ACS800

Firmware Manual
PCP and ESP Control Program

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Firmware Manual

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Table of Contents

Program features

Application macros

Actual signals and parameters

Fieldbus control

Fault tracing

Additional data: actual signals and parameters

Appendix A: Software One-Line Diagrams

Introduction to the manual

Chapter overview

The 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

The manual is compatible with ACS 800 PCP and ESP Control Program (Version BZXR631G and above). See 04.01 SW PACKAGE VERSION.

Safety instructions

Follow all safety instructions delivered with the drive.

- Read the **complete safety instructions** before you install, commission, or use the drive. The complete safety instructions are given at the beginning of the Hardware Manual.
- Read the **software function specific warnings and notes** before changing the default settings of the function. For each function, the warnings and notes are given in this manual in the subsection describing the related user-adjustable parameters.

Reader

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

Contents

The manual consists of the following chapters:

- *Start-up* instructs in performing an ID Run.
- *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.
- *Actual signals and parameters* describes the actual signals and parameters of the drive.
- *Fieldbus control* describes the communication through the serial communication links.

- *Fault tracing* lists the warning and fault messages with the possible causes and remedies.
- *Additional data: actual signals and parameters* contains more information on the actual signals and parameters.
- *Appendix A: Software One-Line Diagrams* diagrams the signal flow for the speed and torque chains.

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type code and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/drives and selecting *Drives - Sales, Support and Service network* on the right pane.

Product training

For information on ABB product training, navigate to www.abb.com/drives and select *Drives - Training courses* on the right pane.

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Start-up

Chapter overview

The chapter instructs how to:

- complete the initial start-up.
- perform an identification run (ID Run) for the drive.

How to start-up

SAFETY		
	 The start-up may only be carried out by a qualified electrician. / instructions must be followed during the start-up procedure. See the appropriate 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 setup (see section *How to perform the ID Run* on page 7).	
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 …	`ACS 800 xx kW` `ID NUMBER 1`

	…and after a few seconds the panel enters the Actual Signal Display.
	The drive is now ready for the start-up.
		`1 -> 0.0 rpm O`
		`FREQ 0.00 Hz`
		`SPD FILT 0.00 rpm`
		`TORQ FILT 0.00 %`

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.
- Select the value you would like to modify by pressing ***ENTER.***
- Change the value using the arrow keys (▲ or ▼), fast change using the double-arrow keys (▲▲ or ▼▼).
- Press ***ENTER*** to accept the new value (brackets disappear).

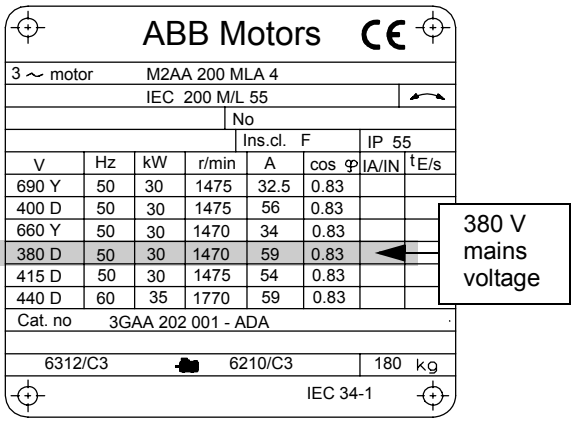
```
1   ->  0.0 rpm   O
99 START-UP DATA
01 LANGUAGE
ENGLISH
```

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

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

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

☐ 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 will result in incorrect 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 rpm   O
99 START-UP DATA
05 MOTOR NOM VOLTAGE
[ ]
```

- motor nominal current

Allowed range: 1/6 · $I_{2hd...}$ 2 · I_{2hd} of ACS800

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

- motor nominal frequency

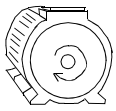
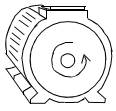
Range: 8…300 Hz

```
 1   ->  0.0 rpm   O
99 START-UP DATA
07 MOTOR NOM FREQ
[ ]
```

- motor nominal speed

Range: 1…18000 rpm

```
 1   ->  0.0 rpm   O
99 START-UP DATA
08 MOTOR NOM SPEED
[ ]
```

	- motor nominal power Range: 0…9000 kW	1 -> 0.0 rpm 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 magnetization or ID Run).	1 -> 0.0 rpm O ** WARNING ** ID MAGN REQ
☐	Select the motor identification. The ID Run (STANDARD) should be selected. For more information, see section *How to perform the ID Run* on page 7.	1 -> 0.0 rpm O 99 START-UP DATA 10 MOTOR ID RUN [STANDARD]
	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 . To change the direction of rotation of the motor: - Disconnect input 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 ground 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.	1 L->[xxx] rpm I FREQ xxx Hz CURRENT xx A POWER xx %  forward direction  reverse direction

SPEED LIMITS AND ACCELERATION/DECELERATION TIMES		
☐	Set the minimum speed.	1 L-> 0.0 rpm O 20 LIMITS 01 MINIMUM SPEED [ ]
☐	Set the maximum speed.	1 L-> 0.0 rpm O 20 LIMITS 02 MAXIMUM SPEED [ ]
☐	Set the acceleration time 1.	1 L-> 0.0 rpm O 22 ACCEL/DECEL 02 ACCELER TIME 1 [ ]
☐	Set the deceleration time 1.	1 L-> 0.0 rpm O 22 ACCEL/DECEL 03 DECELER TIME 1 [ ]
The drive is now ready for use.		

How to perform the ID Run

For a PCP application, the Standard ID Run must be performed.

Uncouple the motor if possible.

Note: 10.04 RUN ENABLE must be set to “Yes” or the digital input made and 10.05 EMERG STOP INPUT must be set to “Not Select” or the digital input made in order to perform the ID Run.

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 SPEED ≤ 0 rpm
- 20.02 MAXIMUM SPEED > 80% of motor rated speed
- 20.05 MAXIMUM TORQUE > 50%
- 22.02 ACCEL TIME 1 ≤ 1 s

- 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 selection to STANDARD.

```
1 L ->1242.0 rpm      O
99 START-UP DATA
10 MOTOR ID RUN
[STANDARD]
```

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

