ⇒ 1	Start
		0	Stop according to parameter 21.03 STOP FUNCTION
4	Reserved		
5	CNTRL_MODE	1	Select control mode 2
		0	Select control mode 1
6	Reserved		
7	Reserved		
8	RESET_FAULT	0 ⇒ 1	Reset drive fault
9 … 15	Reserved		

Table 8 Status Word for the CSA 2.8/3.0 communication profile.

Bit	Name	Value	Description
0	READY	1	Ready to start
		0	Initialising, or initialising error
1	ENABLE	1	Enabled
		0	Coast to stop
2	Reserved		
3	RUNNING	1	Running with selected reference
		0	Stopped
4	Reserved		
5	REMOTE	1	Drive in Remote mode
		0	Drive in Local mode
6	Reserved		
7	AT_SETPOINT	1	Drive at reference
		0	Drive not at reference
8	FAULTED	1	A fault is active
		0	No active faults
9	WARNING	1	A warning is active
		0	No active warnings
10	LIMIT	1	Drive at a limit
		0	Drive at no limit
11 … 15	Reserved		

Diverse status, fault, alarm and limit words

Table 9 The Auxiliary Status Word (Actual Signal 3.03).

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 synchronised.
6	1 START NOT DONE	Drive has not been started after changing the motor parameters in group 99.
7	IDENTIF RUN DONE	Motor ID Run successfully completed.
8	START INHIBITION	Prevention of unexpected start-up active.
9	LIMITING	Control at a limit. See actual signal 3.04 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 followed.
13	M/F COMM ERR	Master/Follower link (on CH2) communication error*.
14 … 15	Reserved	

*See *Master/Follower Application Guide* (3AFY 58962180 [English]).

Table 10 Limit Word 1 (Actual Signal 3.04).

Bit	Name	Active Limit
0	TORQ MOTOR LIM	Pull-out limit.
1	SPD_TOR_MIN_LIM	Speed control torque min. limit.
2	SPD_TOR_MAX_LIM	Speed control torque max. limit.
3	TORQ_USER_CUR_LIM	User-defined current limit.
4	TORQ_INV_CUR_LIM	Internal current limit.
5	TORQ_MIN_LIM	Any torque min. limit.
6	TORQ_MAX_LIM	Any torque max. limit.
7	TREF_TORQ_MIN_LIM	Torque reference min. limit.
8	TREF_TORQ_MAX_LIM	Torque reference max. limit.
9	FLUX_MIN_LIM	Flux reference min. limit.
10	FREQ_MIN_LIMIT	Speed/Frequency min. limit.
11	FREQ_MAX_LIMIT	Speed/Frequency max. 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.

Table 11 Fault Word 1 (Actual Signal 3.05).

Bit	Name	Description
0	SHORT CIRC	For the possible causes and remedies, see the 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 System Fault Word (Actual Signal 3.07).
8	UNDERLOAD	For the possible causes and remedies, see the chapter *Fault tracing*.
9	OVERFREQ	
10 … 15	Reserved	

Table 12 Fault Word 2 (Actual Signal 3.06).

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

Table 13 The System Fault Word (Actual Signal 3.07).

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	

Table 14 Alarm Word 1 (Actual Signal 3.08).

Bit	Name	Description
0	START INHIBIT	For the possible causes and remedies, see the chapter *Fault tracing.*
1	START INTERLOCK	Start interlock signal is on (starting possible).
2	Reserved	
3	THERMISTOR	For the possible causes and remedies, see the chapter *Fault tracing.*
4	ACS 800 TEMP	
5	ENCODER ERR	
6	T MEAS ALM	
7 … 11	Reserved	
12	COMM MODULE	For the possible causes and remedies, see the chapter *Fault tracing.*
13	Reserved	
14	EARTH FAULT	For the possible causes and remedies, see the chapter *Fault tracing.*
15	Reserved	

Table 15 Alarm Word 2 (Actual Signal 3.09).

Bit	Name	Description
0	Reserved	
1	UNDERLOAD (ff6A)	For the possible causes and remedies, see the chapter *Fault tracing.*
2, 3	Reserved	
4	ENCODER	For the possible causes and remedies, see the chapter *Fault tracing.*
5, 6	Reserved	
7	POWFAIL FILE	Error in restoring POWERFAIL.DDF.
8	ALM (OS_17)	Error in restoring POWERDOWN.DDF.
9	MOTOR STALL (7121)	For the possible causes and remedies, see the chapter *Fault tracing.*
10	AI < MIN FUNC (8110)	
11, 12	Reserved	
13	PANEL LOSS (5300)	For the possible causes and remedies, see the chapter *Fault tracing.*
14, 15	Reserved	

Table 16 Alarm Word 3 (Actual Signal 3.10).