```
1 L ->1242.0 rpm      O
ACS 800 55 kW
**WARNING**
ID RUN SEL
```

- To start the ID Run, press the ⏀ key.

Warning when the ID Run is started	Warning after a successfully completed ID Run
1 L -> 1242.0 rpm I ACS 800 55 kW **WARNING** MOTOR STARTS	1 L -> 1242.0 rpm I ACS 800 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 ( ).

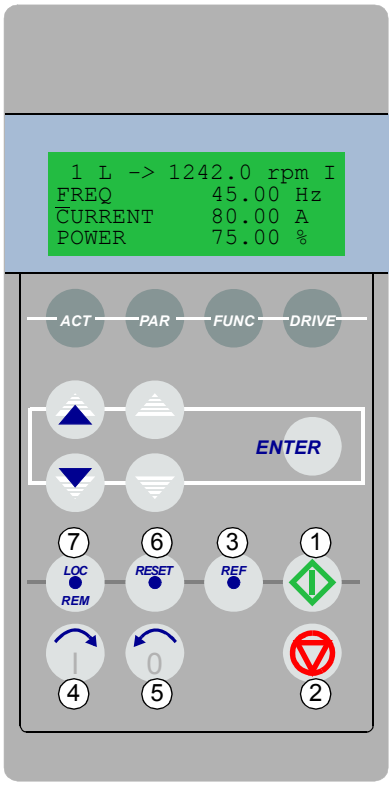
Control panel

Chapter overview

The chapter describes how to control, monitor and change the settings of the drive using the control panel CDP 312R.

The same control panel is used with all ACS800 series drives, so the instructions given apply to all ACS800 types. The display examples shown are based on the Standard Control Program; displays produced by other control 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 by 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)

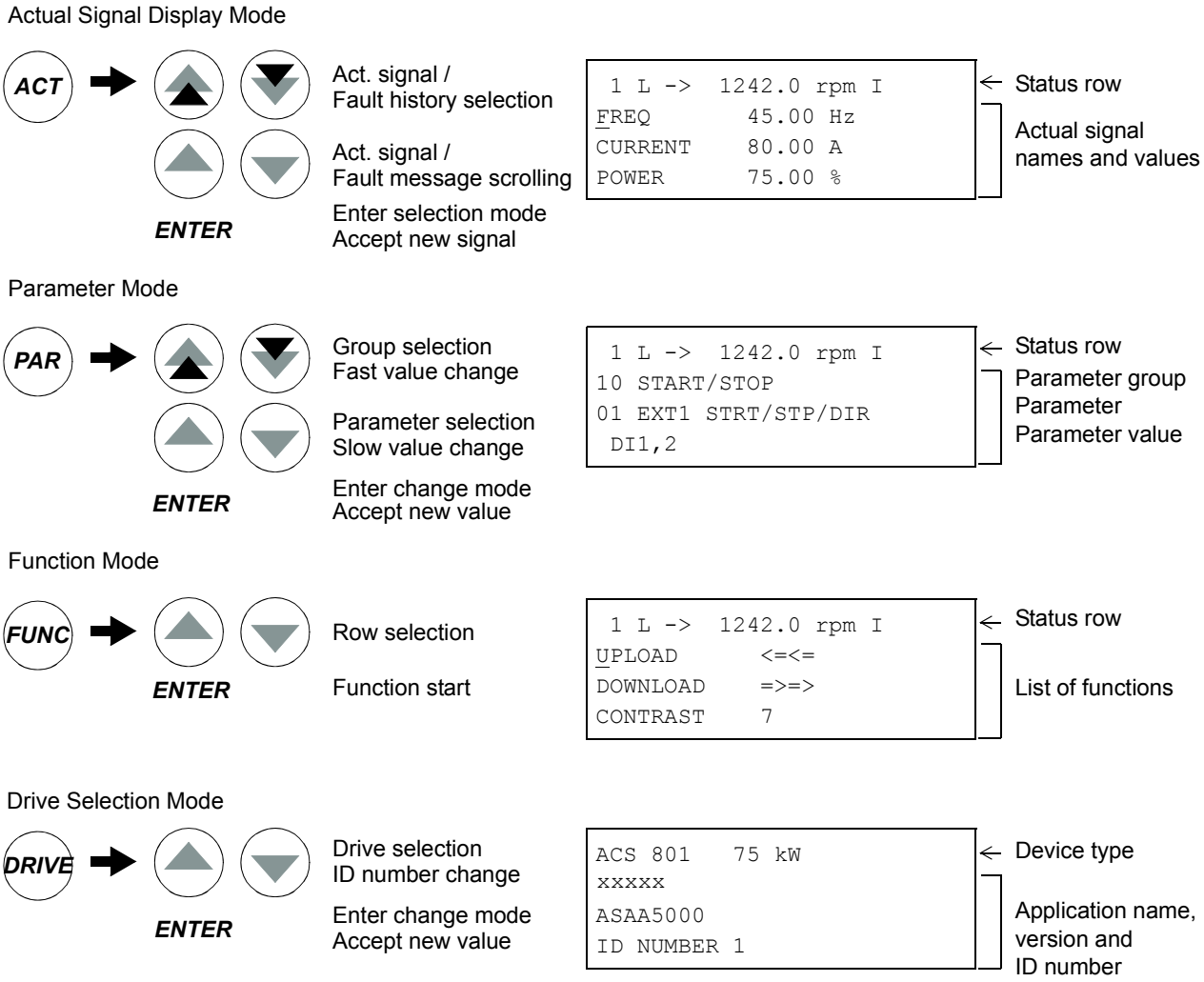
The use of single arrow keys, double arrow keys, and ENTER depend on the operation mode of the panel.

The drive control keys:

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

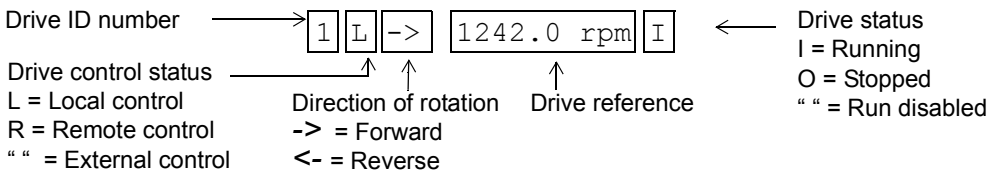
Panel operation mode keys and displays

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.



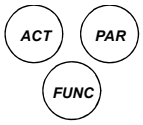
Drive control with the panel

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

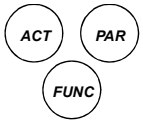
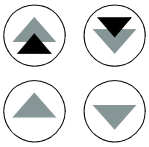
- start, stop, and change direction of the motor
- give the motor speed reference or torque reference
- reset the fault and warning messages
- change between local and external drive control.

The panel can be used for drive control 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 display 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 %

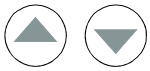
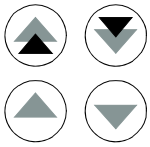
Actual signal display mode

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 does not press any key within one minute.

How to select actual signals to the display

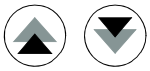
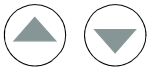
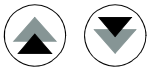
Step	Action	Press Key	Display
1.	To enter the Actual Signal Display Mode.		1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
2.	To select a row (a blinking cursor indicates the selected row).		1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
3.	To enter the actual signal 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 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

The table below includes the step-by-step instructions.

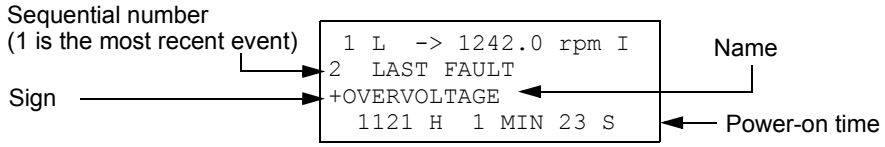
WARNING! If an external source for start command is selected and it is ON, the drive will start immediately after fault reset. If the cause of the fault has not been removed, the drive will trip again.

Step	Action	Press Key	Display
1.	To display an active fault.	ACT	1 L -> 1242.0 rpm ACS 801 75 kW ** FAULT ** ACS 800 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 reports information on the latest events (faults, warnings and resets) logged by the drive. The table below shows how these 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. 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. -RESET FAULT text. Total power-on time.
Drive generates a warning message.	Sequential number of the event. 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. Name of the warning and a “-” sign in front of the name. Total power-on time.

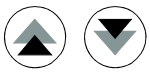
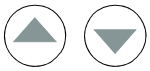
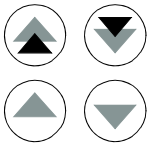
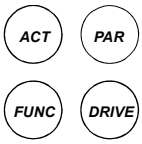
Parameter mode

In the Parameter Mode, the user can:

- view the parameter values
- change the parameter settings.

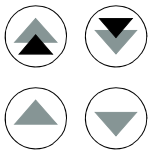
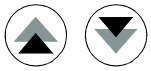
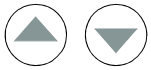
The panel enters the Parameter Mode when the user presses the ***PAR*** key.

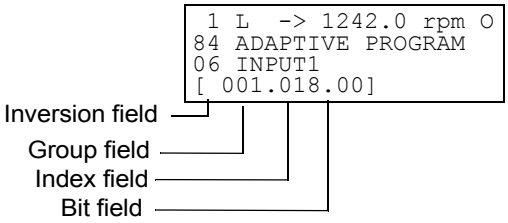
How to select a parameter and change the value

Step	Action	Press Key	Display
1.	To enter the Parameter Mode.		1 L -> 1242.0 rpm O 10 START/STOP/DIR 01 EXT1 STRT/STP/DIR DI1,2
2.	To select a different group.		1 L -> 1242.0 rpm O 11 REFERENCE SELECT 01 KEYPAD REF SEL REF1 (rpm)
3.	To select a parameter.		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

How to adjust a source selection (pointer) parameter

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

Step	Action	Press Key	Display
1.	See the table above to: - enter the Parameter Mode - select the correct parameter group and parameter - enter the parameter setting mode	PAR  ***ENTER***	1 L ->1242.0 rpm O 84 ADAPTIVE PROGRAM 06 INPUT1 [±000.000.00]
2.	To scroll between the inversion, group, index and bit fields.		1 L ->1242.0 rpm O 84 ADAPTIVE PROGRAM 06 INPUT1 [±000.000.00]
3.	To adjust the value of a field.		1 L ->1242.0 rpm O 84 ADAPTIVE PROGRAM 06 INPUT1 [±000.018.00]
4.	To accept the value.	***ENTER***	



Inversion field inverts the selected parameter value.
Plus sign (+): no inversion
Minus (-) sign: inversion.
Bit field selects the bit number (relevant only if the parameter value is a packed boolean word).
Index field selects the parameter index.
Group field selects the parameter group.

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

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

Function mode

In the Function Mode, the user can:

- copy the drive parameter values and motor data from the drive to the panel.
- copy 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.

How to copy data from a drive to the panel

Note:

- Uploading must be completed before downloading.
- The uploading and downloading are possible only if the program versions of the destination drive are the same as the versions of the source drive, see 04.01 SW PACKAGE VER and 04.07 APPL SW VERSION.
- The drive must be stopped during the downloading.

Step	Action	Press Key	Display
1.	Set-up the drives. In each drive, activate the communication to the optional equipment. See parameter group 98 OPTION MODULES.		
2.	In one drive, set the parameters in groups 10 to 97 as preferred.		
3.	Enter the Function Mode.	FUNC	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
4.	Select the upload function (a flashing cursor indicates the selected function).	▲ ▼	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
5.	Enter the upload function.	***ENTER***	1 L -> 1242.0 rpm O UPLOAD <=<=
6.	Switch to external control. (No L on the first row of the display.)	LOC REM	1 -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
7.	Disconnect the panel and reconnect it to the drive into which the data will be downloaded.		

[1)] The parameter groups 98, 99 and the results of the motor identification are not included as 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 download data from the panel to a drive

Consider the notes in section *How to copy 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.	LOC/REM	1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
3.	Enter the Function Mode.	FUNC	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
4.	Select the download function (a flashing cursor indicates the selected function).	▲ ▼	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
5.	Start the download.	***ENTER***	1 L -> 1242.0 rpm O DOWNLOAD =>=>

How to set the display contrast

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

Drive selection mode

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

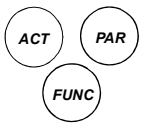
In the Drive Selection Mode, the user can:

- Select the drive with which the panel communicates through the panel link.
- Change the identification number of a drive or panel 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.

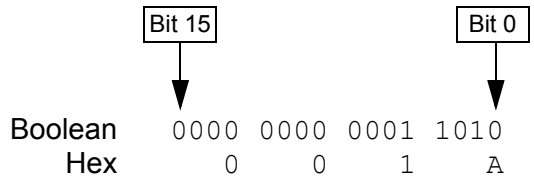
How to select a drive and change its panel link ID number

Step	Action	Press Key	Display
1.	To enter the Drive Selection Mode.		ACS 800 75 kW ASAAA5000 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 double-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.		ACS 800 75 kW ASAAA5000 xxxxxx ID NUMBER 1 1$\vec{o}$ Status Display Symbols: $\vec{o}$ = Drive stopped, direction forward $\overleftarrow{1}$= Drive running, direction reverse F = Drive tripped on a fault
3.	To connect to the last displayed drive and to enter another mode, press one of the mode selection keys. The selected mode is entered.		1 L -> 1242.0 rpm I 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:



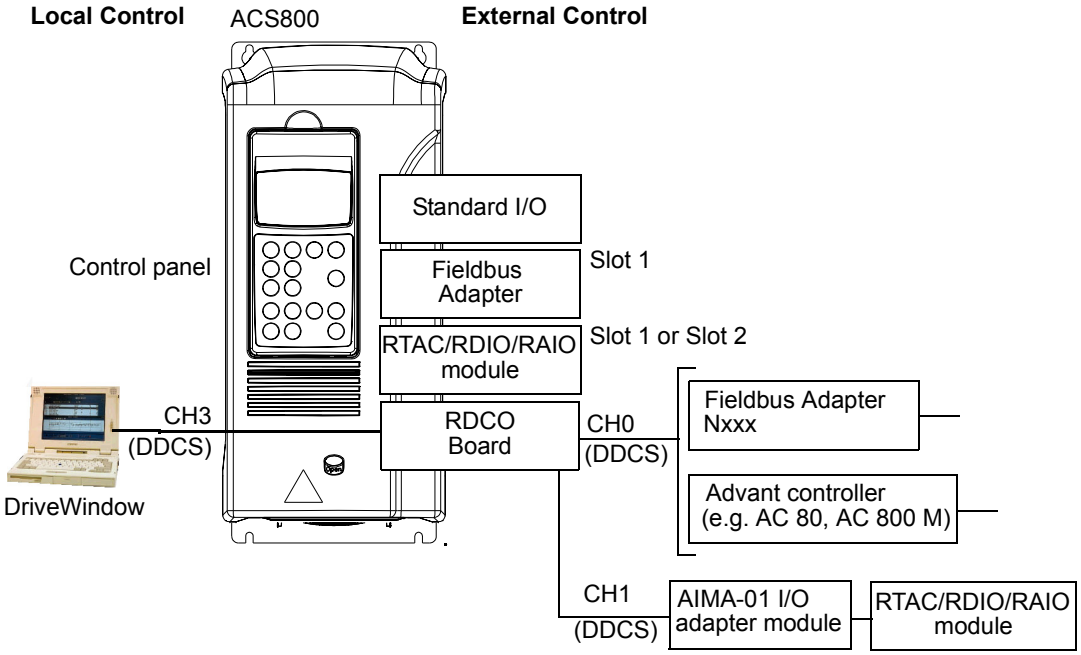
Program features

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

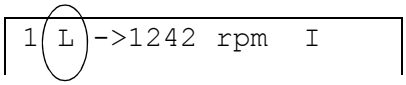
The drive can receive start, stop and direction commands and reference values from the control panel or through digital and analog inputs. An optional fieldbus adapter enables control over an open fieldbus link. A PC equipped with DriveWindow can also control the drive.



Local control

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

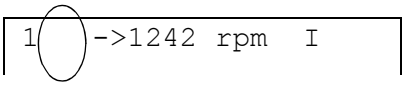
The control panel always overrides the external control signal sources when used in local mode.



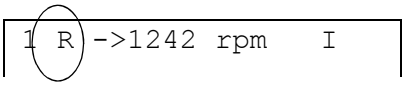
External control

When the drive is in external control, the commands are given through the control terminal block on the standard I/O board (digital and analog inputs), optional I/O extension modules and/or CH0 Fieldbus Adapter. 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



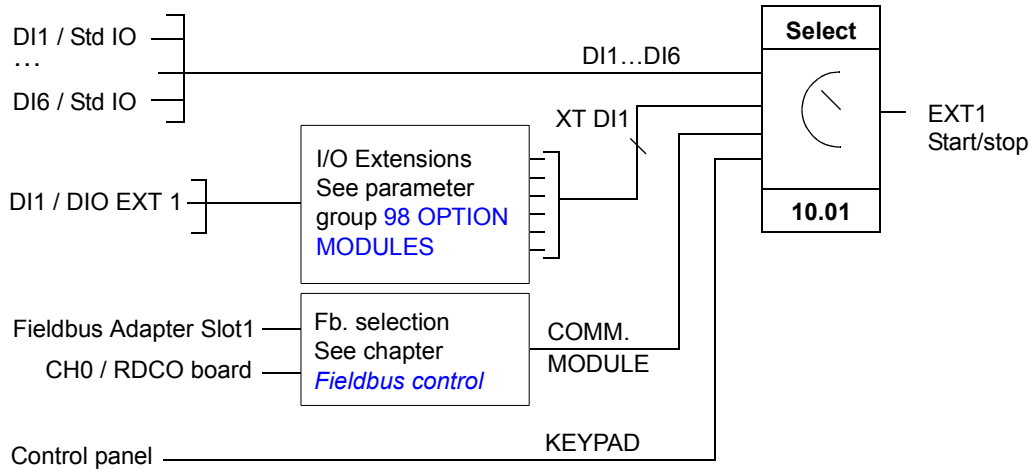
External Control by control panel

Settings

Panel key	Additional Information
LOC/REM	Selection between local and external control.
Parameter	
10.01	Start and stop source for EXT1.
10.02	Direction source for EXT1.
11.01	Selection between EXT1 and EXT2.
11.02	Reference source for EXT1.
11.05	Reference source for EXT2.
Group 98 OPTION MODULES	Activation of the optional I/O and serial communication.

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.

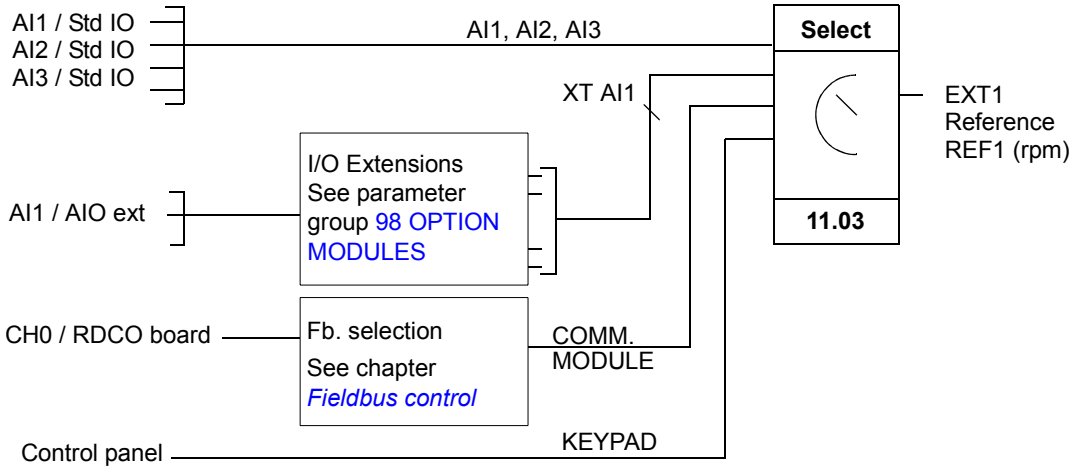


DI1 / Std IO = Digital input DI1 on the standard I/O terminal block

DI1 / DIO ext 1 = Digital input DI1 on the Digital I/O Extension Module 1 (XT DI1 in Parameters)

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 = analog input AI1 on the standard I/O terminal block

AI1 / AIO ext = analog input AI1 on the Analog I/O Extension Module (AI5 in Parameters)

Reference types and processing

It is possible to scale the external reference so that the signal maximum value corresponds to a speed other than the maximum speed limit.

Settings

Parameter	Additional Information
Group 11 REFERENCE SELECT	External reference source, type and scaling.
Group 20 LIMITS	Operating limits.
Group 22 ACCEL/DECEL	Speed reference acceleration and deceleration ramps.

Diagnostics

Actual Signal	Additional Information
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 ANALOG OUTPUTS	Reference value.

Programmable analog inputs

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

Update cycles in the Standard Control Program

Input	Cycle
AI / standard	10 ms
AI / extension	10 ms

Settings

Parameter	Additional Information
Group 11 REFERENCE SELECT	Reference source.
Group 13 ANALOG INPUTS	Processing of the standard inputs.
Group 71 PUMP CONTROLS	Sleep AI.
Group 72 PUMP SETUP	Discharge pressure and fluid level sources.
Group 73 PUMP SETUP	Pt100 source.
Group 98 OPTION MODULES	Activation of optional analog inputs.

Diagnostics

Actual Value	Additional Information
01.20…01.22	Standard inputs
01.27, 01.28	Optional inputs

Programmable analog outputs

Two programmable current outputs are available as standard, and two outputs can be added by using an optional Analog I/O Extension Module. Analog output signals can be inverted and filtered.

The analog 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 analog output through a serial communication link.

Update cycles in the Control Program

Output	Cycle
AO / standard	50 ms
AO / extension	50 ms

Settings

Parameter	Additional information
Group 15 ANALOG OUTPUTS	Value selection and processing (standard outputs).
Group 98 OPTION MODULES	Activation of optional I/O.

Diagnostics

Actual value	Additional information
01.23, 01.24	Values of the standard outputs.
01.29, 01.30	Values of the optional outputs.

Programmable digital inputs

The drive has six programmable digital inputs as a standard. Six extra inputs are available if the optional Digital I/O Extension Modules are used.

Update cycles in the Control Program

Input	Cycle
DI / standard	50 ms
DI / extension	50 ms

Settings

Parameter	Additional Information
Group 10 START/STOP/DIR	Start, stop, direction source.
Group 11 REFERENCE SELECT	Reference selection, reference source.
Group 12 CONSTANT SPEEDS	Constant speed selection.
Group 16 SYSTEM CTR INPUTS	External run enable, fault reset, user macro change
Group 71 PUMP CONTROLS	Pump enable, pump resets source.
Group 72 PUMP SETUP	High pressure, level control selection source.
Group 73 PUMP SETUP	Klixon selection source.
98.03…98.04	Activation of the optional Digital I/O Extension Modules.

Diagnostics

Actual Value	Additional Information
01.18	Standard digital inputs
01.25	Optional digital inputs

Programmable relay outputs

On the standard I/O board there are three programmable relay outputs. Six outputs can be added by using the optional Digital I/O Extension Modules. With 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 Control Program

Output	Cycle
RO / standard	50 ms
RO / extension	50 ms

Settings

Parameter	Additional Information
Group 14 RELAY OUTPUTS	Value selections and operation times
Group 98 OPTION MODULES	Activation of optional relay outputs

Diagnostics

Actual Value	Additional Information
01.19	Standard relay output states
01.26	Optional relays output states

Actual signals

Several actual signals are available:

- Drive output frequency, current, voltage and power
- Motor speed and torque
- Supply voltage and intermediate circuit DC voltage
- Reference values
- Drive temperature
- Operating time counter (h), kWh counter
- Digital I/O and analog I/O status
- PID controller actual values

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 analog outputs.

Settings

Parameter	Additional Information
Group 15 ANALOG OUTPUTS	Selection of an actual signal to an analog output
Group 92 FIELDBUS OUTPUT	Selection of an actual signal to a dataset (serial communication)

Diagnostics

Actual Value	Additional Information
Group 01 ACTUAL SIGNALS… 09 FAULT WORDS	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.

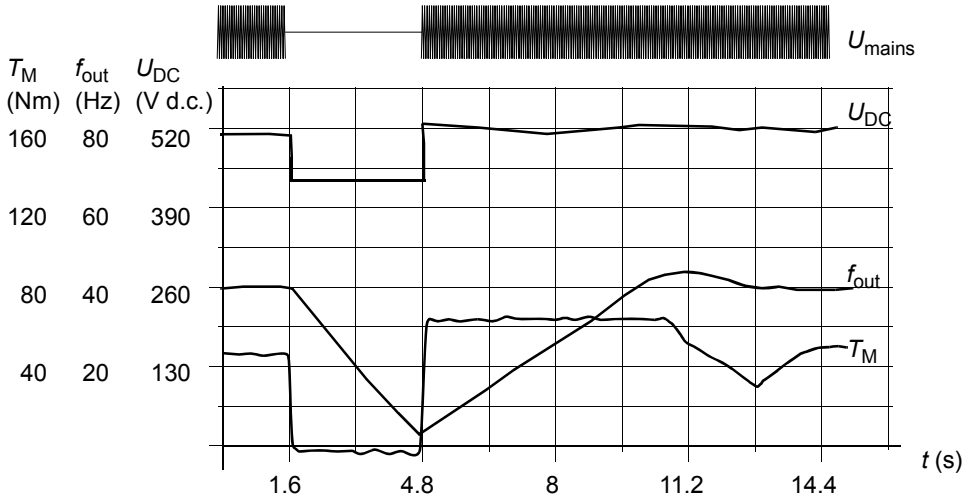
A motor identification magnetization is automatically done the first time the start command is given. During this first start-up, the motor is magnetized at zero speed for several seconds to allow the motor model to be created. This identification method is suitable for most applications. However, as previously stated, for PCP applications, a separate identification run should 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 utilizing the kinetic energy of the rotating motor. The drive will be fully operational as long as the motor rotates and generates energy to the drive. The drive can continue 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 supply is switched off. The drive runs the motor in generator mode. The motor speed falls but the drive is operational as long as the motor has enough kinetic energy.

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

Automatic Start

Since the drive can detect the state of the motor within a few milliseconds, 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 Magnetizing

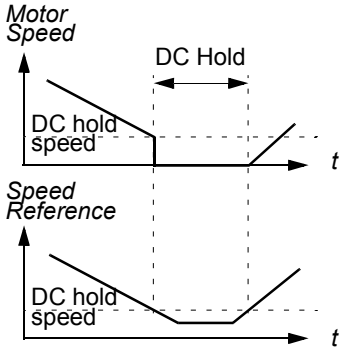
When DC Magnetizing is activated, the drive automatically magnetizes the motor before the start. This feature guarantees the highest possible breakaway torque, up to 200% of motor nominal torque. By adjusting the premagnetizing time, it is possible to synchronize the motor start and e.g. a mechanical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

Settings

Parameters 21.01 and 21.02.

DC Hold

By activating the motor DC Hold feature it is possible to lock the rotor at zero speed. When both the reference and the motor speed fall below the preset DC hold speed, the drive stops the motor and starts to inject DC into the motor. When the reference speed again exceeds the DC hold speed, the normal drive operation resumes.

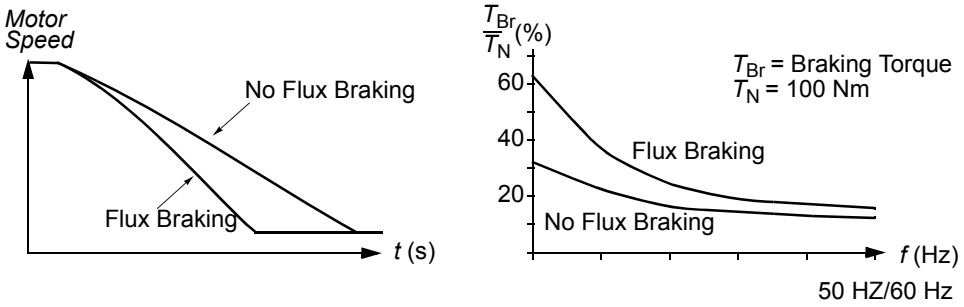


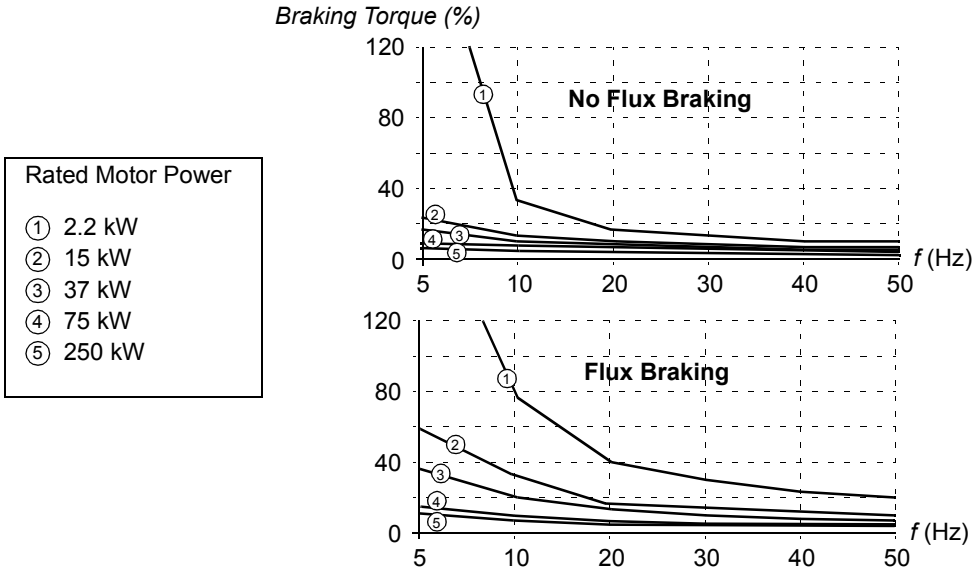
Settings

Parameters 17.01…17.03.

Flux Braking

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





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

- The braking starts immediately after a stop command is given. The function does not need to wait for the flux reduction before it commences 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 27.02.

Flux Optimization

Flux Optimization 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 27.01.

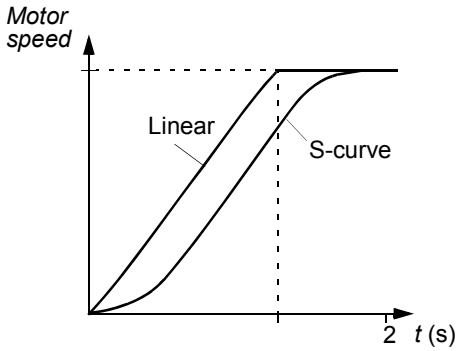
Acceleration and deceleration ramps

It is possible to adjust the acceleration/ deceleration times and the ramp shape.

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.

Constant speeds

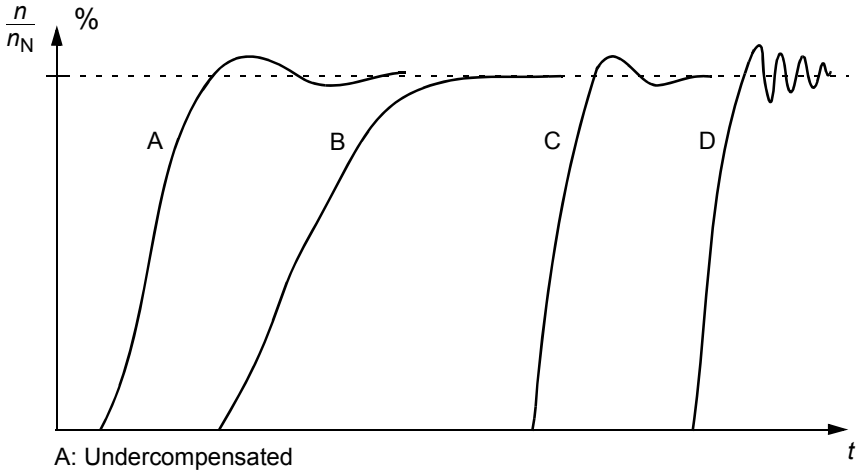
It is possible to predefine constant speeds. Constant speeds are selected with digital inputs. Constant speed activation overrides the external speed reference.

Settings

Parameter group 12 CONSTANT SPEEDS.

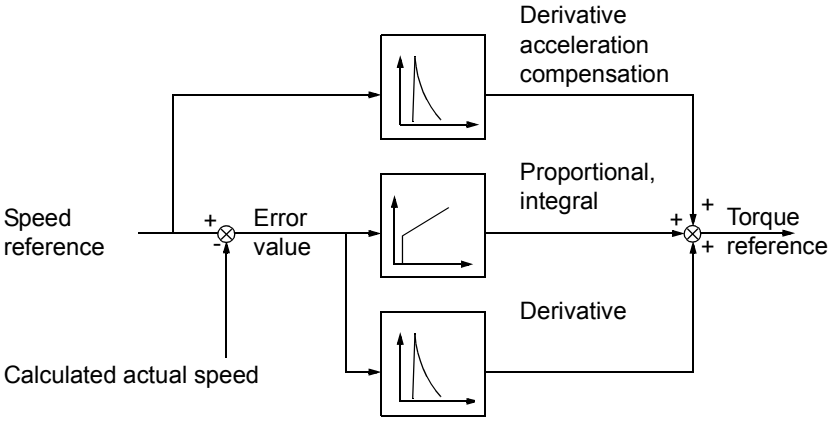
Speed controller tuning

During the motor identification, the drive 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 groups 24 SPEED CTRL TUNE and 20 LIMITS.

Diagnostics

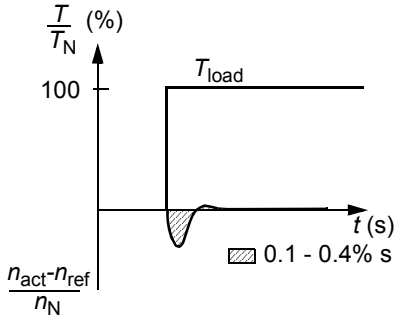
Actual signal 01.01.

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.



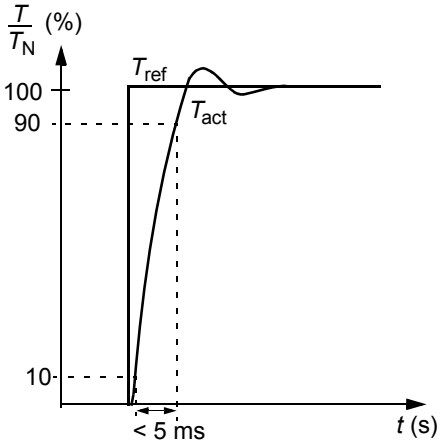
T_N = rated motor torque
n_N = rated motor speed
n_{act} = actual speed
n_{ref} = speed reference

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

Note: DTC is the only control mode for the Factory or PCP macros. Scalar Control is the only control mode available for the ESP macro.

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 with Scalar Control.

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

- In multi-motor drives: 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after motor identification.