Bit	Name	Description
0	REPLACE FAN	For the possible causes and remedies, see the chapter *Fault tracing.*
1	SYNCRO SPEED	
2	BR OVERHEAT	
3	Reserved	
4	IN CHOKE TEMP	For the possible causes and remedies, see the chapter *Fault tracing*.
5 … 15	Reserved	

Additional data: actual signals and parameters

Chapter overview

This chapter lists the actual signal and parameter lists with some additional data. For the descriptions, see chapter *Actual signals and parameters*.

Terms and abbreviations

Term	Definition
PB	Parameter address for the fieldbus communication through a PROFIBUS-DP adapter (RPBA).
FbEq	Fieldbus equivalent: The scaling between the value shown on the panel and the integer used in serial communication.
Absolute Maximum Frequency	Value of 20.02, or 20.01 if the absolute value of the minimum limit is greater than the maximum limit.

Fieldbus addresses

PROFIBUS

See the tables below.

Modbus and Modbus Plus address

4xxyy, where xxyy = drive parameter number

InterBus-S address

xxyy × 100 + 12288 converted into hexadecimal
xxyy = drive parameter number

Example: The index for drive parameter 13.09 is 1309 + 12288 = 13597 = 351D.

Actual signals

Index	Name	Short name	FbEq	Unit	Range	PB
01	ACTUAL SIGNALS					
01.02	SPEED	SPEED	-2000 = -100% 2000 = 100% of motor absolute max. speed	rpm		2
01.03	FREQUENCY	FREQ	-100 = -1 Hz 100 = 1 Hz	Hz		3
01.04	CURRENT	CURRENT	10 = 1 A	A		4
01.05	TORQUE	TORQUE	-10000 = -100% 10000 = 100% of motor nominal torque	%		5
01.06	POWER	POWER	0 = 0% 1000 = 100% of motor nominal power	%		6
01.07	DC BUS VOLTAGE V	DC BUS V	1 = 1 V	V		7
01.08	MAINS VOLTAGE	MAINS V	1 = 1 V	V		8
01.09	OUTPUT VOLTAGE	OUT VOLT	1 = 1 V	V		9
01.10	ACS 800 TEMP	ACS TEMP	1 = 1 °C	C		10
01.11	EXTERNAL REF 1	EXT REF1	1 = 1 rpm	rpm		11
01.12	EXTERNAL REF 2	EXT REF2	0 = 0% 10000 = 100% *(Note 1)*	%		12
01.13	CTRL LOCATION	CTRL LOC	(1,2) LOCAL; (3) EXT1; (4) EXT2		LOCAL; EXT1; EXT2	13
01.14	OP HOUR COUNTER	OP HOURS	1 = 1 h	h		14
01.15	KILOWATT HOURS	KW HOURS	1 = 100 kWh	kWh		15
01.16	APPL BLOCK OUTPUT	APPL OUT	0 = 0% 10000 = 100%	%		16
01.17	DI6-1 STATUS	DI6-1				17
01.18	AI1 [V]	AI1 [V]	1 = 0.001 V	V		18
01.19	AI2 [mA]	AI2 [mA]	1 = 0.001 mA	mA		19
01.20	AI3 [mA]	AI3 [mA]	1 = 0.001 mA	mA		20
01.21	RO3-1 STATUS	RO3-1				21
01.22	AO1 [mA]	AO1 [mA]	1 = 0.001 mA	mA		22
01.23	AO2 [mA]	AO2 [mA]	1 = 0.001 mA	mA		23
01.24	ACTUAL VALUE 1	ACT VAL1	0 = 0% 10000 = 100%	%		24
01.25	ACTUAL VALUE 2	ACT VAL2	0 = 0% 10000 = 100%	%		25
01.26	CONTROL DEVIATION	CONT DEV	-10000 = -100% 10000 = 100%	%		26
01.27	ACTUAL FUNC OUT	ACTUAL F				27
01.28	EXT AO1 [mA]	EXT AO1	1 = 0.001 mA	mA		28
01.29	EXT AO2 [mA]	EXT AO2	1 = 0.001 mA	mA		29
01.30	PP 1 TEMP	PP 1 TEM	1 = 1 °C	°C		30
01.31	PP 2 TEMP	PP 2 TEM	1 = 1 °C	°C		31
01.32	PP 3 TEMP	PP 3 TEM	1 = 1 °C	°C		32
01.33	PP 4 TEMP	PP 4 TEM	1 = 1 °C	°C		33
01.37	MOTOR TEMP EST	MOTOR TE	1 = 1 °C	°C		37
01.38	AI5 [mA]	AI5 [mA]	1 = 0.001 mA	mA		38
01.39	AI6 [mA]	AI6 [mA]	1 = 0.001 mA	mA		39
01.40	DI7-12 STATUS	DI7..12	1 = 1			40
01.41	EXT RO STATUS	EXT RO	1 = 1			41
01.42	PFC OPERATION TIME	PFC OP T	1 = 1	h		42
01.43	MOTOR RUN TIME	M RUNTME	1 = 10 h	h		43
01.44	FAN ON-TIME	FAN TIME	1 = 10 h	h		44