- 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

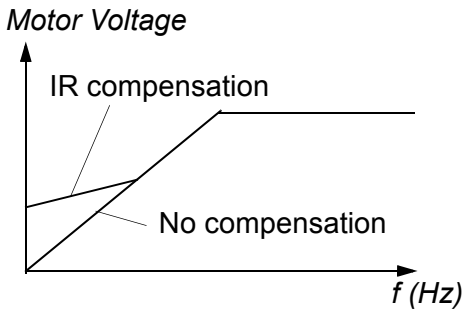
In the Scalar Control mode, some standard features are not available.

Setting

Parameter 99.04.

IR compensation for a scalar controlled drive

IR Compensation is active only when the motor control mode is Scalar (see 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 mode, no IR Compensation is possible/needed.



Setting

Parameter 29.04.

Programmable protection functions

Motor Thermal Protection

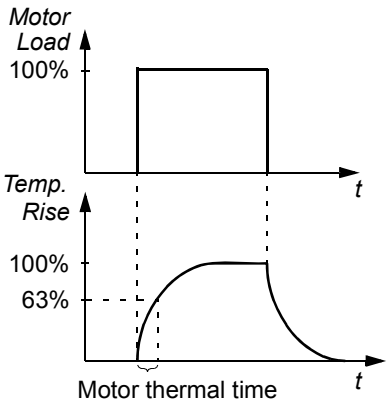
The motor can be protected against overheating by activating the Motor Thermal Protection function and by selecting one of the motor thermal protection modes available.

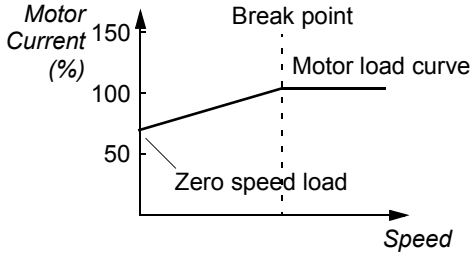
The Motor Thermal Protection modes are based either on a motor temperature thermal model or on an overtemperature indication from a motor thermistor.

Motor temperature thermal model

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

- The motor is at the estimated temperature (value at 01.17 MOTOR TEMP EST saved at power switch off) when power is applied to the drive. When power is applied for the first time, the motor is in the ambient temperature of 86 °F (30 °C).
- 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 at case the ambient temperature exceeds 80 °F (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 30.02…30.12.

Note: It is also possible to use the motor temperature measurement function. See the section *Motor temperature measurement through the standard I/O* on page 44.

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 a motor stall condition (warning indication / fault indication and stop the drive / no reaction).

Settings

Parameters 30.13…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 prevents the motor from starting if it detects a missing motor phase. The Phase Loss function also supervises the motor connection status during normal operation.

Settings

Parameter 30.19.

Ground Fault Protection

The Ground Fault Protection detects ground faults in the motor or motor cable.The protection is based on sum current measurement.

- A ground fault in the line supply does not activate the protection.
- In a grounded supply, the protection activates in 200 microseconds.
- In floating supply networks, the line supply capacitance should be 1 microF or more.
- The capacitive currents due to screened copper motor cables up to 1,000 feet (300 meters) do not activate the protection.
- Ground fault protection is deactivated when the drive is stopped.

Note: With parallel connected inverter modules, the ground fault indication is CUR UNBAL xx. See chapter *Fault tracing*.

Settings

Parameter 30.20.

Communication Fault

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

Settings

Parameters 70.03…70.04.

Preprogrammed Faults

Overcurrent

The overcurrent trip limit for the drive is 3.5 × I_{2hd} (rated output current, heavy-duty use rating.

DC overvoltage

The DC overvoltage trip limit is 1.3 ·U_{1max}, where U_{1max} is the maximum value of the supply voltage range. For:
400 V units, U_{1max} is 415 V
500 V units, U_{1max} is 500 V
690 V units, U_{1max} is 690 V.

The actual voltage in the intermediate circuit corresponding to the supply 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 0.6 · $U_{1min,}$ where U_{1min} is the minimum value of the supply voltage range. For:
400 V and 500 V units, U_{1min} is 380 V
690 V units, U_{1min} is 525 V.

The actual voltage in the intermediate circuit corresponding to the supply voltage trip level is:
307 VDC for 400 V and 500 V units, and
425 VDC for 690 V units.

Drive temperature

The drive supervises the inverter module temperature. If the inverter module temperature exceeds 240 °F (115 °C), a warning is given. The temperature trip level is 260 °F (125 °C).

Enhanced drive temperature monitoring for ACS800-U2, -U4 and -U7, frame sizes R7 and R8

Traditionally, drive temperature monitoring is based on the power semiconductor (IGBT) temperature measurement, which is compared with a fixed maximum IGBT temperature limit. However, certain abnormal conditions, such as cooling fan failure, insufficient cooling air flow, or excessive ambient temperature might cause overheating inside the converter module, which the traditional temperature monitoring alone does not detect. The Enhanced drive temperature monitoring improves the protection in these situations.

The function monitors the converter module temperature by checking cyclically that the measured IGBT temperature is not excessive considering the load current, ambient temperature, and other factors that affect the temperature rise inside the converter module. The calculation uses an experimentally defined equation that

simulates the normal temperature changes in the module depending on the load. The drive generates a warning when the temperature exceeds the limit, and trips when the temperature exceeds the limit by 6 °C.

Note: The monitoring is available only for ACS800-U2, -U4 and -U7, frame size R7 and R8 with Standard Control Program version BZXR631G (and later versions).

Types to which the enhanced drive temperature monitoring is available:
ACS800-Ux-0080-
-0100-2
-0120-2
-0140-2/3/7
-0170-2/3/5/7
-0210-2/3/5/7
-0230-2
-0260-2/3/5/7
-0270-5
-0300-2/5
-0320-3/5/7
-0400-3/5/7
-0440-3/5/7
-0490-3/5/7
-0550-5/7
-0610-5/7

Settings

Parameter	Additional Information
95.10	Ambient temperature

Diagnostics

Warning/Fault	
INV OVERTEMP	Excessive converter module temperature

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 supply 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 23 °F (-5 °C) to 32 °F (0 °C) or above 163 °F (73 °C) to180 °F (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

Power limitation is used to protect the input bridge and the DC intermediate circuit. If the maximum allowed power is exceeded, the drive torque is automatically limited. Maximum overload and continuous power limits depend on the hardware. For specific values refer to the appropriate hardware manual.

Automatic Resets

The drive can automatically reset itself after overvoltage, undervoltage, rod torque, AI < min. and underload faults. The Auto Flt Resets must be activated by the user.

Settings

Parameter group 34 AUTO FLT RESET.

Parameter lock

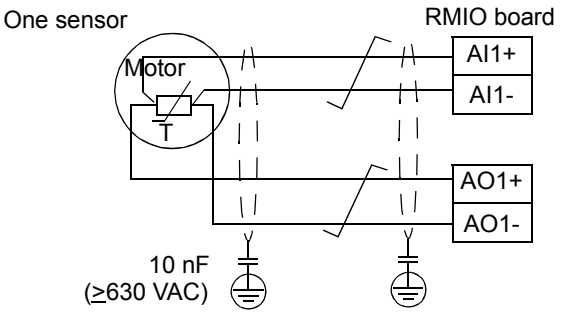
The user can prevent parameter adjustment by activating the parameter lock.

Settings

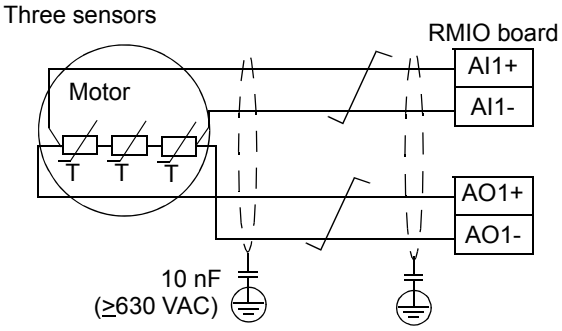
Parameters 16.02 and 16.03.

Motor temperature measurement through the standard I/O

The figure below shows the temperature measurement options of one motor when the RMIO is used as the connection interface.



The minimum voltage of the capacitor must be 630 VAC



WARNING! According to IEC 664, the connection of the motor temperature sensor to the RMIO, requires double or reinforced insulation between motor live parts and the sensor. Reinforced insulation entails a clearance and creeping distance of 0.315” (8mm) (400 / 500 VAC equipment). If the assembly does not fulfil the requirement:

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

Or

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

See also the section *Motor Thermal Protection* on page 39.

Settings

Parameter	Additional Information
15.01	Analog output in a motor 1 temperature measurement
30.03…30.05	Motor 1 temperature measurement settings
Other	
Parameters 13.01…13.05 (AI1 processing) and 15.01…15.05 (AO1 processing) are not effective.	
At the motor end the cable shield should be grounded through a 10 nF capacitor. If this is not possible, the shield is to be left unconnected.	

Diagnostics

Actual values	Additional Information
01.15	Temperature value
09.03	Warning bit state
09.01	Fault bit states
Warnings	
MOTOR 1 TEMP	Chapter *Fault tracing* and parameter 09.03
T MEAS ALM	Chapter *Fault tracing* and parameter 09.03
Faults	
MOTOR 1 TEMP	Chapter *Fault tracing* and parameter 09.01

Adaptive Programming using the function blocks

Conventionally, the user can control the operation of the drive by parameters. Each parameter has a fixed set of choices or a setting range. The parameters make the programming easy, but the choices are limited. The user cannot customize the operation any further. The Adaptive Program makes freer customizing possible without the need of a special programming tool or language:

- The program is built of standard function blocks included in the drive control program.
- The control panel is the programming tool.
- The user can document the program by drawing it on block diagram template sheets.

The maximum size of the Adaptive Program is 15 function blocks. The program may consist of several separate functions.

For more information, see *Application Guide for Adaptive Program* (code: 3AFE64527274 [English]).

DriveAP

DriveAP is a Windows based tool for Adaptive Programming. With DriveAP it is possible to upload the Adaptive Program from the drive and edit it on a PC.

For more information, see the *DriveAP User's Manual* [3AFE64540998 (English)].

Application macros

Chapter overview

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

Overview of macros

Application macros are preprogrammed parameter sets. While starting up the drive, the user can select one of the macros with parameter 99.02.

There are three standard macros.

Factory Macro

Similar functionality to the standard software.

Note: Parameters will vary from the standard software, and DTC is the only possible motor control mode.

PCP Macro

PCP macro allows for controls to come from 4 possible locations:

- Local Mode - Commands come from the keypad in local mode.
- Keypad Remote - Commands come from the keypad in remote mode.
- External 1 - Commands come from remote digital signals.
- External 2 - Commands come from a second remote location for digital signals.

The speed reference can also be selected from the 4 locations listed above. The only motor control mode is DTC, and the speed reference is always given in rpm. The speed reference has bump-less transfer from one location to the next while switching during a run situation. When commanding the speed reference from the keypad while in remote mode, the reference will be memorized on power loss. As long as the run command is still present, the drive will restart and run at the memorized reference on power-up.

The drive is speed controlled at all times, even during shutdown sequences. The drive application allows for backspin control of the pump rods during pump fault occurrence, loss of enable signal, and normal stop commands. Individual pump faults will be discussed in later sections.

Input and Output Signal Defaults

Input Signals	Output Signals
Start/Stop (DI1)	Ready Run (RO1)
External Speed Reference 1 (AI1)	Ready Ref (RO2)
	Tripped (RO3)
	Motor Current (AO1)
	Motor Speed Filt (AO2)

Possible Input and Output Signal Configuration

Input Signals	Output Signals
Start/Stop 1 (DI1)	Ready Run (RO1)
Run Enable (DI2)	At Speed (RO2)
Pump Enable (DI3)	Tripped (RO3)
Level Ctrl Enable (DI4)	Enabled (XT RO1)
Pump Fault Reset (DI5)	DC Overvoltage Limit (XT RO2)
Start/Stop 2 (DI6)	Constant Output for Motor Pt100/PTC (AO1)
High Pressure Sel (XT DI1)	Constant Output for Pump Pt100 (AO2)
Ext1 / Ext2 Sel (XT DI2)	Rod Speed (XT AO1)
External Fault (XT DI3)	Rod Torque (XT AO2)
Runtime Reset (XT DI4)	
Motor Pt100 or PTC (AI1)	
External Speed Reference 1 (AI2)	
External Speed Reference 2 (AI3)	
Pump Pt100 AI Signal (XT AI1)	
Fluid Level Signal (XT AI2)	
Discharge Pressure Signal (XT AI3)	
Unused (XT AI4)	

ESP Macro

The ESP macro is like the PCP macro only the motor control mode is SCALAR and the speed reference is always given in Hz.

Shutdown Definition for PCP & ESP Macros

When the PCP or ESP macro is active and the pump is enabled, the drive is allowed to perform a specialized shutdown sequence to control the backspin of the rods in the well or back flow of fluid through the pump. The controlled shutdown can be performed under any normal stop command: Loss of Run, Stall Condition, High Torque, High Pressure, Underload, and High Pump Temperature.

The sequence of events during a controlled shutdown is as follows:

1. Shutdown is activated.
2. Speed reference is ramped to zero by the decel time specified in 22.02 DECEL TIME. While the speed reference is being ramped, the drive remains in speed control so that the speed regulator is always active.
3. When zero speed is reached, the drive will begin ramping to the backspin speed reference with an accel time specified in 71.05 BACKSPIN ACCEL TIME. If the torque in the pump is driving the motor in the reverse direction then the actual backspin speed will be equal to the backspin speed reference. However, if torque in the pump is not driving the motor in reverse, the actual speed will not equal the backspin speed reference.
4. The backspin speed reference is based upon the actual torque of the system.

   Backspin Speed Ref =
   Backspin Limit - [(Actual Torque Filtered / Max Torque) * Backspin Limit * Backspin Speed Range]
5. As the torque in the system decreases, the backspin speed reference will slowly increase due to the formula listed above. 71.05 BACKSPIN ACCEL TIME is required because as the drive enters into the regenerative quadrant of control, the tighter the speed is controlled the less of a chance for entering into a high DC bus condition which limits the amount of torque the drive can produce. The DC bus will not rise as long as speed is controlled in the negative direction at a very low reference when 100% torque is required. As the torque required decreases, the backspin speed reference is allowed to increase in the negative direction while still retaining control of the load. Thus, the drive is able to control the load through the entire shutdown sequence. Once the entire torque of the system (rod torque and any back flow through the pump) has been released the motor will come to a complete stop, even though the drive has a negative speed reference command. This is possible because 20.06 MINIMUM TORQUE is commanded to zero, which will not allow the drive to rotate the motor in the negative direction (not active in factory macro). After a few seconds at zero speed the drive will drop the run command, thus releasing the flux in the motor.

Note: As 71.06 BACKSPIN SPEED RANGE increases, the backspin speed reference will decrease (if torque is held constant) as shown in the formula above.

Note: If backspin control is not desired, then set 71.06 BACKSPIN SPEED RANGE to “100%.”

Note: When the ESP macro is active, the backspin speed reference is displayed in Hz. However, 71.03 BACKSPIN LIMIT is displayed in rpm. Calculate the Hz for backspin limit by using the following formula.

$$\text{Backspin Limit (Hz)} = \frac{\text{Backspin Limit (RPM)}}{\text{Maximum Speed (RPM)}} \text{ X } \text{Maximum Frequency}$$

This calculation is performed internally to the drive before the backspin limit is used for calculating the backspin speed reference (Hz) while in ESP macro.

Actual signals and parameters

Chapter overview

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

Terms and abbreviations

The table defines the terms and abbreviations used in the parameter and actual signal tables.

Term	Definition
Absolute Maximum Frequency	Value of 29.02 MAXIMUM FREQ, or 29.03 MINIMUM FREQ if the absolute value of the minimum limit is greater than the maximum limit.
Absolute Maximum Speed	Value of 20.02 MAXIMUM SPEED, or 20.01 MINIMUM SPEED if the absolute value of the minimum limit is higher 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.

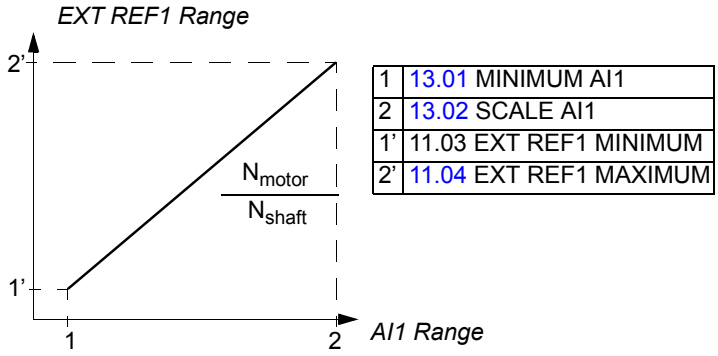
No.	Name/Value	Description	FbEq
01 ACTUAL SIGNALS		Basic signals for monitoring of the drive.	
01.01	MOTOR SPEED FILT	Filtered calculated motor speed in rpm. 100% corresponds to 11.04 EXT1 REF MAXIMUM or 11.07 EXT2 REF MAXIMUM.	200 = 1%
01.02	MOTOR SPEED FILT	Calculated motor speed in rpm. 100% corresponds to 11.04 EXT1 REF MAXIMUM or 11.07 EXT2 REF MAXIMUM.	200 = 1%
01.03	SPEED MEASURED	Measured actual speed from the pulse encoder. 100% corresponds to 11.03 EXT1 REF MAXIMUM or 11.07 EXT2 REF MAXIMUM.	200 = 1%
01.04	ACTUAL MTR FLUX	Absolute value of actual motor flux.	10 = 1%
01.05	FREQUENCY	Calculated output frequency.	100 = 1 Hz
01.06	MOTOR CURRENT	Measured motor current.	10 = 1 A
01.07	MOTOR TORQUE FILT	Filtered, calculated motor torque. 100% is the nominal motor torque.	100 = 1%
01.08	MOTOR TORQUE	Calculated motor torque. 100% is the nominal motor torque.	100 = 1%
01.09	POWER	Motor power. 100% is the nominal motor power.	10 = 1%
01.10	DC BUS VOLTAGE	Measured intermediate circuit voltage.	1 = 1 VDC
01.11	MOTOR VOLTAGE	Calculated motor voltage.	1 = 1 VAC
01.12	ACS800 TEMP	Temperature of the heat sink plate.	1 = 1 °C
01.13	OP HOUR COUNTER	Elapsed time counter. Runs when the control board is powered.	1 = 1 h
01.14	KILOWATT HOURS	kWh counter.	1 = 100 kWh
01.15	MOTOR 1 TEMP	Measured temperature of motor 1. See 30.03 MOT1 TEMP AI1 SEL.	10 = 1 °C
01.16	MOTOR 2 TEMP	Value of analog input 2 displayed in °C, when Pt100 temperature measured is selected.	10 = 1 °C
01.17	MOTOR TEMP EST	Calculated motor temperature based upon DTC motor thermal model. See 30.01 MOT THERM P MODE, 30.09 OTOR THERM TIME, and 30.10 MOTOR LOAD CURVE for thermal model settings.	1 = 1 °C
01.18	DI6-1 STATUS	Status of digital inputs. **Example:** 000001 = DI1 is ON, DI2 to DI6 are OFF.	1 = 1
01.19	RO3-1 STATUS	Status of relay outputs. **Example:** 001 = RO1 is energized, RO2 and RO3 are de-energized.	1 = 1
01.20	AI1 [V]	Value of analog input AI1.	1000 = 1
01.21	AI2 [mA]	Value of analog input AI2.	1000 = 1 mA
01.22	AI3 [mA]	Value of analog input AI3.	1000 = 1 mA
01.23	AO1 [mA]	Value of analog output AO1.	1000 = 1 mA
01.24	AO2 [mA]	Value of analog output AO2.	1000 = 1 mA
01.25	XT DI6-1 STATUS	Status of digital inputs of the Digital I/O Extension modules (optional).	1 = 1
01.26	XT RO6-1 STATUS	Status of digital outputs of the Digital I/O Extension modules (optional).	1 = 1
01.27	XT AI1 [V]	Value of input 1 of the Analog I/O Extension module (optional).	1000 = 1 V
01.28	XT AI2 [V]	Value of input 2 of the Analog I/O Extension module (optional).	1000 = 1 V
01.29	XT AO1 [mA]	Value of output 1 of the Analog I/O Extension module (optional).	1000 = 1 mA
01.30	XT AO2 [mA]	Value of output 2 of the Analog I/O Extension module (optional).	1000 = 1 mA
01.31	CTRL LOCATION	Control location. See 11.01EXT1/EXT2 SEL for EXT CTRL configuration.	0 = Ext1 1 = Ext2

No. Name/Value	Description	FbEq
02 ACTUAL SIGNALS	Speed and torque reference monitoring signals and control program values.	
02.01 SPEED REF 2	Limited speed reference. 100% corresponds to 11.03 EXT1 REF MAXIMUM or 11.07 EXT2 REF MAXIMUM.	200 = 1%
02.02 SPEED REF 3	Ramped and shaped speed reference. 100% corresponds to 11.03 EXT1 REF MAXIMUM or 11.07 EXT2 REF MAXIMUM.	200 = 1%
02.03 SPEED REF 4	Sum of 02.02 SPEED REF 3 and SPEED CORRECTION (zero in this application). 100% corresponds to 11.03 EXT1 REF MAXIMUM or 11.07 EXT2 REF MAXIMUM.	200 = 1%
02.04 TORQ REF 1	Limited sum of M/F torque reference and external torque reference. 100% corresponds to the motor nominal torque.	100 = 1%
02.05 TORQ REF 2	Speed controller output. 100% corresponds to the motor nominal torque.	100 = 1%
02.06 TORQ REF 3	Internal torque reference; after the torque reference selector. 100% corresponds to the motor nominal torque.	100 = 1%
02.07 TORQ REF 4	Sum of 02.06 TORQ REF 3 and LOAD COMPENSATION (zero in this application). 100% corresponds to the motor nominal torque.	100 = 1%
02.08 TORQ REF 5	Sum of 02.07 TORQ REF 4 and TORQ TRIM (zero in this application). 100% corresponds to the motor nominal torque.	100 = 1%
02.09 TORQ USED REF	Final torque reference for the internal torque controller. 100% corresponds to the motor nominal torque.	100 = 1%
02.10 SPEED USED REF	Final speed reference for the internal speed controller. 100% corresponds to 11.03 EXT1 REF MAXIMUM or 11.07 EXT2 REF MAXIMUM.	200 = 1%
04 INFORMATION	Information on the application loaded.	
04.01 SW PACKAGE VER	Name and version identification of the complete software package.	-
04.07 APPL SW VERSION	Control program name.	-
04.09 APPL RELEASE DATE	Control program release date.	-
04.10 BOARD TYPE	Shows the control board type. **Note:** RMIO-Ix boards have different type of FLASH memory chips than RMIO-0x. Only software version BZXR631G or later will operate with RMIO-1x boards.	-
05 PUMP ACTUALS	Application signals for monitoring pump control functions.	
05.01 MOTOR TORQUE	01.08 MOTOR TORQUE scaled to engineering units.	1 = 1 Nm 1 = 1 lbft
05.02 MAX MOTOR TORQUE	Maximum allowed motor torque displayed from 71.01 MAX MOTOR TORQUE.	1 = 1 Nm 1 = 1 lbft
05.03 POWER	01.09 POWER scaled to engineering units.	1 = 1 kW 1 = 1 Hp
05.04 ROD TORQUE	Actual rod torque equals 05.01 MOTOR TORQUE * 71.07 REDUCTION RATIO.	1 = 1 Nm 1 = 1 lbft
05.05 ROD SPEED	Actual rod speed equals 01.02 MOTOR SPEED FILT / 71.07 REDUCTION RATIO.	1 = 1 rpm
05.06 RUNTIME HOURS	Actual time that the drive was enabled and running. Updates once every hour. Value is retained on power loss.	1 = 1 h
05.07 BACKSPIN SPD REF	Reference generated to the speed controller when the drive enters into the shutdown process. See section *Shutdown Definition for PCP & ESP Macros* on page 49.	1 = 1 rpm

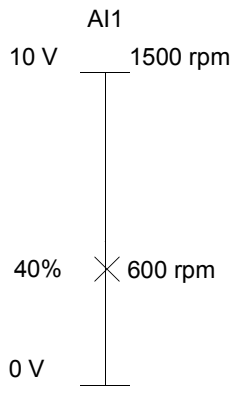
No.	Name/Value	Description	FbEq
05.08	BACKSPIN OPERATION	Identification if the shutdown process is operating or disabled due to normal running conditions.	0 = NOT ACTIVE 1 = ACTIVE
05.09	WELL FLUID LEVEL	Actual fluid level feedback signal.	10 = 1 m 10 = 1 JNTS
05.10	DISCHARGE PRESSURE	Actual discharge pressure feedback signal.	1 = 1 KPa 1 = 1 psi
05.11	MEASURED TEMP	Actual measured temperature from a Pt100 for thermal protection of the pump.	1 = 1 °C
05.12	ROD SPD REF	Actual rod speed reference in pump rpm.	10 = 1 Prpm
06 FIELDBUS INPUTS		Words for monitoring data received from fieldbus.	
06.01	COMMAND WORD	A 16-bit data word. See *Table 3* on page 113.	1 = 1
06.02	SPEED REF1	A 16-bit data word. If 71.19 SPEED REFERENCE is Motor Speed then the fieldbus integer speed range is defined by 11.04 EXT1 REF MAX - 11.03 EXT1 REF MIN. If 71.19 SPEED REFERENCE is Rod Pump Speed then the fieldbus integer speed range scaling is 10:1.	20000 = 100% of speed range
06.03	SPEED REF2	A 16-bit data word. If 71.19 SPEED REFERENCE is Motor Speed then the fieldbus integer speed range is defined by 11.07 EXT2 REF MAX - 11.06 EXT2 REF MIN. If 71.19 SPEED REFERENCE is Rod Pump Speed then the fieldbus integer speed range scaling is 10:1.	20000 = 100% of speed range
06.04	PUMP COMMAND	A 16-bit data word. See *Table 4* on page 113.	1 = 1
07 AI SCALED		Signals for the Adaptive Program	
07.01	AI1 SCALED	Value of analog input AI1 scaled to an integer value.	2000 = 1 V
07.02	AI2 SCALED	Value of analog input AI2 scaled to an integer value.	1000 = 1 mA
07.03	AI3 SCALED	Value of analog input AI3 scaled to an integer value.	1000 = 1 mA
07.04	AI5 SCALED	Value of analog input AI5 scaled to an integer value.	1000 = 1 mA
07.05	AI6 SCALED	Value of analog input AI6 scaled to an integer value.	1000 = 1 mA
07.06	LCU ACT SIGNAL1	A 16-bit data word. Line-side converter signal selected by 95.08 LCU PAR1 SEL.	1 = 1
07.07	LCU ACT SIGNAL2	A 16-bit data word. Line-side converter signal selected by 95.09 LCU PAR1 SEL.	1 = 1
08 STATUS WORDS		Status signals for monitoring of the drive.	
08.01	MAIN STATUS WORD	A 16-bit data word. See *Table 5* on page 114.	1 = 1
08.02	PUMP STATUS WORD	A 16-bit data word. See *Table 6* on page 115.	1 = 1
09 FAULT WORDS		Fault and alarm signals for monitoring the drive.	
09.01	FAULT WORD 1	A 16-bit data word. See *Table 7* on page 116.	1 = 1
09.02	FAULT WORD 2	A 16-bit data word. *Table 8* on page 116.	1 = 1
09.03	ALARM WORD 1	A 16-bit data word. *Table 9* on page 117.	1 = 1
09.04	LIMIT WORD	A 16-bit data word. *Table 10* on page 118.	1 = 1
10 START/STOP/DIR		The sources for external start, stop, direction and run enable control.	
10.01	START / STOP 1	Defines the connections and the source of the start and stop commands for external control location 1.	
	NOT SEL	This function is not selected.	1

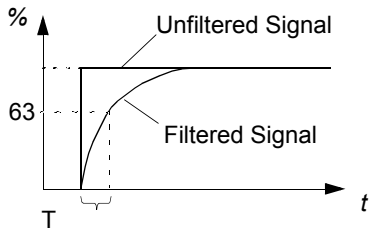
No.	Name/Value	Description	FbEq
	DI1	Start and stop through digital input DI1. 0 = stop; 1 = start. **WARNING!** After a fault reset, the drive will start if DI1 = 1.	2
	DI1P-2P	Pulse start through DI1. Transition from 0 to 1 = start. Pulse stop through DI2. Transition from 1 to 0 = stop.	3
	DI6	See selection DI1.	4
	KEYPAD	Start and stop through the control panel. See chapter *Control panel* for additional details.	5
	FIELDBUS	See selection DI1. Instead of a digital input, the command comes from 06.01 COMMAND WORD bit 03. See chapter *Fieldbus control*.	6
	XT DI1	See selection DI1.	7
	KEYPADorFBUS	Start and stop through DI1, FIELDBUS or KEYPAD. See selections DI1, FIELDBUS or KEYPAD for more information. **Note:** DI1 must equal 1 in order to control through the fieldbus or keypad. DI1 will start and stop the drive. If DI1 is equal to 1 and the drive has been stopped (either through the fieldbus or keypad), it can be restarted through the fieldbus or keypad. All start inputs are pulsed, as are the fieldbus and keypad stop inputs.	8
	PARAM 10.06	Source selected by 10.06 STRT/STP 1 PTR.	9
10.02	START / STOP 2	Defines the connections and the source of the start and stop commands for external control location 2.	
	NOT SEL	This function is not selected.	1
	DI1	See 10.01 START / STOP 1.	2
	DI1P-2P	See 10.01 START / STOP 1.	3
	DI6	See 10.01 START / STOP 1.	4
	KEYPAD	See 10.01 START / STOP 1.	5
	FIELDBUS	See 10.01 START / STOP 1.	6
	XT DI1	See 10.01 START / STOP 1.	7
	KEYPADorFBUS	See 10.01 START / STOP 1.	8
	PARAM 10.07	Source selected by 10.07 STRT/STP 2 PTR.	9
10.03	DIRECTION	Enables the control of direction of rotation of the motor, or fixes the direction.	
	FORWARD	Fixed to forward.	1
	DI2	If digital input DI2 = 1, the direction is reverse.	2
	DI3	See selection DI2.	3
	DI4	See selection DI2.	4
	XT DI2	See selection DI2.	5
	XT DI3	See selection DI2.	6
	XT AI1	Direction will reverse if the speed reference is negative; 11.02 EXT REF1 SELECT or 11.05 EXT REF2 SELECT must be “XT AI1”.	7
	FIELDBUS	See selection DI2. Instead of a digital input, the command comes from 06.01 COMMAND WORD bit 04. See chapter *Fieldbus control*.	8
	KEYPAD	Selected by control panel.	9
	KEYPADorFBUS	Direction is selected through FIELDBUS or KEYPAD. See selections FIELDBUS and KEYPAD for more information.	10

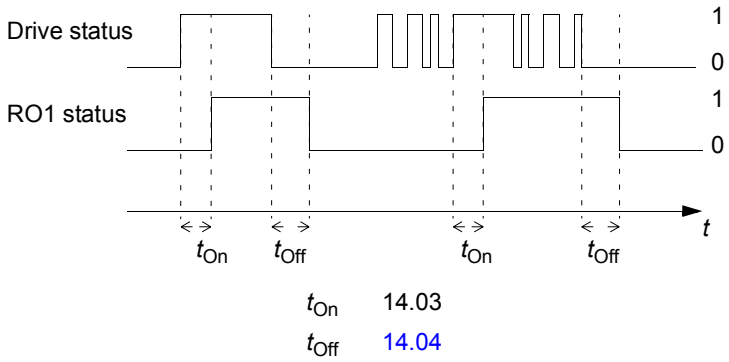
No.	Name/Value	Description	FbEq
10.04	RUN ENABLE	Sets the run enable signal on, or selects a source for the external run enable signal. If no run enable signal is on, the drive will not start, or stops if it is running.	
	YES	Run enable signal is ON.	1
	DI1	External signal required through digital input 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
	FIELDBUS	See selection DI1. Instead of a digital input, the command comes from 06.01 COMMAND WORD bit 00. See chapter *Fieldbus control*.	8
	PARAM 10.08	Source selected by 10.08 RUN ENABLE PTR	9
10.05	EMERG STOP INPUT	Disables E-stop functionality or selects a source for the hardwired signal.	
	DI2	Hardwired E-stop signal required through digital input DI2. 0 = stop by 21.05 EME STOP MODE.	1
	DI3	See selection DI2.	2
	DI4	See selection DI2.	3
	DI5	See selection DI2.	4
	XT DI2	See selection DI2.	5
	NOT SELECT	There is no hardwired E-stop signal.	6
	PARAM 10.09	Source selected by 10.09 E-STOP PTR.	7
10.06	STRT/STP 1 PTR	Defines the source or constant for selection PARAM 10.06 of 10.01 START / STOP 1.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or a constant value: - Parameter pointer: Inversion, group, index and bit fields. The bit number effective only for blocks handling boolean inputs. - Constant value: Inversion and constant fields. Inversion field must have value C to enable the constant setting.	-
10.07	STRT/STP 2 PTR	Defines the source or constant for selection PARAM 10.07 of 10.02 START / STOP 2.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or a constant value. See 10.06 STRT/STP 1 PTR for information on the difference.	-
10.08	RUN ENABLE PTR	Defines the source or constant for selection PARAM 10.08 of 10.04 RUN ENABLE.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or a constant value. See 10.06 STRT/STP 1 PTR for information on the difference.	-
10.09	E-STOP PTR	Defines the source or constant for selection PARAM 10.09 of 10.05 EMERG STOP INPUT	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or a constant value. See 10.06 STRT/STP 1 PTR for information on the difference.	-
11 REFERENCE SELECT		External control location selection and external pump speed reference sources and limits.	
11.01	EXT1/EXT2 SEL	Specifies the source from which the drive reads the signal that selects between the two external control locations, EXT1 or EXT2.	

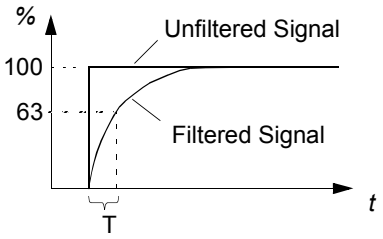
No.	Name/Value	Description	FbEq
	NOT SELECT	EXT1 is active, EXT2 is disabled. The control signal sources are defined by 10.01 START / STOP 1 and 11.02 EXT REF1 SELECT.	1
	DI2	External signal required through digital input DI2; 0=EXT1, 1=EXT2.	2
	DI3	See selection DI2.	3
	DI4	See selection DI2.	4
	DI5	See selection DI2.	5
	DI6	See selection DI2.	6
	XT DI1	See selection DI2.	7
	XT DI2	See selection DI2.	8
	FIELDBUS	See selection DI2. Instead of a digital input, the command comes from 06.04 PUMP COMMAND bit 00. See chapter *Fieldbus control*.	9
	PARAM 11.08	Source selected by 11.08 EXT1/EXT2 PTR	10
11.02	EXT REF1 SELECT	Selects the source for EXT1 speed reference input. The analog input should be scaled such that the 100% input level = maximum speed reference. The 100% input level can be either voltage (10v) or current (20mA) depending upon the channel selected.	
	AI1	Analog input AI1 (voltage).	1
	AI2	Analog input AI2 (current).	2
	AI3	Analog input AI3 (current).	3
	XT AI1	Analog input XT AI1 (voltage/current selected by hardware switch).	4
	FIELDBUS	06.02 SPEED REF1. See chapter *Fieldbus control*.	5
	KEYPAD	Control panel. The first line in the display shows the reference value.	6
	KEYPADorFBUS	Reference comes from either FIELDBUS or KEYPAD. The keypad reference tracks the fieldbus reference when the fieldbus reference changes. See selections FIELDBUS or KEYPAD for more information.	7
	PARAM 11.09	Source selected by 11.09 EXT REF1 PTR	8
11.03	EXT REF1 MINIMUM	Defines the minimum value for external reference 1 (absolute value). Corresponds to the minimum setting of the used source signal.  1 13.01 MINIMUM AI1 2 13.02 SCALE AI1 1' 11.03 EXT REF1 MINIMUM 2' 11.04 EXT REF1 MAXIMUM ***Example:*** Analog input AI1 is selected as the reference source (value of 11.02 EXT REF1 SELECT is AI1). The reference minimum and maximum correspond the AI minimum and maximum settings as above.	
	0.0…18000.0 rpm	Setting range in rpm. (Hz if 99.04 MOTOR CTRL MODE is SCALAR).	1 = 1 rpm

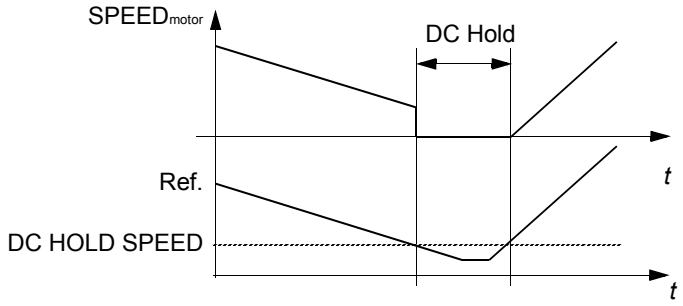
No.	Name/Value	Description	FbEq
11.04	EXT REF1 MAXIMUM	Defines the maximum value for external reference 1 (absolute value). Corresponds to the maximum setting of the used source signal. **Note:** When PCP or ESP macros are active with the Fluid Level Regulator enabled, the reference generated by the level regulator is scaled by the active external reference limits (REF1 or REF2).	
	0.0…18000.0 rpm	Setting range in rpm. (Hz if 99.04 MOTOR CTRL MODE is SCALAR).	1 = 1 rpm
11.05	EXT REF2 SELECT	Selects the source for EXT2 speed reference input. The analog input should be scaled such that the 100% input level = maximum speed reference. The 100% input level can be either voltage (10v) or current (20mA) depending upon the channel selected.	
	AI1	See 11.02 EXT REF1 SELECT.	1
	AI2	See 11.02 EXT REF1 SELECT.	2
	AI3	See 11.02 EXT REF1 SELECT.	3
	XT AI1	See 11.02 EXT REF1 SELECT.	4
	FIELDBUS	06.03 SPEED REF2. See chapter *Fieldbus control*.	5
	KEYPAD	See 11.02 EXT REF1 SELECT.	6
	KEYPADorFBUS	See 11.02 EXT REF1 SELECT.	7
	PARAM 11.10	Source selected by 11.10 EXT REF2 PTR	8
11.06	EXT REF2 MINIMUM	Defines the minimum value for external reference 2 (absolute value). Corresponds to the maximum setting of the used source signal.	
	0.0…18000.0 rpm	Setting range in rpm. (Hz if 99.04 MOTOR CTRL MODE is SCALAR).	1 = 1 rpm
11.07	EXT REF2 MAXIMUM	Defines the maximum value for external reference 2 (absolute value). Corresponds to the maximum setting of the used source signal. Note: When PCP or ESP macros are active with the Fluid Level Regulator enabled, the reference generated by the level regulator is scaled by the active external reference limits (REF1 or REF2).	
	0.0…18000.0 rpm	Setting range in rpm. (Hz if 99.04 MOTOR CTRL MODE is SCALAR).	1 = 1 rpm
11.08	EXT1/EXT2 PTR	Defines the source or constant for selection PARAM 11.08 of 11.01 EXT1/EXT2 SEL.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or a constant value. See 10.06 STRT/STP 1 PTR for information on the difference.	-
11.09	EXT REF1 PTR	Defines the source or constant for selection PARAM 11.09 of 11.02 EXT REF1 SELECT.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or a constant value. See 10.06 STRT/STP 1 PTR for information on the difference.	-
11.10	EXT REF2 PTR	Defines the source or constant for selection PARAM 11.10 of 11.05 EXT REF2 SELECT.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or a constant value. See 10.06 STRT/STP 1 PTR for information on the difference.	-
12 CONSTANT SPEEDS		Constant speed selection and values. An active constant speed overrides the drive speed reference (unless otherwise indicated).	
12.01	RAMPED SPEED SEL	Selects the activation signal source for the ramped constant speeds.	
	NOT SELECT	This function is not selected.	1
	DI5	Digital input DI5 = 1 selects RAMPED SPD1.	2

No.	Name/Value	Description	FbEq
	DI5-DI6	Digital input DI5 = 1 selects RAMPED SPD1. Digital input DI6 = 1 selects RAMPED SPD2. **Note:** If both digital inputs = 1, the speed reference is set to zero.	3
	XT DI3	See selection DI5.	4
	XT DI3-XT DI4	See selection DI5-DI6.	5
	FIELDBUS	See selection DI5-DI6. Instead of digital inputs, the selection comes from 06.01 COMMAND WORD bits 05 and 06. See chapter *Fieldbus control*.	6
12.02	RAMPED SPD 1	Defines the ramped speed 1.	
	-1800.0…1800.0 rpm	Setting range.	1 = 1 rpm
12.03	RAMPED SPD 2	Defines the ramped speed 2.	
	-1800.0…1800.0 rpm	Setting range.	1 = 1 rpm
13 ANALOG INPUTS		The analog input signal processing	
13.01	MINIMUM AI1	Defines the minimum value for analog 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 1, this value corresponds to the value of 11.03 EXT REF1 MINIMUM.	
	0 V	Zero Volts. **Note:** The program cannot detect a loss of analog input signal.	1
	2 V	Two Volts.	2
	TUNED VALUE	The value measured by the tuning function. See the selection TUNE.	3
	TUNE	The value measurement triggering. Procedure: - Connect the minimum signal to input. - Set the parameter to TUNE. **Note:** The readable range in tuning is 0 V to 10 V.	4
13.02	SCALE AI1	Scales analog input AI1. **Example:** The effect on speed reference REF1 when: - 11.04 EXT REF1 MAXIMUM = 1500 rpm. - Actual AI1 value = 4 V (40% of the full scale value). - 13.02 SCALE AI1 = 100%. 	
	50…500%	Scaling range.	1 = 1%

No.	Name/Value	Description	FbEq
13.03	FILTER AI1 ms	Defines the filter time constant for analog input AI1.  $O = I \cdot (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware (10 ms time constant). This cannot be changed by any parameter.	
	1…5000 ms	Filter time constant.	1 = 1 ms
13.04	MINIMUM AI2	Defines the minimum value for analog input AI2. When used as a reference, the value corresponds to the reference minimum setting.	
	0 mA	Zero milliAmps. **Note:** The program cannot detect a loss of analog input signal.	1
	4 mA	Four milliAmps.	2
	TUNED VALUE	The value measured by the tuning function. See selection TUNE.	3
	TUNE	The value measurement triggering. Procedure: 1. Connect the minimum signal to input. 2. Set the parameter to TUNE. **Note:** The readable range in tuning is 0 mA to 20 mA.	4
13.05	SCALE AI2	See 13.02 SCALE AI1	1 = 1%
13.06	FILTER AI2 ms	See 13.03 FILTER AI1 ms	1 = 1 ms
13.07	MINIMUM AI3	See 13.04 MINIMUM AI2	1…4
13.08	SCALE AI3	See 13.02 SCALE AI1	1 = 1%
13.09	FILTER AI3 ms	See 13.03 FILTER AI1 ms	1 = 1 ms
13.10	ZERO XT AI1	Defines the minimum value for analog input XT AI1. When used as a reference, the value corresponds to the reference minimum setting. ***Example:*** If XT AI1 is selected as the source for external reference 1, this value corresponds to the value of 11.03 EXT REF1 MINIMUM.	