Index	Name	Short name	FbEq	Unit	Range	PB
01.45	CTRL BOARD TEMP	CTRL B T	1 = 1 °C	°C		45
02	ACTUAL SIGNALS					
02.01	SPEED REF 2	S REF 2	0 = 0%	rpm		51
02.02	SPEED REF 3	S REF 3	20000 = 100% of motor absolute max. frequency	rpm		52
02.09	TORQ REF 2	T REF 2	0 = 0%	%		59
02.10	TORQ REF 3	T REF 3	10000 = 100% of	%		60
02.13	TORQ USED REF	T USED R	motor nominal torque	%		63
02.17	SPEED ESTIMATED	SPEED ES	0 = 0% 20000 = 100% of motor absolute max. frequency	rpm		67
03	ACTUAL SIGNALS					
03.01	MAIN CTRL WORD	MAIN CW	*(Note 2)*		0 ... 65535 (Decimal)	76
03.02	MAIN STATUS WORD	MAIN SW	*(Note 2)*		0 ... 65535 (Decimal)	77
03.03	AUX STATUS WORD	AUX SW	*(Note 2)*		0 ... 65535 (Decimal)	78
03.04	LIMIT WORD 1	LIMIT W1	*(Note 2)*		0 ... 65535 (Decimal)	79
03.05	FAULT WORD 1	FAULT W1	*(Note 2)*		0 ... 65535 (Decimal)	80
03.06	FAULT WORD 2	FAULT W2	*(Note 2)*		0 ... 65535 (Decimal)	81
03.07	SYSTEM FAULT	SYS FLT	*(Note 2)*		0 ... 65535 (Decimal)	82
03.08	ALARM WORD 1	ALARM W1	*(Note 2)*		0 ... 65535 (Decimal)	83
03.09	ALARM WORD 2	ALARM W2	*(Note 2)*		0 ... 65535 (Decimal)	84
03.10	ALARM WORD 3	ALARM W3	*(Note 2)*		0 ... 65535 (Decimal)	85
03.20	LATEST FAULT	LAST FLT			0 ... 65535 (Decimal)	94
03.21	2.LATEST FAULT	2.FAULT			0 ... 65535 (Decimal)	95
03.22	3.LATEST FAULT	3.FAULT			0 ... 65535 (Decimal)	96
03.23	4.LATEST FAULT	4.FAULT			0 ... 65535 (Decimal)	97
03.24	5.LATEST FAULT	5.FAULT			0 ... 65535 (Decimal)	98
03.25	LATEST WARNING	LAST WRN			0 ... 65535 (Decimal)	99
03.26	2.LATEST WARNING	2.WARN			0 ... 65535 (Decimal)	
03.27	3.LATEST WARNING	3.WARN			0 ... 65535 (Decimal)	
03.28	4.LATEST WARNING	4.WARN			0 ... 65535 (Decimal)	
03.29	5.LATEST WARNING	5.WARN			0 ... 65535 (Decimal)	

(Note 1) Percent of maximum process reference (PFC macro) or maximum frequency (Hand/Auto macro).

(Note 2) The contents of these data words are detailed in the chapter *Fieldbus control*.