	0 V	Zero Volts. **Note:** The program cannot detect a loss of analog input signal.	1
	TUNED VALUE	The value measured by the tuning function. See selection TUNE.	2
	TUNE	The value measurement triggering. Procedure: 1. Connect the minimum signal to input. 2. Set the parameter to TUNE. **Note:** The readable range in tuning is 0 V to 10 V.	3
13.11	SCALE XT AI1	See 13.02 SCALE AI1	1 = 1%
13.12	FILTER XT AI1 ms	See 13.03 FILTER AI1 ms	1 = 1 ms
13.13	ZERO XT AI2	See 13.10 ZERO XT AI1.	1…3
13.14	SCALE XT AI2	See 13.02 SCALE AI1	1 = 1%
13.15	FILTER XT AI2 ms	See 13.03 FILTER AI1 ms	1 = 1 ms
13.16	SCALE XT AI3	See 13.02 SCALE AI1	1 = 1%
13.17	SCALE XT AI4	See 13.02 SCALE AI1	1 = 1%

No.	Name/Value	Description	FbEq
14 RELAY OUTPUTS		Status information indicated through relay outputs.	
14.01	RO1 POINTER	The relay output is controlled by use of “pointers”. This parameter selects the word that the desired bit is packed in. Example: +.002.026.01 = Main Status Word bit 1 (RDY_RUN).	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or a constant value. See 10.06 STRT/STP 1 PTR for information on the difference.	-
14.03	RO1 TON DELAY	Defines the operation delay for the relay output RO1. The figure below illustrates the operation and release delays for relay output RO1.  t_{On} 14.03 t_{Off} 14.04	
	0.01…9999.00 s	Setting range.	1 = 1 s
14.04	RO1 TOFF DELAY	Defines the release delay for the relay output RO1.	
	0.01…9999.00 s	Setting range.	1 = 1 s
14.05	RO2 POINTER	See 14.01 RO1 POINTER.	-
14.07	RO2 TON DELAY	See 14.03 RO1 TON DELAY.	1 = 1 s
14.08	RO2 TOFF DELAY	See 14.04 RO1 TOFF DELAY.	1 = 1 s
14.09	RO3 POINTER	See 14.01 RO1 POINTER.	-
14.11	RO3 TON DELAY	See 14.03 RO1 TON DELAY.	1 = 1 s
14.12	RO3 TOFF DELAY	See 14.04 RO1 TOFF DELAY.	1 = 1 s
14.13	XT RO1 POINTER	See 14.01 RO1 POINTER.	-
14.15	XT RO2 POINTER	See 14.01 RO1 POINTER.	-
14.17	XT RO3 POINTER	See 14.01 RO1 POINTER.	-
14.19	XT RO4 POINTER	See 14.01 RO1 POINTER.	-
15 ANALOG OUTPUTS		The analog output signal processing	
15.01	ANALOG OUTPUT1	The analog output is controlled by use of “pointers”. This parameter selects the word that is the desired output. Example: +.001.002.00 = MOTOR SPEED FILT.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or a constant value. See 10.06 STRT/STP 1 PTR for information on the difference.	-
15.03	MINIMUM AO1	Defines the minimum value of the analog output signal AO1.	
	0 mA	Zero mA.	1
	4 mA	Four mA.	2
	10 mA	Ten mA. 50% offset on 0 to 20 mA for testing or indication of direction.	3

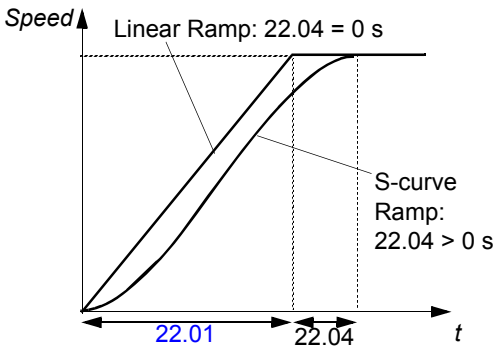
No.	Name/Value	Description	FbEq
15.04	FILTER AO1 ms	Defines the filtering time constant for analog output AO1.  $O = I \cdot (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant **Note:** Even if you select 0 s as the minimum value, the signal is still filtered with a time constant of 10 ms due to the signal interface hardware. This cannot be changed by any parameters.	
	0…10000 ms	Filter time constant.	1 = 1 ms
15.05	SCALE AO1	When the value of the signal selected in 15.01 ANALOG OUTPUT 1 equals this parameter, the output = 20 mA.	
	0…65535	Setting range.	10 = 1
15.06	ANALOG OUTPUT2	See 15.01 ANALOG OUTPUT1.	-
15.08	MINIMUM AO2	See 15.03 MINIMUM AO1.	1…3
15.09	FILTER AO2 ms	See 15.04 FILTER AO1 ms.	1 = 1 ms
15.10	SCALE AO2	See 15.05 SCALE AO1.	10 = 1
15.11	XT ANALOG OUTPUT1	See 15.01 ANALOG OUTPUT1.	-
15.13	MINIMUM XT AO1	See 15.03 MINIMUM AO1.	1…3
15.14	FILTER XT AO1	See 15.04 FILTER AO1 ms.	1 = 1 ms
15.15	SCALE XT AO1	See 15.05 SCALE AO1.	10 = 1
15.16	XT ANALOG OUTPUT 2	See 15.01 ANALOG OUTPUT1.	-
15.18	MINIMUM XT AO2	See 15.03 MINIMUM AO1.	1…3
15.19	FILTER XT AO2	See 15.04 FILTER AO1 ms.	1 = 1 ms
15.20	SCALE XT AO2	See 15.05 SCALE AO1.	10 = 1
16 SYSTEM CTR INPUTS		Fault reset, parameter lock, etc.	
16.01	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 SELECT	Fault reset only from the control panel keypad (RESET key).	1
	DI2	Reset through digital input DI2 or by control panel: - If the drive is in external control mode: Reset by a rising edge of DI2 - If the drive is in local control mode: Reset by the RESET key of the control panel.	2
	DI3	See selection DI2.	3
	DI4	See selection DI2.	4
	DI5	See selection DI2.	5
	DI6	See selection DI2.	6
	FIELDBUS	See selection DI2. Instead of a digital input, the selection comes from 06.01 COMMAND WORD bit 07. See chapter *Fieldbus control*.	7
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

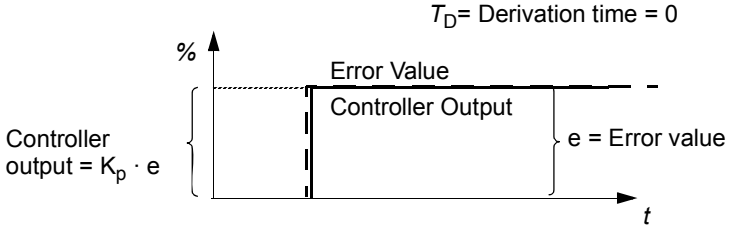
No.	Name/Value	Description	FbEq
	LOCKED	Locked. Parameter values cannot be changed from the control panel. The lock can be opened by entering the valid Pass Code.	65535
16.03	PASS CODE	Selects the pass code for the parameter lock.	
	0…32767	Setting 358 opens the lock. The value reverts back to 0 automatically.	1 = 1
16.04	LOCAL LOCK	Disables entering to 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
16.05	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	Saving started.	0
	SAVE…	Saving is done.	1
17 DC HOLD		DC hold settings. **Note:** This group is not visible if 99.04 is SCALAR.	
17.01	DC HOLD ACTIVE	Activates/deactivates the DC hold function. DC Hold is not possible if 99.04 MOTOR CTRL MODE is SCALAR. When both the reference and the speed drop below 17.02 DC HOLD SPEED, the drive will stop generating sinusoidal current and start to inject DC into the motor. The current is set by 17.03 DC HOLD CURRENT. When the reference speed exceeds 17.02 DC HOLD SPEED, normal drive operation continues.  **Note:** DC Hold has no effect if the start signal is switched off. **Note:** Injecting DC current into the motor causes the motor to heat up. In applications where long DC hold times are required, externally ventilated motors should be used. If the DC hold period is long, the DC hold cannot prevent the motor shaft from rotating if a constant load is applied to the motor. See section *DC Hold* on page 33.	
	NO	Function inactive.	0
	YES	Function active.	65535
17.02	DC HOLD SPEED	Defines the DC Hold speed. See 17.01 DC HOLD ACTIVE.	
	0…3600 rpm	Speed in rpm.	1 = 1 rpm
17.03	DC HOLD CURR	Defines the DC hold current. See 17.01 DC HOLD ACTIVE.	
	0…100.0%	Current in percent of the motor nominal current.	1 = 1%

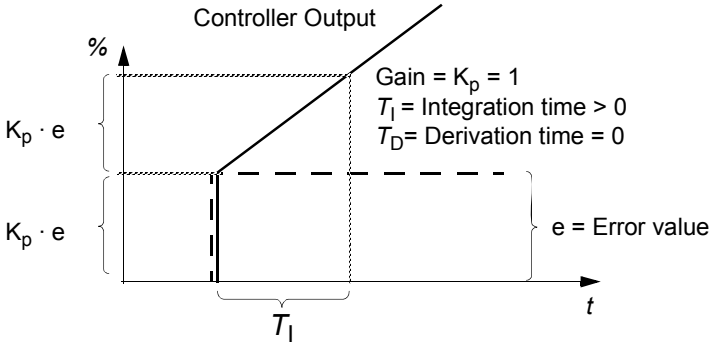
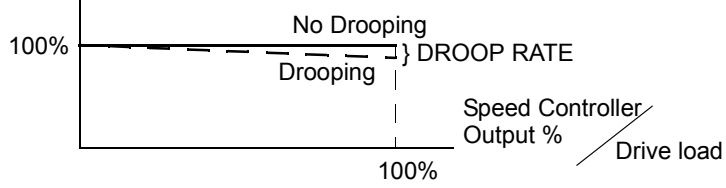
No.	Name/Value	Description	FbEq
20 LIMITS		Drive operation limits.	
20.01	MINIMUM SPEED	Defines the allowed minimum speed. The value cannot be set if 99.04 MOTOR CTRL MODE is SCALAR. **WARNING!** The limit is linked to the motor nominal speed setting i.e. 99.08 MOTOR NOM SPEED. If 99.08 MOTOR NOM SPEED is changed, the default speed limit will also change.	
	-18000 / (no. of pole pairs) …MAXIMUM SPEED	Minimum speed limit	20000 = 11.04 EXT REF1 MAX
20.02	MAXIMUM SPEED	Defines the allowed minimum speed. The value cannot be set if 99.04 MOTOR CTRL MODE is SCALAR. **WARNING!** The limit is linked to the motor nominal speed setting i.e. 99.08 MOTOR NOM SPEED. If 99.08 MOTOR NOM SPEED is changed, the default speed limit will also change.	
	MINIMUM SPEED…18000 / (no. of pole pairs)	Maximum speed limit.	20000 = 11.04 EXT1 REF MAX
22.03	EM STOP RAMP TIME	Defines the time inside which the drive is stopped if the drive receives an emergency stop command.	200 = 1%
20.04	MAXIMUM CURRENT	Defines the allowed maximum motor current in percent of the rated heavy-duty use output current (I_{2hd}).	
	0.0…x.xA	Current limit	10 = 1 A
20.05	SPC TORQMAX	Maximum torque limit of the speed regulator output.	
	0…600.0%	Setting range.	100 = 1%
20.06	SPC TORQMIN	Minimum torque limit of the speed regulator output.	
	-600.0…0%	Setting range.	100 = 1%
20.07	FREQ TRIP MARGIN	Defines the allowable overspeed limit, in frequency units, for the overspeed protection function. This value is added to 20.02 MAXIMUM SPEED (if 99.04 MOTOR CTRL MODE = DTC) or 29.02 MAXIMUM FREQ (if 99.04 MOTOR CTRL MODE = SCALAR) to define the overspeed limit. If the motor speed exceeds the sum of 20.02 MAXIMUM SPEED + 20.07 FREQ TRIP MARGIN, the trip OVERSPEED FAULT is activated. **Example:** 99.07 MOTOR NOM FREQ = 60 Hz 99.08 MOTOR NOM SPEED = 1140 rpm 20.02 MAXIMUM SPEED = 1140 rpm 20.07 FREQ TRIP MARGIN = 30 Hz For this example, the MAXIMUM SPEED = MOTOR NOM SPEED and the FREQ TRIP MARGIN = [0.5 x MOTOR NOM FREQ], therefore the drive will trip at 1.5 x the Nominal Speed (Freq) or 1710 rpm (90 Hz).	
	0…500 Hz	Setting range.	100 = 1 Hz
21 START/STOP		Start and stop modes of the motor.	
21.01	START FUNCTION	Selects the motor starting method. See also section *Automatic Start* on page 33.	

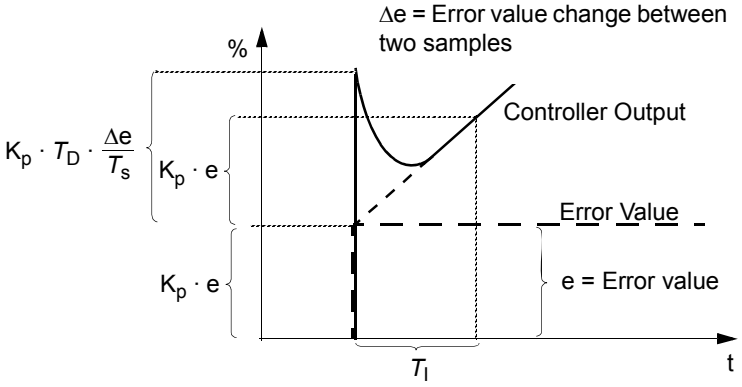
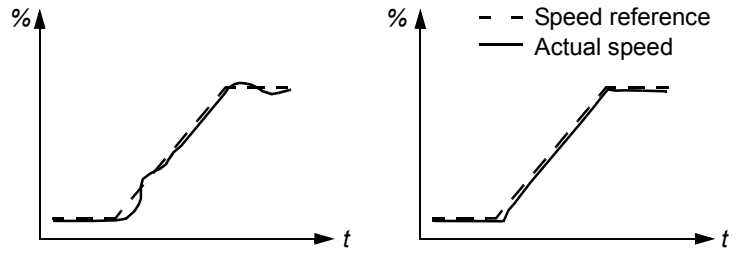
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td>AUTO</td><td>Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting to a rotating machine) and the automatic restart function (stopped motor can be restarted immediately without waiting the motor flux to die away). The drive motor control program identifies the flux as well as the mechanical state of the motor and starts the motor instantly under all conditions.
Note: In scalar control mode (99.04 MOTOR CTRL MODE is SCALAR), no flying start or automatic restart is possible by default.</td><td>1</td></tr>
<tr><td></td><td>DC MAGN</td><td>DC magnetizing should be selected if a high break-away torque is required. The drive pre-magnetizes the motor before the start. The pre-magnetizing 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 magnetizing is selected.
Note: DC magnetizing cannot be selected in scalar control mode (99.04 MOTOR CTRL MODE is SCALAR).</td><td>2</td></tr>
<tr><td></td><td>CNST DCMAGN</td><td>Constant DC magnetizing should be selected instead of DC magnetizing if constant pre-magnetizing 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-magnetizing time is set long enough. The pre-magnetizing time is defined by 21.02 CONST MAGN TIME.
Note: Starting to a rotating machine is not possible when DC magnetizing is selected.
Note: DC magnetizing cannot be selected in scalar control mode (99.04 MOTOR CTRL MODE is SCALAR).
WARNING! The drive will start after the set magnetizing time has passed although the motor magnetization is not completed. Ensure always in applications where a full break-away torque is essential, that the constant magnetizing time is long enough to allow generation of full magnetization and torque.</td><td>3</td></tr>
<tr><td>21.02</td><td>CONST MAGN TIME</td><td>Defines the magnetizing time in the constant magnetizing mode. See 21.01 START FUNCTION. After the start command, ACS800 automatically pre-magnetizes the motor the set time.</td><td></td></tr>
<tr><td></td><td>30.0…10000.0 ms</td><td>Magnetizing time. To ensure full magnetizing, set this value to the same value as or higher than the rotor time constant. If not known, use the rule-of-thumb value given in the table below:
<table><tr><th>Motor Rated Power</th><th>Constant Magnetizing Time</th></tr><tr><td>< 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>1 = 1 ms</td></tr>
</table>

No.	Name/Value	Description	FbEq
21.03	FREE DIRECT MAGN	When FREE DIRECT MAGN is set to ON and 21.01 START FUNCTION is set to CNST DC MAGN, the drive will memorize the rotor's last position (angle of flux). When the drive is restarted, the flux will be applied in the last position when stopped. **CAUTION!** If the machine moves after the drive has stopped controlling the motor, the memorized flux position may not be correct for the rotor position since the rotor has moved. This may cause the motor to rotate to the last memorized position. This should be less than half a rotation.	
	OFF	FREE DIRECT MAGN deactivated.	0
	ON	FREE DIRECT MAGN activated.	65535
21.04	STOP FUNCTION	Selects the motor stop function.	
	RAMP STOP	Stop along a ramp defined by the active deceleration time. See group 22 ACCEL/DECEL.	0
	COAST STOP	Stop by cutting off the motor power supply. The motor coasts to a stop.	65535
21.05	EME STOP MODE	The drive stopping method when an E-Stop command has been received.	
	STOP RAMPING	The drive ramps to zero speed in the time set by 22.03 EM STOP RAMP TIME. When the drive reaches zero speed, it will turn off (remove RUN).	1
	STOP TORQUE	The drive decelerates to zero speed at the torque limits. When the drive reaches zero speed it will turn off (remove RUN).	2
	COAST STOP	The drive coasts to a stop (immediate removal of RUN).	3
21.06	ESTOP COAST DELAY	Time allowed for the drive to stop, after an E-stop command is received, before an internal coast stop is commanded.	
	0…100 s	Setting range.	1 = 1 s
22 ACCEL/DECEL		Acceleration and deceleration times. See section *Acceleration and deceleration ramps* on page 35.	
22.01	ACCEL TIME 1	Defines the acceleration time, i.e. the time required for the speed to change from zero to the maximum speed. - If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. - If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference signal. - If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive operating limits.	
	0.00…1000.00 s	Acceleration time.	100 = 1 s

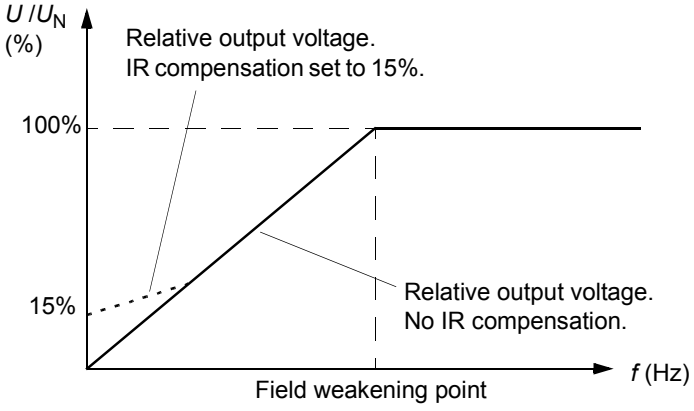
No.	Name/Value	Description	FbEq
22.02	DECEL TIME 1	Defines the deceleration time, i.e. the time required for the speed to change from the maximum to zero. - If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference signal. - If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. - If the deceleration time is set too short, the drive will automatically prolong the deceleration in order not to exceed drive operating limits. If there is any doubt about the deceleration time being too short, ensure that the DC overvoltage control is on. **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 braking chopper and a braking resistor.	
	0.00…1800.00 s	Deceleration time	100 = 1 s
22.03	EM STOP RAMP TIME	Defines the time inside which the drive is stopped if the drive receives an emergency stop command.	
	0.0…1000.0 s	E-stop deceleration time.	10 = 1 s
22.04	RAMP SHAPE TIME	0.0 s: Linear Ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.01 to 1000.0 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 section in between. A rule of thumb. A suitable relation between the ramp shape time and the acceleration ramp is 1/5. 	
	0.00…1000.00 s	Acceleration time.	100 = 1 s
23 SPEED REFERENCES		Speed controller variables. **Note:** These values are READ ONLY.	
23.01	SPEED REF	Initial speed reference from keypad or remote source.	20000 = EXT REF MAX
24 SPEED CTRL TUNE		Speed controller variables. See section *Speed controller tuning* on page 36.	
24.01	PI TUNE	Start automatic tuning of the speed controller. Instructions: - Run the motor at a constant speed of 20 to 40% of the rated speed. - Change the parameter to ON. **Note:** The motor load must be connected to the motor.	
	OFF	No autotuning.	0

No.	Name/Value	Description	FbEq
	ON	Activates the speed controller autotuning. Automatically reverts to NO.	65535
24.02	DAMPENING COEF	Coefficient of dampening for PI TUNE. A lower value yields an increased dynamic response. **Note:** Visible only after entering proper passcode in 16.03 PASS CODE.	
	0.00…8.00	Setting range.	10 = 1
24.03	P-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. Gain = K_p = 1 T_I = Integration time = 0 T_D= Derivation time = 0  	
	0.0…250.0	Gain.	100 = 1
24.04	P-GAIN MIN	The proportional gain setting when the speed controller output is zero. **Note:** Visible only after entering proper passcode in 16.03 PASS CODE.	
	0…100	Setting range.	1 = 1
24.05	P-GAIN WEAKPOINT	The output level of the speed controller where the gain is set to GAIN. **Note:** Visible only after entering proper passcode in 16.03 PASS CODE.	
	0…Max Torque%	Setting range.	1 = 1%
24.06	P-GAIN WP FILT	This can soften the rate of change for the proportional gain. **Note:** Visible only after entering proper passcode in 16.03 PASS CODE.	
	0…99999 ms	Filter time constant.	1 = 1 ms

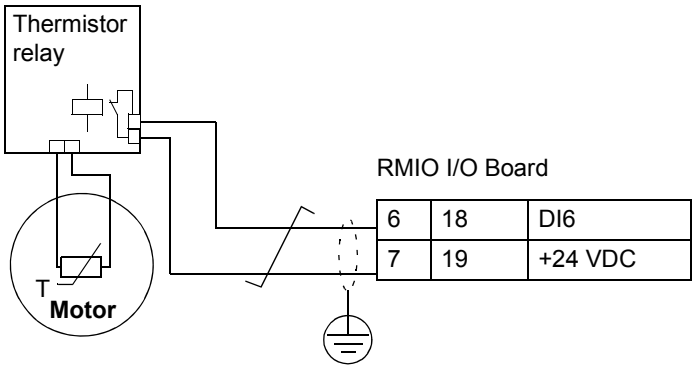
No.	Name/Value	Description	FbEq
24.09	INTEGRATION TIME	Defines an integration time for the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant. The shorter the integration time, the faster the continuous error value is corrected. 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.	1000 = 1 s
24.10	INTEG INIT VALUE	Initial value of the integrator.	
	-300.00…300.00%	Setting range.	100 = 1%
24.11	DROOP RATE	Defines the droop rate. The parameter value needs to be changed only if both the Master and the Follower are speed-controlled. The droop rate needs to be set both for the Master and the Follower. The correct droop rate for a process must be found out case by case in practice. The drooping prevents a conflict between the Master and the Follower by allowing a slight speed difference between them. The drooping slightly decreases the drive speed as the drive load increases. The actual speed decrease at a certain operating point depends on the droop rate setting and the drive load (= torque reference / speed controller output). At 100% speed controller output, drooping is at its nominal level, i.e. equal to the value of the DROOP RATE. The drooping effect decreases linearly to zero along with the decreasing load. **Speed Decrease =** Speed Controller Output · Drooping · Max. Speed *Motor Speed % of nominal* **Example:** Speed Controller output is 50%, DROOP RATE is 1%, maximum speed of the drive is 1500 rpm. Speed decrease = 0.50 · 0.01 · 1500 rpm = 7.5 rpm 	
	0.0…100.0%	Setting range.	10 = 1%

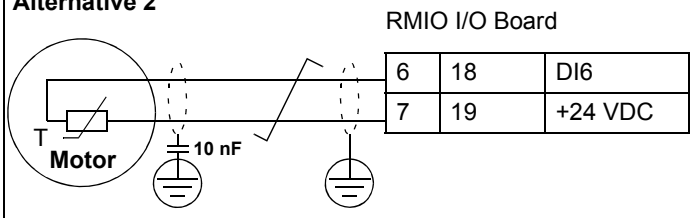
No.	Name/Value	Description	FbEq
24.12	DERIVATION TIME	Defines the derivation time for the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. **Note:** Changing this parameter is recommended only if a pulse encoder is used. The figure below shows the speed controller output after an error step when the error remains constant. Gain = K_p = 1 T_I = Integration time > 0 T_D= Derivation time > 0 T_s= Sample time period = 2 ms Δe = Error value change between two samples 	
	0.0…9999.8 ms	Derivation time value.	1 = 1 ms
24.13	DERIV FILT TIME	Derivation time for the speed controller.	
	0.0…10000.0 ms	Setting range.	1 = 1 ms
24.14	ACC COMP DERV	Defines the derivation time for acceleration compensation. In order to compensate inertia during acceleration a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described in 24.12 DERIVATION TIME. **Note:** As a general rule, set this parameter to the value between 50 and 100% of the sum of the mechanical time constants of the motor and the driven machine. (The speed controller autotuning does this automatically, see 24.01 PI TUNE.) The figure below shows the speed responses when a high inertia load is accelerated along a ramp. **No Acceleration Compensation** **Acceleration Compensation** 	
	0.00…999.98 s	Derivation time.	10 = 1 s
24.15	ACC COMP FILT	Acceleration compensation term filter coefficient.	

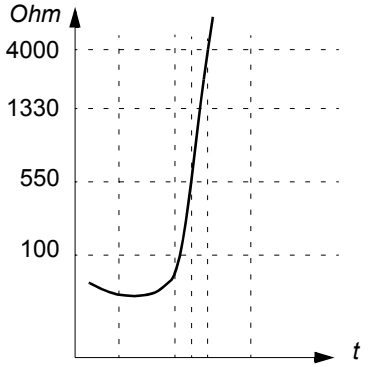
No.	Name/Value	Description	FbEq
	0.00…999999.00 ms	Setting range.	1 = 1 ms
24.16	SLIP GAIN	Defines the slip gain for the motor slip compensation control. 100% means full slip compensation; 0% means no slip compensation. The default value is 100%. Other values can be used if a static speed error is detected despite of the full slip compensation. **Example:** 1000 rpm constant speed reference is given to the drive. Despite of the full slip compensation (SLIP GAIN = 100%), a manual tachometer measurement from the motor axis gives a speed value of 998 rpm. The static speed error is 1000 rpm - 998 rpm = 2 rpm. To compensate the error, the slip gain should be increased. At the 106% gain value, no static speed error exists.	
	0.0…400.0%	Slip gain value.	1 = 1%
24.17	KPS TIS MIN FREQ	The minimum frequency limit above which the relative gain and integral time is defined by KPS VAL MIN FREQ and TIS VAL MIN FREQ. **Note:** Visible only after entering proper passcode in 16.03 PASS CODE.	
	0…200 Hz	Setting range.	1 = 1 Hz
24.18	KPS TIS MAX FREQ	The frequency point which relative KPS and TIS equal 100%. **Note:** Visible only after entering proper passcode in 16.03 PASS CODE.	
	0…200 Hz	Setting range.	1 = 1 Hz
24.19	KPS VAL MIN FREQ	The relative gain percentage of the KPS value at the speed defined by KPS TIS MIN FREQ. **Note:** Visible only after entering proper passcode in 16.03 PASS CODE.	
	100…500%	Setting range.	1 = 1%
24.20	TIS VAL MIN FREQ	The relative gain percentage of the TIS value at the speed defined by KPS TIS MIN FREQ. **Note:** Visible only after entering proper passcode in 16.03 PASS CODE.	
	100…500%	Setting range.	1 = 1%
24.21	SPEED FDBK FILT	The time constant of the first order actual speed filter. **Note:** Visible only after entering proper passcode in 16.03 PASS CODE.	
	0.0…999999.0 ms	Setting range.	1 = 1 ms
27 FLUX CONTROL		Flux control variables. Improves the stability of a system by decreasing the amount of electrical motor flux when low torque requirements are present.	
27.01	FLUX OPTIMIZATION	Activates/deactivates the flux optimization function. **Note:** The function cannot be used if 99.04 MOTOR CTRL MODE is SCALAR. See section *Flux Optimization* on page 35.	
	NO	Inactive.	0
	YES	Active.	65535

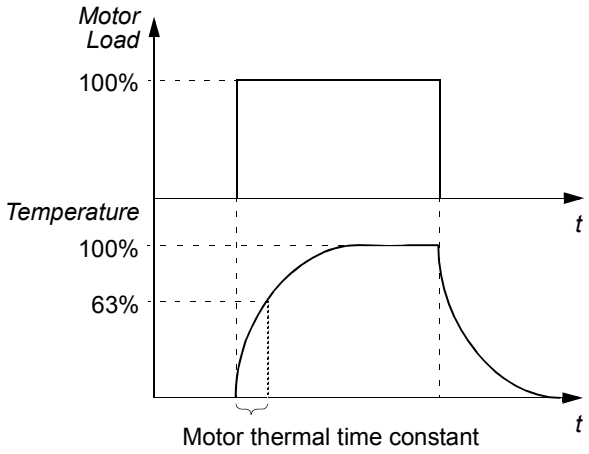
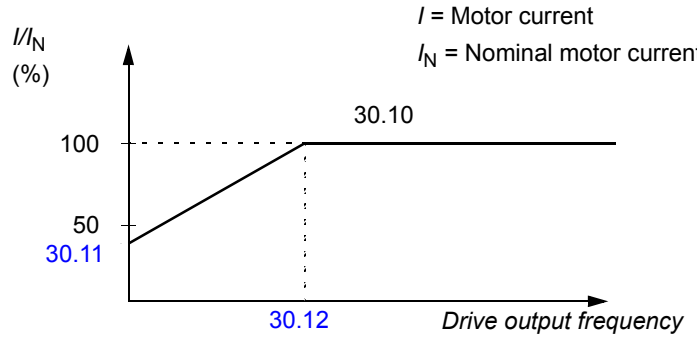
No.	Name/Value	Description	FbEq
27.02	FLUX BRAKING	Activates/deactivates the flux braking function. **Note:** The function cannot be used if 99.04 MOTOR CTRL MODE is SCALAR. See section *Flux Braking* on page 34.	
	NO	Inactive.	0
	YES	Active.	65535
27.03	FLUX REFERENCE	Maximum flux reference. Used if 27.01 FLUX OPTIMAZATION is NO or if the required motor torque is > 30%.	
	25…140%	Setting range.	10 = 1%
27.04	FS METHOD	Activates the flux correction at low frequencies, < 3 Hz, when the torque exceeds 30%. Effective in the motoring and generating modes.	
	OFF	Inactive.	0
	ON	Active.	65535
29 SCALAR CONTROL		Frequency reference variables. **Note:** This group is not visible if 99.04 MOTOR CTRL MODE = DTC.	
29.01	FREQUENCY REF	Initial frequency reference from the keypad or remote source. **Note:** This parameter is READ ONLY.	100 = 1 Hz
29.02	MAXIMUM FREQ	Defines the maximum limit for drive output frequency.	
	MINIMUM FREQ… 300.00 Hz	Maximum frequency limit.	100 = 1 Hz
29.03	MINIMUM FREQ	Defines the minimum limit for drive output frequency.	
	-300.00 Hz… MAXIMUM FREQ	Minimum frequency limit.	100 = 1 Hz
29.04	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 99.04 MOTOR CTRL MODE is SCALAR. 	
	0…30%	Setting range.	100 = 1% (UN)
30 FAULT FUNCTIONS		Programmable protection functions	
30.01	MOT THERM P MODE	Selects the thermal protection mode of the motor. When overtemperature is detected, the drive reacts as defined by 30.02 MOTOR THERM PROT.	

No.	Name/Value	Description	FbEq
	DTC	The protection is based on the calculated motor thermal model. The following assumptions are used in the calculation: - The motor is at the estimated temperature (value of 01.17 MOTOR TEMP EST saved at power switch off) when the power is switched on. With the first power switch on, the motor is at the ambient temperature 86 °F (30 °C). - 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 fine tune the model by 30.10 MOTOR LOAD CURVE. **Note:** The model cannot be used with high power motors (99.06 MOTOR NOM CURRENT 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 the estimated temperature (value of 01.17 MOTOR TEMP EST saved at power switch off) when the power is switched on. With the first power switch on, the motor is at the ambient temperature 86 °F (30 °C). - 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 30.09 MOTOR THEM TIME and the motor load curve (set by 30.10, 30.11 and 30.12). 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>No.</th><th>Name/Value</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>
<tr><td></td><td>KLIXON</td><td>Temperature switch in the motor windings. Uses digital input DI6.</td><td>4</td></tr>
<tr><td>30.02</td><td>MOTOR THERM PROT</td><td>Selects how the drive reacts when the motor overtemperature is detected by the function defined by 30.01 MOT THERM P MODE. See section Motor Thermal Protection on page 39.</td><td></td></tr>
<tr><td></td><td>NO</td><td>Inactive</td><td>1</td></tr>
<tr><td></td><td>WARNING</td><td>The drive generates a warning when the temperature exceeds the warning level (95% of the nominal value).</td><td>2</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td>FAULT</td><td>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).</td><td>3</td></tr>
<tr><td>30.03</td><td>MOT1 TEMP AI1 SEL</td><td>Activates the motor 1 temperature measurement function and selects the sensor type.</td><td></td></tr>
<tr><td></td><td>NOT IN USE</td><td>The function is inactive.</td><td>1</td></tr>
<tr><td></td><td>1xPT100</td><td>The function is active. The temperature is measured with one Pt100 sensor. Analog output AO1 feeds constant current through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through analog input AI1 and converts it to degrees centigrade.</td><td>2</td></tr>
<tr><td></td><td>2xPT100</td><td>The function is active. Temperature is measured using two Pt100 sensors. See selection 1xPT100.</td><td>3</td></tr>
<tr><td></td><td>3xPT100</td><td>The function is active. Temperature is measured using three Pt 100 sensors. See selection 1xPT100.</td><td>4</td></tr>
<tr><td></td><td>1…3 PTC</td><td>The function is active. The temperature is supervised using one to three PTC sensors. Analog output AO1 feeds constant current through the sensor(s). The resistance of the sensor increases sharply as the motor temperature rises over the PTC reference temperature (T_{ref}), as does the voltage over the resistor. The temperature measurement function reads the voltage through analog input AI1 and converts it into Ohms. The figure below shows typical PTC sensor resistance values as a function of the motor operating temperature.
<table><tr><th>Temperature</th><th>Resistance</th></tr><tr><td>Normal</td><td>0…1.5 kOhm</td></tr><tr><td>Excessive</td><td>≥ 4 kOhm</td></tr></table> 
</td><td>5</td></tr>
<tr><td>30.04</td><td>MOT1 TEMP ALM</td><td>Defines the alarm limit for motor 1 temperature measurement. The alarm indication is given when the limit is exceeded.</td><td></td></tr>
<tr><td></td><td>-10…10000 Ohm/°C (PTC/Pt100)</td><td>Limit in °C or Ohms.
°C: 30.03 MOT1 TEMP AI1 SEL is 1xPT100, 2XPT100, 3XPT100.
Ohm: 30.03 MOT1 TEMP AI1 SEL is 1…3 PTC.</td><td>1 = 1 °C</td></tr>
<tr><td>30.05</td><td>MOT1 TEMP FLT</td><td>Defines the fault trip limit for motor 1 temperature measurement. The fault indication is given when the limit is exceeded.</td><td></td></tr>
<tr><td></td><td>-10…10000 Ohm/°C (PTC/Pt100)</td><td>Limit in °C or Ohms.
°C: 30.03 MOT1 TEMP AI1 SEL is 1xPT100, 2XPT100, 3XPT100.
Ohm: 30.03 MOT1 TEMP AI1 SEL is 1…3 PTC.</td><td>1 = 1 °C</td></tr>
</table>

No.	Name/Value	Description	FbEq
30.09	MOTOR THERM TIME	Defines the thermal time constant for the user-defined thermal model (see selection USER MODE of 30.01 MOTOR THERM P MODE).  	
	256.0…9999.8 s	Time constant	1 = 1 s
30.10	MOTOR LOAD CURVE	Defines the load curve together with 30.11 ZERO SPEED LOAD and 30.12 BREAK POINT. The load curve is used in the user-defined thermal model (see selection USER MODE of 30.01 MOTOR THERM P MODE).  	
	50.0…150.0%	Allowed continuous motor load in percent of the nominal motor current.	1 = 1%
30.11	ZERO SPEED LOAD	Defines the load curve together with 30.10 MOTOR LOAD CURVE and 30.12 BREAK POINT.	
	25.0…150.0%	Allowed continuous motor load at zero speed in percent of the nominal motor current	1 = 1%
30.12	BREAK POINT	Defines the load curve together with 30.10 MOTOR LOAD CURVE and 30.11 ZERO SPEED LOAD.	
	1.0…300.0 Hz	Drive output frequency at 100% load	100 = 1 Hz
30.13	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 30.14 STALL FREQ HI and - the conditions above have been valid longer than 30.15 STALL TIME. See section *Stall Protection* on page 40.	

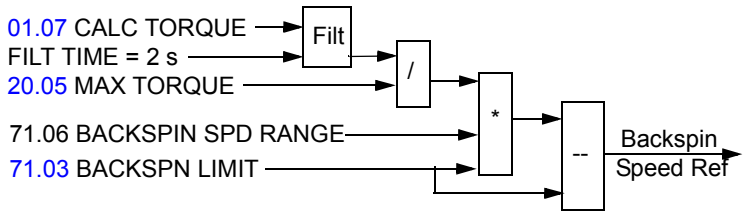
No.	Name/Value	Description	FbEq
	NO	Protection is invalid.	1
	WARNING	The drive generates a warning. The indication disappears in half of the time set by 30.15 STALL TIME.	2
	FAULT	The drive trips on a fault.	3
30.14	STALL FREQ HI	Defines the frequency limit for the stall function. See 30.13 STALL FUNCTION.	
	0.5…50.0 Hz	Stall frequency.	100 = 1 Hz
30.15	STALL TIME	Defines the time for the stall function. See 30.13 STALL FUNCTION.	
	10.00…400.00 s	Stall time.	1 = 1 s
30.19	MOTOR PHASE LOSS	Activates the motor phase loss supervision function. See section *Motor Phase Loss* on page 40.	
	NO	Inactive.	0
	FAULT	Active. The drive trips on a fault.	65535
30.20	GROUND FAULT	Selects how the drive reacts when an ground fault is detected in the motor or the motor cable. See section *Ground Fault Protection* on page 40.	
	NO	Inactive.	0
	FAULT	Active. The drive trips on a fault.	65535
30.21	UNDERVOLTAGE	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
30.22	OVERVOLTAGE	Activates or deactivates the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque. **Note:** If a braking chopper and resistor are connected to the drive, the controller must be off (selection NO) to allow chopper operation.	
	OFF	Overvoltage control deactivated.	0
	ON	Overvoltage control activated.	65535
30.23	AI<MIN FUNC	Selects how the drive reacts when an analog input signal falls below the set minimum limit. Only active if 11.02 EXT REF1 SELECT or 11.05 EXT REF2 SELECT is using an AI. **Note:** The analog input minimum setting must be set to 0.5 V (1 mA) or above (see group 13 ANALOG INPUTS).	
	NO	Inactive.	1

No.	Name/Value	Description	FbEq
	WARNING	The drive generates a warning AI < MIN FUNC and continues to run. **WARNING!** Make sure that it is safe to continue operation in case the analog input signal is lost.	2
	FAULT	The drive trips on fault and shuts down.	3
	LAST SPEED	The drive generates a warning and freezes the speed to the level the drive was operating at. The speed is determined by the average speed over the previous 10 seconds. **WARNING!** Make sure that it is safe to continue operation in case the analog signal is lost.	4
30.24	KEYPAD LOSS FUNC	Selects how the drive reacts to a control panel communication break. **Note:** Only active if 11.02 EXT REF1 SELECT or 11.05 EXT REF2 SELECT is using KEYPAD.	
	FAULT	The drive trips on a fault and shuts down.	1
	LAST SPEED	The drive generates a warning and freezes the speed to the level the drive was operating at. The speed is determined by the average speed over the previous 10 seconds. **WARNING!** Make sure that it is safe to continue operation in case the analog input is lost.	2
30.25	EXTERNAL FAULT	Selects an interface for an external fault signal.	
	NOT SELECT	Inactive.	1
	DI2	External fault indication is given through digital input DI2. 0 = Fault trip; drive will shutdown. 1 = No external fault.	2
	DI3	See selection DI2.	3
	DI4	See selection DI2.	4
	DI5	See selection DI2.	5
	DI6	See selection DI2.	6
	XT DI2	See selection DI2.	7
	XT DI3	See selection DI2.	8
34 AUTO FLT 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).	
34.01	OVERVOLTAGE CTRL	Activates/deactivates the automatic reset for the intermediate link overvoltage fault.	
	OFF	Inactive.	0
	ON	Active.	65535
34.02	UNDERVOLTAGE CTRL	Activates/deactivates the automatic reset for the intermediate link undervoltage fault.	
	OFF	Inactive.	0
	ON	Active.	65535
34.03	ROD TORQ CTRL	Activates/deactivates the automatic reset for the high torque limit fault.	
	OFF	Inactive.	0
	ON	Active.	65535

No.	Name/Value	Description	FbEq
34.04	AI<MIN CTRL	Activates/deactivates the automatic reset for the intermediate link AI < min fault.	
	OFF	Inactive.	0
	ON	Active.	65535
34.05	UNDERLOAD CTRL	Activates/deactivates the automatic reset for the underload fault.	
	OFF	Inactive.	0
	ON	Active.	65535
34.06	NUMBER OF TRIALS	Defines the number of automatic fault resets the drive performs within the time defined by 34.08 TRIAL TIME.	
	0…10	Number of the automatic resets.	1 = 1
34.07	OFF DELAY TIME	Defines the time that the drive will wait after a fault before attempting an automatic reset. See 34.06 NUMBER OF TRIALS.	
	0.0…100000.0 s	Resetting delay.	1 = 1 s
34.08	TRIAL TIME	Defines the time for the automatic fault reset function. See 34.06 NUMBER OF TRIALS.	
	0.0…100000.0 s	Allowed resetting time.	1 = 1 s
34.09	PRESS SWITCH CTRL	Activates/deactivates the automatic reset for the high pressure switch fault.	
	OFF	Inactive.	0
	ON	Active.	65535
34.10	LINE CONV CTRL	Activates/deactivates the automatic reset for the line converter fault (fault on line side converter).	
	OFF	Inactive.	0
	ON	Active.	65535
50 PULSE ENCODER		Encoder connection. Visible only when a pulse encoder module (optional) is installed and activated by 98.01 ENCODER MODULE. The settings will remain the same even though the application macro is changed.	
50.01	ENCODER PULSE NR	States the number of encoder pulses per one revolution.	
	0…29999 ppr	Pulse number in pulses per round (ppr).	1 = 1 ppr
50.02	SPEED MEAS MODE	Defines how the encoder pulses are calculated.	
	A_- B DIR	Channel A: positive edges calculated for speed. Channel B: direction.	1
	A_-_	Channel A: positive and negative edges calculated for speed. Channel B: not used.	2
	A_-_ B DIR	Channel A: positive and negative edges are calculated for speed. Channel B: direction.	3
	A_-_ B_-_	All edges of the signals are calculated. (**Recommended Setting.**)	4
50.03	SPEED FDBK SEL	Defines how the encoder pulses are calculated.	
	INTERNAL	Calculated speed estimate.	1
	ENCODER	Actual speed measured with an encoder.	2

No.	Name/Value	Description	FbEq
50.04	ENCODER FAULT	Defines the operation of the drive if a failure is detected in communication between the pulse encoder and the Pulse Encoder Interface Module or in between the module and the drive. Encoder supervision function activates if either of the following conditions is valid: - There is a 20% difference between the estimated speed and the measured speed received from the encoder. - No pulses are received from the encoder within the defined time and the motor torque is at the allowed maximum value.	
	ALARM	The drive generates a warning indication.	0
	FAULT	The drive trips on a fault, gives a fault indication and stops the motor.	65535
50.05	NTAC FILTER	Medium filter time for the speed measurement in the NTAC module.	
	0…20 ms	Setting range.	1 = 1 ms
51 MASTER ADAPTER		The parameters are visible and need to be adjusted only when a fieldbus adapter module (optional) is installed and activated by 98.02 COMM MODULE. For details on the parameters, refer to the manual for the fieldbus module. These parameter settings will remain the same even if the macro is changed.	
52 STANDARD MODBUS		The setting for the standard modbus link.This group will be visible only when Standard Modbus is selected by 98.02 COMM MODULE.	
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 = 1
52.02	BAUDRATE	Defines the transfer rate of the link.	
	600	600 bit/s.	1
	1200	1200 bit/s.	2
	2400	2400 bit/s.	3
	4800	4800 bit/s.	4
	9600	9600 bit/s.	5
	19200	19200 bits/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 fiber optic channels.	
70.01	CH0 NODE 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.	
	0…254	Address.	1 = 1
70.02	CH0 BAUD RATE	The communication speed of channel 0.	
	8 Mbit/s	8 megabits per second.	0

No.	Name/Value	Description	FbEq
	4 Mbit/s	4 megabits per second.	1
	2 Mbit/s	2 megabits per second.	2
	1 Mbit/s	1 megabits per second.	3
70.03	CH0 TIMEOUT	The delay time before a CH0 COMM LOSS is declared.	
	0…60000 ms	Setting range.	1 = 1 ms
70.04	CH0 COM LOSS CTRL	Action the drive will take when a CH0 COMM LOSS is detected.	
	NO ERR CHK	CH0 communication loss is not checked.	1
	WARNING	COMM LOSS warning will be displayed on keypad.	2
	FAULT	The drive will remove the run command and coast to a stop. If the PCP or ESP macro is active and the pump is enabled (71.02 PUMP ENABLE), the drive will enter a shutdown sequence where it controls the backspin of the motor until zero speed is reached.	3
70.12	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 = 1
71 PUMP CONTROLS		Pump setup and control functions (only available in PCP & ESP macros).	
71.01	MAX MOTOR TORQUE	Maximum torque limit of the motor in lbft. This parameter is converted to percent of 99.11 CALC MOTOR TORQUE and written to 20.05 MAXIMUM TORQUE. This parameter does not take any gear reduction in the system into consideration.	
	0.0…10000.0 Nm 0.0…10000.0 lbft	Setting range.	1 = 1 Nm 1 = 1 lbft