Parameters

Index	Name/Selection	Default (PFC macro)	Default (HAND/ AUTO macro)	USER 1	USER 2	PB
10	START/STOP/DIR					
10.01	EXT1 STRT/STP/DIR	DI1	DI1			101
10.02	EXT2 STRT/STP/DIR	DI6	DI6			102
10.03	DIRECTION	FORWARD	FORWARD			103
11	REFERENCE SELECT					
11.01	KEYPAD REF SEL	REF1 (Hz)	REF1 (Hz)			126
11.02	EXT1/EXT2 SELECT	EXT2	DI5			127
11.03	EXT REF1 SELECT	AI1	AI1			128
11.04	EXT REF1 MINIMUM	0 Hz	0 Hz			129
11.05	EXT REF1 MAXIMUM	52 Hz	52 Hz			130
11.06	EXT REF2 SELECT	AI1	AI2			131
11.07	EXT REF2 MINIMUM	0%	0%			132
11.08	EXT REF2 MAXIMUM	100%	100%			133
12	CONSTANT FREQ					
12.01	CONST FREQ SEL	NOT SEL	NOT SEL			151
12.02	CONST FREQ 1	25 Hz	25 Hz			152
12.03	CONST FREQ 2	30 Hz	30 Hz			153
12.04	CONST FREQ 3	35 Hz	35 Hz			154
13	ANALOGUE INPUTS					
13.01	MINIMUM AI1	0 V	0 V			176
13.02	MAXIMUM AI1	10 V	10 V			177
13.03	SCALE AI1	100%	100%			178
13.04	FILTER AI1	0.10 s	0.10 s			179
13.05	INVERT AI1	NO	NO			180
13.06	MINIMUM AI2	4 mA	4 mA			181
13.07	MAXIMUM AI2	20 mA	20 mA			182
13.08	SCALE AI2	100%	100%			183
13.09	FILTER AI2	0.10 s	0.10 s			184
13.10	INVERT AI2	NO	NO			185
13.11	MINIMUM AI3	4 mA	4 mA			186
13.12	MAXIMUM AI3	20 mA	20 mA			187
13.13	SCALE AI3	100%	100%			188
13.14	FILTER AI3	0.10 s	0.10 s			189
13.15	INVERT AI3	NO	NO			190
14	RELAY OUTPUTS					
14.01	RELAY RO1 OUTPUT	M1 START	READY			201
14.02	RELAY RO2 OUTPUT	M2 START	RUNNING			202
14.03	RELAY RO3 OUTPUT	FAULT	FAULT(-1)			203
14.04	RDIO MOD1 RO1	M4 START	M4 START			204
14.05	RDIO MOD1 RO2	M5 START	M5 START			205
14.06	RDIO MOD2 RO1	RUNNING	RUNNING			206
14.07	RDIO MOD2 RO2	FAULT	FAULT			207
15	ANALOGUE OUTPUTS					
15.01	ANALOGUE OUTPUT1	FREQUENCY	FREQUENCY			226
15.02	INVERT AO1	NO	NO			227
15.03	MINIMUM AO1	0 mA	0 mA			228
15.04	FILTER AO1	2.00 s	2.00 s			229
15.05	SCALE AO1	100%	100%			230
15.06	ANALOGUE OUTPUT2	ACTUAL 1	CURRENT			231
15.07	INVERT AO2	NO	NO			232
15.08	MINIMUM AO2	0 mA	0 mA			233
15.09	FILTER AO2	2.00 s	2.00 s			234
15.10	SCALE AO2	100%	100%			235
16	SYSTEM CTRL INPUTS					
16.01	RUN ENABLE	YES	YES			251