71.02	PUMP ENABLE	Selection for activating the backspin control during shutdown. This parameter is also used for enabling the fault operation of the shutdown functions listed in Groups 72 and 73 (i.e. pressure, discharge pressure, rod torque limits, fluid level, stall, underload, and thermal functions).	
	DISABLE	Pump controlled shutdown feature is inactive. If one of the fault functions listed above is tripped, the display will only show a warning message and will not shutdown.	1
	ENABLE	Pump controlled shutdown feature is active. If one of the fault functions listed above is tripped, the display will show a warning during the shutdown process and will change to a fault at zero rod speed and torque.	2
	DI2	If digital input DI2 = 1, pump controlled shutdown feature is active, otherwise, it is inactive.	3
	DI3	See selection DI2.	4
	DI4	See selection DI2.	5
	DI5	See selection DI2.	6
	DI6	See selection DI2.	7
	FIELDBUS	See selection DI2. Instead of a digital input, the selection comes from 06.04 PUMP COMMAND bit 01. See chapter *Fieldbus control*.	8

No.	Name/Value	Description	FbEq
71.03	BACKSPIN LIMIT	Sets the maximum limit to the backspin speed reference used during the controlled shutdown. If backspin control is not desired then set this value to zero. (See 71.06 BACKSPN SPD RANGE). For optimum performance, set equal to or slightly greater than the motor's rpm slip.	
	-500.00…0.00 rpm	Setting range.	1 = 1 rpm
71.04	ROD TORQ STOP LIM	When 05.04 ROD TORQUE decreases to a value less than this parameter setting, the drive will discontinue the shutdown process and initiate a coast to stop command. This setting is used to eliminate excessive shut down times.	
	0.0…10000.0 Nm 0.0…10000.0 lbft	Setting range.	1 = 1 Nm 1 = 1 lbft
71.05	BACKSPN ACCEL TIME	Defines the time to accel from 0 to 71.03 BACKSPIN LIMIT during a shutdown. During a controlled shutdown, pump will decelerate from the current running speed by following the ramp of the speed reference (22.02 DECEL TIME) until zero speed is reached. At this point the pump begins to accelerate in the negative speed direction following the backspin acceleration time specified in this parameter. Excessive time will cause instability during the shutdown process (i.e. Default = 3 seconds is recommended in most cases).	
	0.00…3600.00 s	Setting range.	1 = 1 s
71.06	BACKSPN SPD RANGE	Sets the percent of 71.03 BACKSPIN LIMIT used for calculating the backspin speed reference during shutdown, when the load torque requirement equals 100% of 20.05 MAXIMUM TORQUE (see formula). Excessive speed range will cause instability during shutdown process. Keep this value at a very small number (i.e. Default = 0% is recommended in most cases). **Example:** 71.03 = 100 rpm 71.06 = 50% 1.07 = 100% 20.05 = 100% 71.02 = Enable Backspin Speed Ref = 50 rpm  	
	0.00…100.00%	Setting range.	1 = 1%
71.07	REDUCTION RATIO	Defines the entire gear reduction within the mechanical system of the pumps between the motor shaft and the pump rods. This parameter is used in calculating 05.05 ROD SPEED and 05.04 ROD TORQUE for the application.	
	1.00…10000.00:1	Setting range.	1 = 1
71.08	PUMP FLT RST SEL	Defines the command source used to reset faults associated with the pump (i.e. High Pressure, High Rod Torque, Underload, etc.) and drive faults (i.e. Overvoltage, Undervoltage, Overcurrent, etc.). 16.01 FAULT RESET SEL will also reset both pump and drive faults.	

No.	Name/Value	Description	FbEq
	PANEL RESET	Control keypad reset button is used to reset faults.	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
	XT DI3	See selection DI1.	8
	XT DI4	See selection DI1.	9
	FIELDBUS	See selection DI1. Instead of a digital input, the selection comes from 06.04 PUMP COMMAND bit 03. See chapter *Fieldbus control*.	10
71.09	RUNTIME RESET	Defines the command source used to reset 05.06 RUNTIME HOURS.	
	NOT SELECT	Runtime counter reset feature is disabled.	1
	DI1	The runtime counter is reset by digital input DI1 = 1.	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
	XT DI3	See selection DI1.	8
	XT DI4	See selection DI1.	9
	FIELDBUS	See selection DI1. Instead of a digital input, the selection comes from 06.04 PUMP COMMAND bit 02. See chapter *Fieldbus control*.	10
71.10	SLEEP FUNCTION	Activates the sleep function for PCP and ESP macros. **Note:** 71.02 PUMP ENABLE must be active before sleep function will shutdown the drive.	
	NOT SELECT	Sleep function is disabled.	1
	LOW LIMIT	Sleep function is activated when 71.11 SLEEP AI SELECT is less than or equal to 71.13 SLEEP LEVEL. When sleep function is activated, the message SLEEP MODE will be displayed on the control keypad and the drive will shut down. Sleep function will stay active until 71.11 SLEEP AI SELECT increases to a level greater than or equal to 71.14 WAKE-UP LEVEL.	2
	HIGH LIMIT	Sleep function is activated when 71.11 SLEEP AI SELECT is greater than or equal to 71.13 SLEEP LEVEL. When sleep function is activated, the message SLEEP MODE will be displayed on the control keypad and the drive will shut down. Sleep function will stay active until 71.11 SLEEP AI SELECT decreases to a level less than or equal to 71.14 WAKE-UP LEVEL.	3
71.11	SLEEP AI SELECT	Selects the analog input source used to compare to 71.13 SLEEP LEVEL and 71.14 WAKE-UP LEVEL for sleep functionality.	
	AI1	Analog input AI1 will be scaled to represent 0 to 100%.	1
	AI2	See selection AI1.	2

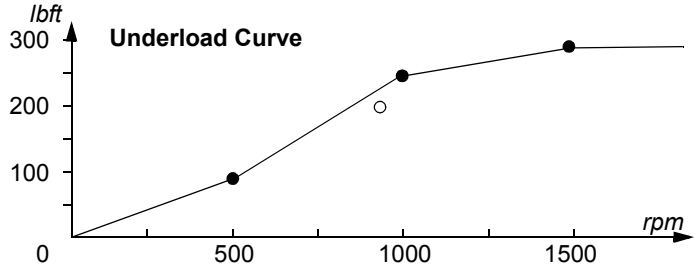
No.	Name/Value	Description	FbEq
	AI3	See selection AI1.	3
	XT AI1	See selection AI1.	4
	XT AI2	See selection AI1.	5
	XT AI3	See selection AI1.	6
	XT AI4	See selection AI1.	7
	AI2 - AI3	The difference between AI3 and AI2 will be scaled to represent 0 to 100%.	8
71.12	SLEEP DELAY TIME	Defines the delay for the sleep start function. See 71.13 and 71.14. When the input meets the sleep function criteria, the counter starts. When the input exceeds the criteria, the counter resets.	
	0.00…10000.00 s	Setting range.	1 = 1 s
71.13	SLEEP LEVEL	Percentage setpoint that triggers the sleep function to be activated after 71.12 SLEEP DELAY TIME has expired.	
	0.00…100.00%	Setting range.	1 = 1%
71.14	WAKE-UP LEVEL	Percentage setpoint that terminates the active sleep function.	
	0.00…100.00%	Setting range.	1 = 1%
71.15	TORQUE UNITS	Selects the unit of display for all torque display values on the keypad.	
	LBFT	Pound-feet will be used.	0
	Nm	Newton-meters will be used.	65535
71.16	PRESSURE UNITS	Selects the unit of display for all pressure display values on the keypad.	
	PSI	Pounds per square inch will be used.	0
	KPa	KiloPascals will be used.	65535
71.17	DEPTH UNITS	Selects the unit of display for all depth display values on the keypad.	
	JOINTS	Joints will be used.	0
	METERS	Meters will be used.	65535
71.18	POWER UNITS	Selects the unit of display for all power display values on the keypad.	
	KW	Kilowatts will be used.	0
	HP	Horsepower will be used.	65535
71.19	SPEED REFERENCE	Selects whether speed reference is in motor rpm or pump rpm (which is motor rpm/reduction ratio).	
	MOTOR SPEED	Ref is motor rpm.	0
	ROD PMP SPD	Ref is pump rpm.	65535
72 PUMP SETUP		Pump setup functions (only available in PCP nd ESP macro).	
72.01	HIGH PRESSURE SEL	Source selection for the high pressure input. A warning will be displayed during the shutdown process; once rod speed and rod torque reach zero, the fault message “HIGH PRESS” will be displayed. **Note:** 71.02 PUMP ENABLE must be active before a high pressure fault will shutdown the drive.	
	NOT SELECT	Function is inactive.	1
	DI1	If digital input DI1 = 0, a high pressure condition is indicated.	2
	DI2	See selection DI1.	3
	DI3	See selection DI1.	4

No.	Name/Value	Description	FbEq
	DI4	See selection DI1.	5
	DI5	See selection DI1.	6
	DI6	See selection DI1.	7
	XT DI1	See selection DI1.	8
	XT DI4	See selection DI1.	9
72.02	PRESSURE LATCH	Selects the function of the fault condition for both 72.01 HIGH PRESSURE SEL and 72.05 DISCHRG PRESS SEL.	
	LATCHING	Once high pressure or high discharge pressure occurs, the fault stays active until a fault reset is triggered after the drive completes the shutdown process.	1
	NONLATCHING	Once high pressure or high discharge pressure occurs, the warning message will be displayed as long as the tripped condition is still active. Once the high pressure or high discharge pressure condition is removed, the drive will regain a normal run condition. If the shutdown process finishes and the drive shuts off and the high pressure or high discharge pressure condition is removed, the drive will automatically start if a valid run command is still present.	2
	LATCH 0 SPD	Once high pressure or high discharge pressure occurs, the warning message will be displayed as long as the tripped condition is still active. Once the high pressure or high discharge pressure condition is removed, the drive will regain a normal run condition. If the shutdown process finishes and the drive shuts off and the high pressure or high discharge pressure condition is removed, the drive will NOT automatically start if a valid run command is still present. A fault message will be displayed once rod speed and rod torque reach zero and stays active until a fault reset is triggered after the drive completes the shutdown process.	3
72.03	DISCHRG FLT ENA	Enables the discharge pressure function. A warning will be displayed during the shutdown process; once rod speed and rod torque reach zero, the fault message “DISCHRG FLT” will be displayed. **Note:** 71.02 PUMP ENABLE must be active before a high pressure fault will shutdown the drive.	
	DISABLED	Function is inactive.	0
	ENABLED	Function is active.	65535
72.04	MAX DISCHRG PRESS	Maximum pressure that will be present in the mechanical system. This parameter is used to scale 72.05 DISCHARGE PRESS SEL.	
	0.00…10000.00 KPa / 0.00…10000.00 PSI	Setting range.	1 = 1 KPa / 1 = 1 psi
72.05	DISCHRG PRESS SEL	Selects the analog input source for the discharge pressure signal.	
	NOT SELECT	Discharge pressure function is inactive.	1
	AI1	Analog input AI1 will be scaled to represent 0 to 72.04 MAX DISCHRG PRESS.	2
	AI2	See selection AI1.	3
	AI3	See selection AI1.	4
	XT AI1	See selection AI1.	5
	XT AI2	See selection AI1.	6
	XT AI3	See selection AI1.	7
	XT AI4	See selection AI1.	8

No.	Name/Value	Description	FbEq
72.06	HIGH DISCHRG TIME	On delay time at which a high discharge condition must be present before the drive will enter the shutdown process.	
	1.00…1000000.00 s	Setting range.	1 = 1 s
72.07	ROD TORQ TIME ENA	Enables 72.08 ROD TORQUE 1 FUNC. **Note:** 71.02 PUMP ENABLE must be active before a high pressure fault will shutdown the drive.	
	DISABLED	Function is inactive.	0
	ENABLED	Function is active.	65535
72.08	ROD TORQ 1 FUNC	Selects the function of the fault condition for 72.09 ROD TORQ 1 LIMIT. A warning will be displayed during the shutdown process, once rod speed and rod torque reach zero, the fault message “ROD TORQ LIM” will be displayed.	
	NO	Function is inactive.	1
	LOW LIMIT	Rod torque 1 function is tripped if 05.04 ROD TORQUE is less than or equal to 72.09 ROD TORQUE 1 LIM and 05.05 ROD SPEED is less than or equal to 72.10 ROD TORQ1 SPD LIM for a period of time greater than 72.11 ROD TORQUE 1 TIME. A hysteresis (of ROD TORQUE * 5%) is present in the comparator which means, once the condition is set, it will latch until the ROD TORQUE increases to a value of [ROD TORQ 1 LIM + (ROD TORQUE * .05)].	2
	HIGH LIMIT	Rod torque 1 function is tripped if 05.04 ROD TORQUE is greater than or equal to 72.09 ROD TORQUE 1 LIMIT and 05.05 ROD SPEED is less than or equal to 72.10 ROD TORQ1 SPD LIM for a period of time greater than 72.11 ROD TORQUE 1 TIME. A hysteresis (of ROD TORQUE * 5%) is present in the comparator which means, once the condition is set, it will latch until the ROD TORQUE decreases to a value of [ROD TORQ 1 LIM - (ROD TORQUE * .05)].	3
72.09	ROD TORQ 1 LIM	The rod torque limit used for the 72.08 ROD TORQ1 FUNC.	
	0.00…10000.00 Nm 0.00…10000.00 lbft	Setting range.	1 = 1 Nm 1 = 1 lbft
72.10	ROD TORQ1 SPD LIM	The rod speed limit used for the 72.08 ROD TORQ1 FUNC.	
	0…10000 rpm	Setting range.	1 = 1 rpm
72.11	ROD TORQ1 TIME	On delay time at which the rod torque 1 limit condition must be set before the drive will enter the shutdown process. See 72.08 ROD TORQ1 FUNC.	
	0.00…10000.00 s	Setting range.	1 = 1 s
72.12	ROD TORQ2 SPD ENA	Enables 72.13 ROD TORQ2 FUNCTION. **Note:** 71.02 PUMP ENABLE must be active before rod torque 2 limit will shut down the drive.	
	DISABLED	Function is inactive.	0
	ENABLED	Function is active.	65535

No.	Name/Value	Description	FbEq
72.13	ROD TORQ2 FUNC	Selects the function of the fault condition for 72.14 ROD TORQ2 LIM. The warning “TORQ 2 SPD” will be displayed during the rod torque 2 speed adjustment, and will not cause the drive to enter the shutdown process. If the rod torque 2 speed is triggered more than the 72.18 ROD TQ2 LIM COUNT in a 7200 second time period, the drive will enter the shutdown process and display a warning “TORQ 2 LIM.” Once rod torque and rod speed reach zero, the fault message “TORQ 2 LIM” will be displayed.	
	NO	Function is inactive.	1
	LOW LIMIT	Rod torque 2 function is tripped if 05.04 ROD TORQUE is less than or equal to 72.14 ROD TORQ2 LIM for a period of time greater than 72.15 ROD TORQ2 TIME. A hysteresis (of ROD TORQUE * 5%) is present in the comparator which means, once the condition is set, it will latch until the ROD TORQUE increases to a value of [ROD TORQ2 LIMIT + (ROD TORQUE * .05)].	2
	HIGH LIMIT	Rod torque 2 function is tripped if 05.04 ROD TORQUE is greater than or equal to 72.14 ROD TORQ2 LIM for a period of time greater than 72.15 ROD TORQ2 TIME. A hysteresis (of ROD TORQUE * 5%) is present in the comparator which means, once the condition is set, it will latch until the ROD TORQUE decreases to a value of [ROD TORQ2 LIMIT - (ROD TORQUE * .05)].	3
72.14	ROD TORQ2 LIMIT	The limit used for 72.13 ROD TORQ2 FUNC.	
	0.00…10000.00 Nm 0.00…10000.00 lbft	Setting range.	1 = 1 Nm 1 = 1 lbft
72.15	ROD TORQ2 TIME	On delay time at which the rod torque 2 limit condition must be set before the drive will enter the adjustment process.	
	0.00…100000.00 s	Setting range.	1 = 1 s
72.16	ROD TORQ2 SPEED	Added to the speed reference once the rod torque 2 limit function has been triggered.	
	-3600.00…3600.00 rpm	Setting range.	1 = 1 rpm
72.17	ROD TQ2 SPD TIME	Time at which the 72.16 ROD TORQ2 SPEED will stay in effect after the rod torque has decreased to a value that deactivates the rod torque 2 function.	
	1.00…100000.00 s	Setting range.	1 = 1 s
72.18	ROD TQ2 LIM COUNT	Maximum number of times that the rod torque 2 function can be triggered in a 7200 second time period before the drive will enter into the shutdown process. If the 7200 second time period expires before the limit count is reached, the internal counter for the number of rod torque 2 triggers is reset. If a continuous reset is desired with no limitation, then set the value to “0”.	
	0…100	Setting range.	1 = 1
72.19	LEVEL CTRL ENABLE	Selection for activating fluid level PI regulator to generate the speed reference for the drive. The fluid level PI regulator overrides the external reference 1 and 2 selection of Group 11. However, constant speeds and local keypad control overrides the fluid level PI regulator reference.	
	DISABLE	Function is inactive.	1
	ENABLE	Function is active.	2
	DI2	Digital input DI2 = 1 enables the fluid level regulator.	3
	DI3	See selection DI2.	4

No.	Name/Value	Description	FbEq
	DI4	See selection DI2.	5
	DI5	See selection DI2.	6
	DI6	See selection DI2.	7
	XT DI1	See selection DI2.	8
	XT DI2	See selection DI2.	9
	FIELDBUS	See selection DI2. Instead of a digital input, the selection comes from 06.04 PUMP COMMAND bit 04. See chapter *Fieldbus control*.	10
72.20	FLUID LEVEL MAX	Maximum fluid level depth that will be present in the mechanical system. Used to scale 72.22 FLUID LEVEL SEL.	
	0.00…100000.00 m / 0.00…100000.00 JNTS	Setting range.	1 = 1 m / 1 = 1 JNTS
72.21	FLUID LEVEL SET	Fluid level PI regulator setpoint that determines the depth (or fluid level) to try and regulate.	
	0.00…100000.00 m / 0.00…100000.00 JNTS	Setting range.	1 = 1 m / 1 = 1 JNTS
72.22	FLUID LEVEL SEL	Analog input source for 05.09 WELL FLUID LEVEL. **Note:** No alarm is associated with this analog signal for high fluid level indication.	
	NOT SELECT	No analog signal has been selected to represent the fluid level feedback. **NOTE:** This selection does not deactivate the fluid level PI regulator.	1
	AI1	Analog inputs to AI1 will be scaled to represent 0 to 72.20 FLUID LEVEL MAX.	2
	AI2	See selection AI1.	3
	AI3	See selection AI1.	4
	AI2 - AI3	The difference between AI3 and AI2 will be scaled to represent 0 to 72.20 FLUID LEVEL MAX. **Note:** This selection is used when both downhole pressure and tubing pressure are used as the fluid level feedback signal.	5
	XT AI2	See selection AI1.	6
	XT AI3	See selection AI1.	7
	XT AI4	See selection AI1.	8
72.23	FLUID LVL P-GAIN	Sets the immediate reaction step of the PI regulator. This value should be kept low to avoid unwanted oscillation from the drive speed reference causing the pump to cycle up and down in rpm.	
	0.00…5.00	Setting range.	1 = 1
72.24	LVL INTEG TIME	Integration time of the PI regulator. This value should be kept at a fairly large value to avoid unwanted oscillation from the drive speed reference causing the pump to cycle up and down in rpm.	
	1.00…3600.00 s	Setting range.	1 = 1 s
72.25	LEVEL CTRL INVERT	Selects the reaction characteristics of the fluid level PI regulator.	
	NORMAL PI	The PI regulator output will increase, causing the speed reference to increase, if the feedback signal selected by 72.22 FLUID LEVEL SEL is less than 72.21 FLUID LEVEL SET.	0

No.	Name/Value	Description	FbEq
	INVERT PI	The PI regulator output will increase, causing the speed reference to increase, if the feedback signal selected by 72.22 FLUID LEVEL SEL is greater than 72.21 FLUID LEVEL SET.	65535
72.26	DSCH PRS TRIP LVL	Used to trip the drive for a DISCHRG FLT. When 05.10 DISCHARGE PRESSURE is equal to or greater than this value for 72.06 DISCHRGE TIME, the drive will shutdown.	
	0.00…10000.00 KPa 0.00…10000.00 PSI	Setting range.	1 = 1 KPa 1 = 1 psi
73 PUMP SETUP		Underload and thermal protection.	