Index	Name/Selection	Default (PFC macro)	Default (HAND/ AUTO macro)	USER 1	USER 2	PB
16.02	PARAMETER LOCK	OPEN	OPEN			252
16.03	PASS CODE	0	0			253
16.04	FAULT RESET SEL	NOT SEL	NOT SEL			254
16.05	USER MACRO IO CHG	NOT SEL	NOT SEL			255
16.06	LOCAL LOCK	OFF	OFF			256
16.07	PARAMETER SAVE	DONE	DONE			257
20	LIMITS					
20.01	MINIMUM FREQ	0.00 Hz	0.00 Hz			351
20.02	MAXIMUM FREQ	(calculated)	(calculated)			352
20.03	MAXIMUM CURRENT	(drive type-specific)	(drive type-specific)			353
20.04	MAXIMUM TORQUE	300.0%	300.0%			354
20.05	OVERVOLTAGE CTRL	ON	ON			355
20.06	UNDERVOLTAGE CTRL	ON	ON			356
20.11	P MOTORING LIM	300.0%	300.0%			361
20.12	P GENERATING LIM	-300.0%	-300.0%			362
21	START/STOP					
21.01	START FUNCTION	AUTO	AUTO			376
21.02	CONST MAGN TIME	500.0 ms	500.0 ms			377
21.03	STOP FUNCTION	COAST	COAST			378
21.08	SCALAR FLYSTART	NO	NO			383
21.09	START INTRL FUNC	OFF2 STOP	OFF2 STOP			384
22	ACCEL/DECEL					
22.01	ACC/DEC 1/2 SEL	ACC/DEC 1	ACC/DEC 1			401
22.02	ACCEL TIME 1	3.00 s	3.00 s			402
22.03	DECEL TIME 1	3.00 s	3.00 s			403
22.04	ACCEL TIME 2	60.00 s	60.00 s			404
22.05	DECEL TIME 2	60.00 s	60.00 s			405
22.06	ACC/DEC RAMP SHPE	0.00 s	0.00 s			406
22.07	EM STOP RAMP TIME	3.00 s	3.00 s			407
23	SPEED CTRL					
23.01	GAIN	10.0	10.0			426
23.02	INTEGRATION TIME	2.50 s	2.50 s			427
23.03	SLIP GAIN	100.0%	0.0 ms			428
25	CRITICAL FREQ					
25.01	CRIT FREQ SELECT	OFF	OFF			476
25.02	CRIT FREQ 1 LOW	0 rpm	0 rpm			477
25.03	CRIT FREQ 1 HIGH	0 rpm	0 rpm			478
25.04	CRIT FREQ 2 LOW	0 rpm	0 rpm			479
25.05	CRIT FREQ 2 HIGH	0 rpm	0 rpm			480
26	MOTOR CONTROL					
26.01	FLUX OPTIMIZATION	NO	NO			501
26.02	FLUX BRAKING	YES	YES			502
26.04	HEX FIELD WEAKEN	NO	NO			504
30	FAULT FUNCTIONS					
30.01	AI<MIN FUNCTION	FAULT	FAULT			601
30.02	PANEL LOSS	FAULT	FAULT			602
30.03	EXTERNAL FAULT	NOT SEL	NOT SEL			603
30.04	MOTOR THERM PROT	NO	NO			604
30.05	MOT THERM P MODE	DTC	DTC			605
30.06	MOTOR THERM TIME	(calculated)	(calculated)			606
30.07	MOTOR LOAD CURVE	100.0%	100.0%			607
30.08	ZERO SPEED LOAD	74.0%	74.0%			608
30.09	BREAK POINT	45.0 Hz	45.0 Hz			609
30.10	STALL FUNCTION	FAULT	FAULT			610
30.11	STALL FREQ HI	20.0 Hz	20.0 Hz			611
30.12	STALL TIME	20.00 s	20.00 s			612

Index	Name/Selection	Default (PFC macro)	Default (HAND/ AUTO macro)	USER 1	USER 2	PB
30.13	UNDERLOAD FUNC	NO	NO			613
30.14	UNDERLOAD TIME	600 s	600 s			614
30.15	UNDERLOAD CURVE	1	1			615
30.16	MOTOR PHASE LOSS	NO	NO			616
30.17	EARTH FAULT	FAULT	FAULT			617
30.18	PRESET FREQ	10.00 Hz	10.00 Hz			618
30.19	COMM FLT FUNC	FAULT	FAULT			619
30.20	MAIN REF DS T-OUT	1.00 s	1.00 s			620
30.21	COMM FLT RO/AO	ZERO	ZERO			621
30.22	AUX REF DS T-OUT	3.00 s	3.00 s			622
31	AUTOMATIC RESET					
31.01	NUMBER OF TRIALS	0	0			626
31.02	TRIAL TIME	30.0 s	30.0 s			627
31.03	DELAY TIME	0.0 s	0.0 s			628
31.04	OVERCURRENT	NO	NO			629
31.05	OVERVOLTAGE	NO	NO			630
31.06	UNDERVOLTAGE	NO	NO			631
31.07	AI SIGNAL<MIN	NO	NO			632
32	SUPERVISION					
32.01	FREQ1 FUNCTION	NO	NO			651
32.02	FREQ1 LIMIT	0 Hz	0 Hz			652
32.03	FREQ2 FUNCTION	NO	NO			653
32.04	FREQ2 LIMIT	0 Hz	0 Hz			654
32.05	CURRENT FUNCTION	NO	NO			655
32.06	CURRENT LIMIT	0 A	0 A			656
32.07	REF1 FUNCTION	NO	NO			657
32.08	REF1 LIMIT	0 Hz	0 Hz			658
32.09	REF2 FUNCTION	NO	NO			659
32.10	REF2 LIMIT	0%	0%			660
32.11	ACT1 FUNCTION	NO	NO			661
32.12	ACT1 LIMIT	0%	0%			662
32.13	ACT2 FUNCTION	NO	NO			663
32.14	ACT2 LIMIT	0%	0%			664
33	INFORMATION					
33.01	SOFTWARE VERSION	(Version)	(Version)			676
33.02	APPL SW VERSION	(Version)	(Version)			677
33.03	TEST DATE	(Date)	(Date)			678
40	PI CONTROL					
40.01	PI GAIN	2.5	N/A			851
40.02	PI INTEG TIME	3.00 s	N/A			852
40.03	ERROR VALUE INV	NO	N/A			853
40.04	ACTUAL VALUE SEL	ACT1	N/A			854
40.05	ACTUAL1 INPUT SEL	AI2	N/A			855
40.06	ACTUAL2 INPUT SEL	AI3	N/A			856
40.07	ACT1 MINIMUM	0%	N/A			857
40.08	ACT1 MAXIMUM	100%	N/A			858
40.09	ACT2 MINIMUM	0%	N/A			859
40.10	ACT2 MAXIMUM	100%	N/A			860
40.11	ACT1 UNIT SCALE	0.10	N/A			861
40.12	ACTUAL 1 UNIT	bar	N/A			862
40.13	ACT2 UNIT SCALE	0.10	N/A			863
40.14	ACTUAL 2 UNIT	bar	N/A			864
40.15	ACTUAL FUNC SCALE	0.10	N/A			865
41	PFC CONTROL 1					
41.01	SET POINT 1/2 SEL	SET POINT 1	N/A			876
41.02	SET POINT 1 SRCE	EXTERNAL	N/A			877
41.03	SPOINT 1 INTERNAL	40.0%	N/A			878

Index	Name/Selection	Default (PFC macro)	Default (HAND/ AUTO macro)	USER 1	USER 2	PB
41.04	SPOINT 2 INTERNAL	40.0%	N/A			879
41.05	REFERENCE STEP 1	0.0%	N/A			880
41.06	REFERENCE STEP 2	0.0%	N/A			881
41.07	REFERENCE STEP 3	0.0%	N/A			882
41.08	REFERENCE STEP 4	0.0%	N/A			883
41.09	START FREQ 1	50.0 Hz	N/A			884
41.10	START FREQ 2	50.0 Hz	N/A			885
41.11	START FREQ 3	50.0 Hz	N/A			886
41.12	START FREQ 4	50.0 Hz	N/A			887
41.13	LOW FREQ 1	25.0 Hz	N/A			888
41.14	LOW FREQ 2	25.0 Hz	N/A			889
41.15	LOW FREQ 3	25.0 Hz	N/A			890
41.16	LOW FREQ 4	25.0 Hz	N/A			891
42	PFC CONTROL 2					
42.01	NBR OF AUX MOTORS	ONE	N/A			901
42.02	AUX MOT START DLY	5.0 s	N/A			902
42.03	AUX MOT STOP DLY	3.0 s	N/A			903
42.04	INTERLOCKS	SET1	N/A			904
42.06	AUTOCHANGE INTERV	0 h 00 min	N/A			906
42.07	AUTOCHANGE LEVEL	0.0%	N/A			907
42.08	FREQ TIME ON DLY	0.0 s	N/A			908
42.09	FREQ TIME OFF DLY	0.0 s	N/A			909
42.10	PFC START DELAY	500 ms	N/A			910
42.11	REGUL BYPASS CTRL	NO	N/A			911
43	SLEEP FUNCTION					
43.01	SLEEP SELECTION	INTERNAL	N/A			926
43.02	SLEEP DELAY	60.0 s	N/A			927
43.03	SLEEP LEVEL	0.0 Hz	N/A			928
43.05	WAKE UP LEVEL	0.0%	N/A			930
44	PFC PROTECTION					
44.01	INPUT PROT CTRL	NOT SEL	NOT SEL			951
44.02	AI MEASURE INLET	NOT USED	NOT USED			952
44.03	AI IN LOW LEVEL	0.0%	0.0%			953
44.04	VERY LOW CTRL	NOT SEL	NOT SEL			954
44.05	AI IN VERY LOW	0.0%	0.0%			955
44.06	DI STATUS INLET	NOT USED	NOT USED			956
44.07	INPUT CTRL DLY	0 s	0 s			957
44.08	INLET FORCED REF	0%	0%			958
44.09	OUTPUT PROT CTRL	NOT SEL	NOT SEL			959
44.10	AI MEASURE OUTLET	NOT USED	NOT USED			960
44.11	AI OUT HIGH LEVEL	0.0%	0.0%			961
44.12	VERY HIGH CTRL	NOT SEL	NOT SEL			962
44.13	AI OUT VERY HIGH	0%	0%			963
44.14	DI STATUS OUTLET	NOT USED	NOT USED			964
44.15	OUTPUT CTRL DLY	0 s	0 s			965
44.16	OUTLET FORCED REF	0%	0%			966
44.17	PI REF DEC TIME	1.00 s	1.00 s			967
44.18	APPL PROFILE CTRL	APPL OUTPUT	APPL OUTPUT			968
44.19	PROFILE OUTP LIM	100%	100%			969
44.20	PROF LIMIT ON DLY	0.0 h	0.0 h			970
51	COMM MOD DATA					1026 ...
52	STANDARD MODBUS					
52.01	STATION NUMBER	1	1			1051
52.02	BAUDRATE	9600	9600			1052
52.03	PARITY	ODD	ODD			1053
70	DDCS CONTROL					

Index	Name/Selection	Default (PFC macro)	Default (HAND/ AUTO macro)	USER 1	USER 2	PB
70.01	CHANNEL 0 ADDR	1	1			1375
70.02	CHANNEL 3 ADDR	1	1			1376
90	D SET REC ADDR					
90.01	AUX DS REF3	0	0			1735
90.02	AUX DS REF4	0	0			1736
90.03	AUX DS REF5	0	0			1737
90.04	MAIN DS SOURCE	1	1			1738
90.05	AUX DS SOURCE	3	3			1739
92	D SET TR ADDR					
92.01	MAIN DS STATUS WORD	302	302			1771
92.02	MAIN DS ACT1	102	102			1772
92.03	MAIN DS ACT2	105	105			1773
92.04	AUX DS ACT3	305	305			1774
92.05	AUX DS ACT4	308	308			1775
92.06	AUX DS ACT5	306	306			1776
98	OPTION MODULES					
98.02	COMM. MODULE LINK	NO	NO			1902
98.03	DI/O EXT MODULE 1	NO	NO			1903
98.04	DI/O EXT MODULE 2	NO	NO			1904
98.06	AI/O EXT MODULE	NO	NO			1906
98.07	COMM PROFILE	ABB DRIVES	ABB DRIVES			1907
98.08	AI/O EXT AI1 FUNC	UNIPOLAR AI5	UNIPOLAR AI5			1908
98.09	AI/O EXT AI2 FUNC	UNIPOLAR AI6	UNIPOLAR AI6			1909
99	START-UP DATA					
99.01	LANGUAGE	ENGLISH	ENGLISH			1926
99.02	APPLICATION MACRO	PFC	HAND/AUTO			1927
99.03	APPLIC RESTORE	NO	NO			1928
99.04	MOTOR CTRL MODE	DTC	DTC			1929
99.05	MOTOR NOM VOLTAGE	0 V	0 V			1930
99.06	MOTOR NOM CURRENT	0.0 A	0.0 A			1931
99.07	MOTOR NOM FREQ	50.0 Hz	50.0 Hz			1932
99.08	MOTOR NOM SPEED	1 rpm	1 rpm			1933
99.09	MOTOR NOM POWER	0.0 kW	0.0 kW			1934
99.10	MOTOR ID RUN	NO	NO			1935
99.11	DEVICE NAME	PFC Application +	PFC Application +			1936

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