73.01	UNDERLOAD FUNC	Enables the underload functionality. Underload allows for a custom curve to be entered by the customer using parameters 73.02…73.07. The curve consists of both rod torque and rod speed to create the X-Y coordinates of a chart (see chart below). Actual rod torque and speed are used to compare to the custom curve created. If the actual rod torque/speed point falls below the curve for a period of time specified by 73.08 U-LOAD ACT TIME, then the underload function is triggered. When the underload function is triggered, the drive will enter the shutdown process and display a warning message “UNDERLOAD”; when rod torque and speed reach zero, then the fault message “UNDERLOAD” will be displayed. **Example:** 73.02 = 100 lbft 73.03 = 500 rpm 73.04 = 250 lbft 73.05 = 1000 rpm 73.06 = 300 lbft 73.07 = 1500 rpm Rod Torque = 200 lbft (05.04) Rod Speed = 900 rpm (05.05)  The solid points along the curve make up the defined underload curve; the hollow point represents the actual rod torque/speed plot. **Note:** 71.02 PUMP ENABLE must be active before underload fault will shutdown the drive.	
	NO	Function is inactive.	1
	UNDERLOAD	Function is active.	2
73.02	ROD TORQUE 1	Rod torque 1 value used for the “Y” position of the first X-Y plot to create the user defined underload curve for the system.	
	0.00…10000.00 Nm / 0.00…10000.00 lbft	Setting range.	1 = 1 Nm / 1 = 1 lbft
73.03	ROD SPEED 1	Rod speed 1 value used for the “X” position of the first X-Y plot to create the user defined underload curve for the system.	
	-3600.00…3600.00 rpm	Setting range.	1 = 1 rpm

No.	Name/Value	Description	FbEq
73.04	ROD TORQUE 2	Rod torque 2 value used for the “Y” position of the second X-Y plot to create the user defined underload curve for the system.	
	0.00…10000.00 Nm / 0.00…10000.00 lbft	Setting range.	1 = 1 Nm / 1 = 1 lbft
73.05	ROD SPEED 2	Rod speed 2 value used for the “X” position of the second X-Y plot to create the user defined underload curve for the system.	
	-3600.00…3600.00 rpm	Setting range.	1 = 1 rpm
73.06	ROD TORQUE 3	Rod torque 3 value used for the “Y” position of the third X-Y plot to create the user defined underload curve for the system.	
	0.00…10000.00 Nm / 0.00…10000.00 lbft	Setting range.	1 = 1 Nm / 1 = 1 lbft
73.07	ROD SPEED 3	Rod speed 3 value used for the “X” position of the third X-Y plot to create the user defined underload curve for the system.	
	-3600.00…3600.00 rpm	Setting range.	1 = 1 rpm
73.08	U-LOAD ACT TIME	On delay time that underload conditions must be present before the underload fault is triggered.	
	0.00…100000.00 s	Underload fault delay.	1 = 1 s
73.09	THERM PROT FUNC	Selects the functionality of the thermal fault protection for the PCP and ESP macros. **Note:** 71.02 PUMP ENABLE must be active before a thermal protection fault will shut down the drive.	
	NO	Function is inactive. However, the Pt100 feedback temperature can still be monitored on the keypad at 05.11 MEASURED TEMP.	1
	WARNING	A warning message “OVERTEMP” is displayed on the keypad, but the drive will not enter the shutdown process. Warning is triggered when the 05.11 MEASURED TEMP becomes greater than 73.13 ALARM TEMP for 5 sec. or the Klixon digital input is 0 VDC.	2
	FAULT	A warning message “OVERTEMP” is displayed on the keypad, but the drive will not enter the shutdown process, if the 05.11 MEASURED TEMP becomes greater than 73.13 ALARM TEMP for 5 sec. but less than 73.14 FAULT TEMP. If 05.11 MEASURED TEMP becomes greater than 73.14 FAULT TEMP or the Klixon digital input reaches 0 VDC for 5 sec., then the drive will enter into the shutdown process. The warning message “OVERTEMP” is displayed during the shutdown process; when rod torque and speed reach zero, then the fault message “OVERTEMP” will be displayed.	3
73.10	TEMP FDBK TYPE	Selects the type of temperature sensing device used as feedback.	
	KLIXON	A Klixon is a contact closure device that is connected to 73.11 KLIXON DI SEL. The contact opens upon an overtemperature.	1
	PT-100	A Pt100 is an analog device that changes its resistance as the temperature changes. The resistance increases as temperature increases, causing a larger voltage to be dropped across this resistance. The analog input of the drive measures this voltage drop and scales it to temperature. **Note:** Analog output AO2 automatically supplies a constant current to the Pt100 device and must be wired to operate properly.	2
73.11	KLIXON DI SEL	Digital Input source for the Klixon device. See 73.09 THERM PROT FUNC and 73.10 TEMP FDBK TYPE.	
	DI1	Digital input DI1 is used for Klixon thermal protection.	1

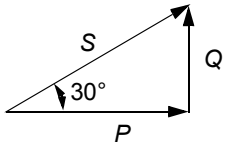
No.	Name/Value	Description	FbEq
	DI2	See selection DI1.	2
	DI3	See selection DI1.	3
	DI4	See selection DI1.	4
	DI5	See selection DI1.	5
	DI6	See selection DI1.	6
	XT DI1	See selection DI1.	7
	XT DI2	See selection DI1.	8
	XT DI3	See selection DI1.	9
	XT DI4	See selection DI1.	10
73.12	PUMP PT100 AI SEL	Analog input source for the Pt100 device. See 73.09 THERM PROT FUNC and 73.10 TEMP FDBK TYPE. **Note:** This is not the motor thermal protection feedback input selection.	
	NOT SELECT	Thermal protection using Pt100 is inactive.	1
	AI1	Analog input AI1 will be scaled to °C and written to 05.11 MEASURED TEMP.	2
	XT AI1	See selection AI1.	3
	XT AI2	See selection AI1.	4
73.13	ALARM TEMP	Temperature at which a warning message “OVERTEMP” is displayed on the keypad.	
	0.00…200.00 °C	Pt100 alarm trigger level.	1 = 1 °C
73.14	FAULT TEMP	Temperature at which the drive will enter into the shutdown process, if 73.09 THERM PROT FUNC is set to fault.	
	0.00…200.00 °C	Pt100 fault trigger level.	1 = 1 °C
83 ADAPT PROG CTRL		Control of the Adaptive Program execution. For more information, see *Adaptive Program Application Guide* (code: 3AFE64527274 [English]).	
83.01	ADAPT PROG CMD	Selects the operation mode for the Adaptive Program.	
	STOP	Stop. The program cannot be edited.	1
	RUN	Run. The program cannot be edited.	2
	EDIT	Stop to edit mode. Program can be edited.	3
83.02	EDIT COMMAND	Selects the command for the block placed in the location defined by 83.03 EDIT BLOCK. The program must be in editing mode (see 83.01 ADAPT PROG CMD).	
	NO	Home value. The value automatically restores to NO after an editing command has been executed.	1

No.	Name/Value	Description	FbEq
	PUSH	Shifts the block in location defined by 83.03 EDIT BLOCK and the following blocks one location up. A new block can be placed in the emptied location by programming the Block Parameter Set as usual. ***Example:*** A new block needs to be placed in between the current block number four (parameters 84.20…84.25) and five (parameters 84.25…84.29). In order to do this: - Shift the program to the editing mode by 83.01 ADAPT PROG CMD. - Select location number five as the desired location for the new block by 83.03 EDIT BLOCK. - Shift the block in location number 5 and the following blocks one location forward by 83.02 EDIT COMMAND (selection PUSH). - Program the emptied location number 5 by parameters 84.25…84.29 as usual.	2
	DELETE	Deletes the block in location defined by 83.03 EDIT BLOCK and shifts the following blocks one step down.	3
	PROTECT	Activation of the Adaptive Program protection. Activate as follows: - Ensure the Adaptive Program operation mode is RUN or STOP 83.01 ADAPT PROG CMD). - Set the passcode (83.05 PASSCODE). - Change 83.02 EDIT COMMAND to PROTECT. When activated: - All parameters in group 84 excluding the block output parameters are hidden (read protected). - It is not possible to switch the program to the editing mode (83.01 ADAPT PROG CMD). - 83.05 PASSCODE is set to 0.	4
	UNPROTECT	Inactivation of the Adaptive Program protection. Inactivate as follows: - Ensure the Adaptive Program operation mode is RUN or STOP (83.01 ADAPT PROG CMD). - Set the passcode (83.05 PASSCODE). - Change 83.02 EDIT COMMAND to UNPROTECT. **Note:** If the passcode is lost, it is possible to reset the protection also by changing the application macro setting (99.02 APPLICATION MACRO).	5
83.03	EDIT BLOCK	Defines the block location number for the command selected by 83.02 EDIT COMMAND.	
	0…15	Block location number.	1 = 1
83.04	TIMELEVEL SEL	Selects the execution cycle time for the Adaptive Program. The setting is valid for all blocks.	
	12 ms	12 milliseconds	1
	100 ms	100 milliseconds	2
	1000 ms	1000 milliseconds	3
83.05	PASSCODE	Sets the passcode for the Adaptive Program protection. The passcode is needed at activation and inactivation of the protection. See 83.02 EDIT COMMAND.	

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td>0…</td><td>Passcode. The setting restores to 0 after the protection is activated/ inactivated.
Note: When activating, write down the passcode and store it in a safe place.</td><td>1 = 1</td></tr>
<tr><td colspan="2">84 ADAPTIVE PROGRAM</td><td>- selections of the function blocks and their input connections.
- diagnostics
For more information, see Adaptive Program Application Guide (code: 3AFE64527274 [English]).</td><td></td></tr>
<tr><td>84.01</td><td>STATUS</td><td>Shows the value of the Adaptive Program status word. The table below shows the alternative bit states and the corresponding values on the panel display.
<table>
<tr><th>Bit</th><th>Display</th><th>Meaning</th></tr>
<tr><td>0</td><td>1</td><td>Stopped</td></tr>
<tr><td>1</td><td>2</td><td>Running</td></tr>
<tr><td>2</td><td>4</td><td>Faulted</td></tr>
<tr><td>3</td><td>8</td><td>Editing</td></tr>
<tr><td>4</td><td>10</td><td>Checking</td></tr>
<tr><td>5</td><td>20</td><td>Pushing</td></tr>
<tr><td>6</td><td>40</td><td>Popping</td></tr>
<tr><td>8</td><td>100</td><td>Initializing</td></tr>
</table></td><td>1 = 1</td></tr>
<tr><td>84.02</td><td>FAULTED PAR</td><td>Points out the faulted parameter in the Adaptive Program.</td><td>-</td></tr>
<tr><td>84.05</td><td>BLOCK1</td><td>Selects the function block for Block Parameter Set 1. See Adaptive Program Application Guide (code: 3AFE64527274 [English]).</td><td></td></tr>
<tr><td></td><td>ABS</td><td></td><td>11</td></tr>
<tr><td></td><td>ADD</td><td></td><td>10</td></tr>
<tr><td></td><td>AND</td><td></td><td>2</td></tr>
<tr><td></td><td>BWISE</td><td></td><td>26</td></tr>
<tr><td></td><td>COMPARE</td><td></td><td>16</td></tr>
<tr><td></td><td>COUNT</td><td></td><td>21</td></tr>
<tr><td></td><td>DPOT</td><td></td><td>23</td></tr>
<tr><td></td><td>EVENT</td><td></td><td>20</td></tr>
<tr><td></td><td>FILTER</td><td></td><td>13</td></tr>
<tr><td></td><td>MASK-SET</td><td></td><td>24</td></tr>
<tr><td></td><td>MAX</td><td></td><td>17</td></tr>
<tr><td></td><td>MIN</td><td></td><td>18</td></tr>
<tr><td></td><td>MULDIV</td><td></td><td>12</td></tr>
<tr><td></td><td>NO</td><td></td><td>1</td></tr>
<tr><td></td><td>OR</td><td></td><td>3</td></tr>
<tr><td></td><td>PI</td><td></td><td>14</td></tr>
<tr><td></td><td>PI-BAL</td><td></td><td>15</td></tr>
<tr><td></td><td>PI-NEG</td><td></td><td>25</td></tr>
<tr><td></td><td>RAMP</td><td></td><td>22</td></tr>
<tr><td></td><td>SR</td><td></td><td>5</td></tr>
<tr><td></td><td>SW-CB</td><td></td><td>7</td></tr>
<tr><td></td><td>SW-IL</td><td></td><td>19</td></tr>
</table>

No.	Name/Value	Description	FbEq
	TOFF		9
	TON		8
	TRIGG		6
	WR-I		27
	WR-PB		28
	XOR		4
84.06	INPUT1	Selects the source for input I1 of Block Parameter Set 1.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	Parameter index or a constant value: - Parameter pointer: Inversion, group, index and bit fields. The bit number is effective only for blocks handling boolean inputs. - Constant value: Inversion and constant fields. Inversion field must have value C to enable the constant setting. ***Example:*** The state of digital input DI2 is connected to Input 1 as follows: - Set the source selection parameter (84.06) to +.01.17.01. (The control program stores the state of digital input DI2 to bit 1 of actual signal 01.17.) - If you need an inverted value, switch the sign of the pointer value (-01.17.01.).	-
84.07	INPUT2	See 84.06 INPUT1.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	See 84.06 INPUT1.	-
84.08	INPUT3	See 84.06 INPUT1.	
	-255.255.31…+255.255.31 / C.-32768…C.32767	See 84.06 INPUT1.	-
84.09	OUTPUT	Stores and displays the output of Block Parameter Set 1.	-
…	…		
84.79	OUTPUT	Stores the output of Block Parameter Set 15.	-
85 USER CONSTANTS		Storage of the Adaptive Program constants and messages. For more information, see *Adaptive Program Application Guide* (code: 3AFE 64527274 [English])	
85.01	CONSTANT1	Sets a constant for the Adaptive Program.	
	-8388608…8388607	Integer value.	1 = 1
85.02	CONSTANT2	Sets a constant for the Adaptive Program.	
	-8388608…8388607	Integer value.	1 = 1
85.03	CONSTANT3	Sets a constant for the Adaptive Program.	
	-8388608…8388607	Integer value.	1 = 1
85.04	CONSTANT4	Sets a constant for the Adaptive Program.	
	-8388608…8388607	Integer value.	1 = 1
85.05	CONSTANT5	Sets a constant for the Adaptive Program.	
	-8388608…8388607	Integer value.	1 = 1
85.06	CONSTANT6	Sets a constant for the Adaptive Program.	
	-8388608…8388607	Integer value.	1 = 1
85.07	CONSTANT7	Sets a constant for the Adaptive Program.	
	-8388608…8388607	Integer value.	1 = 1

No.	Name/Value	Description	FbEq
85.08	CONSTANT8	Sets a constant for the Adaptive Program.	
	-8388608…8388607	Integer value.	1 = 1
85.09	CONSTANT9	Sets a constant for the Adaptive Program.	
	-8388608…8388607	Integer value.	1 = 1
85.10	CONSTANT10	Sets a constant for the Adaptive Program.	
	-8388608…8388607	Integer value.	1 = 1
85.11	STRING1	Stores a message to be used in the Adaptive Program (EVENT block).	
	MESSAGE1	Message.	-
85.12	STRING2	Stores a message to be used in the Adaptive Program (EVENT block).	
	MESSAGE2	Message.	-
85.13	STRING3	Stores a message to be used in the Adaptive Program (EVENT block).	
	MESSAGE3	Message.	-
85.14	STRING4	Stores a message to be used in the Adaptive Program (EVENT block).	
	MESSAGE4	Message.	-
85.15	STRING5	Stores a message to be used in the Adaptive Program (EVENT block).	
	MESSAGE5	Message.	-
92 FIELDBUS OUTPUT		Addresses of the parameters that are to be sent over the fieldbus.	
92.01	DATASET2 OUTPUT1	Pointer for the parameter that's value is sent over the fieldbus.	
	0…10000	Setting range.	1 = 1
92.02	DATASET2 OUTPUT2	Pointer for the parameter that's value is sent over the fieldbus.	
	0…10000	Setting range.	1 = 1
92.03	DATASET2 OUTPUT3	Pointer for the parameter that's value is sent over the fieldbus.	
	0…10000	Setting range.	1 = 1
95 HARDWARE SPECIFIC		Fan speed control, sine filter application etc.	
95.01	FAN SPD CTRL MODE	Selects the speed control of the optional inverter cooling fan.	
	CONST 50 Hz	Fan is running at constant frequency of 50 Hz when powered.	0
	RUN/STOP	Drive stopped: Fan is running at constant frequency of 10 Hz. Drive running: Fan is running at constant frequency of 50 Hz.	1
	CONTROLLED	The speed of the fan is determined from IGBT temperature vs. fan speed curve.	2
95.05	ENA INC SW FREQ	Activates the minimum switching frequency limitation for Ex-motor applications.	
	NO	Inactive.	0
	YES	Active. Minimum switching frequency limit is set to 2 kHz. Used with motors with an ATEX certification based on 2 kHz minimum switching frequency.	65535

No.	Name/Value	Description	FbEq
95.06	LCU Q POW REF	Defines the reference value for the line-side converter reactive power generation. Line-side converter can generate reactive power to the supply network. This reference is written into line-side converter unit 24.02 Q POWER REF2. For more information, see *IGBT Supply Control Program 7.x Firmware manual* [3AFE68315735 (English)]. **Example 1:** When 24.03 Q POWER REF2 SEL is set to PERCENT, value 10000 of 24.02 Q POWER REF2 equals to value 100% of 24.01 Q POWER REF (i.e. 100% of the converter nominal power given in 04.06 CONV NOM POWER). **Example 2:** When 24.03 Q POWER REF2 SEL is set to kVAr, value 1000 of 24.02 Q POWER REF2 equals to 24.01 Q POWER REF value calculated with the following equation: 100 · (1000 kVAr divided by converter nominal power in kVAr)%. **Example 3:** When 24.03 Q POWER REF2 SEL is set to PHI, value 3000 of 24.02 POWER REF2 equals approximately to 24.01 Q POWER REF value calculated with the following equation: $\cos(30) = \frac{P}{S} = \frac{P}{\sqrt{P^2 + Q^2}}$  Positive reference 30° denotes capacitive load. Negative reference 30° denotes inductive load. P = signal 01.09 POWER value 24.03 Q POWER REF2 SEL values are converted to degrees by the line-side converter control program: -3000…30000 -30°…30°. Value -10000/10000 equals to -30°/30°, since the range is limited to -3000/3000.	
	-10000…10000	Reference value.	1 = 1
95.07	LCU DC REF [V]	Defines the intermediate circuit DC voltage reference for the line-side converter. This reference is written into line-side converter 23.01 DC VOLT REF. For more information, see *IGBT Supply Control Program 7.x Firmware manual* [3AFE68315735 (English)].	
	0…1100 V	Voltage	1 = 1 V
95.08	LCU PAR1 SEL	Selects the line-side converter address from which 07.06 LCU ACT SIGNAL 1 is read.	
	0…9999	Line-side converter parameter index.	1 = 1
95.09	LCU PAR 2 SEL	Selects the line-side converter address from which 07.07 LCU ACT SIGNAL 2 is read.	
	0…9999	Line-side converter parameter index.	1 = 1
95.10	TEMP INV AMBIENT	Defines the ambient temperature for the Enhanced drive temperature monitoring function. See *Enhanced drive temperature monitoring for ACS800-U2, -U4 and -U7, frame sizes R7 and R8* on page 41. **Note:** If ambient temperature exceeds 40 °C, the drive load capacity decreases. See the derating instructions in the appropriate hardware manual.	
	20…50°C	Temperature	10 = 1 °C

No.	Name/Value	Description	FbEq
98 OPTION MODULES		Activation of the optional I/O extension modules and fieldbus adapter. For more information on option modules, see the module manuals. These parameter settings will remain the same even if the macro is changed.	
98.01	ENCODER MODULE	Activates the communication to the optional pulse encoder module.	
	NTAC	Communication active. Module type: NTAC module. Connection interface: Fibre optic DDCS link. **Note:** Module node number must be set to 16. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* (Code: 3AFY58919730 [English]).	0
	NO	Inactive.	1
	RTAC-SLOT1	Communication active. Module type: RTAC. Connection interface: Option slot 1 of the drive.	2
	RTAC-SLOT2	Communication active. Module type: RTAC. Connection interface: Option slot 2 of the drive.	3
	RTAC-DDCS	Communication active. Module type: RTAC. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 16. For directions, see *User's Manual for RDIO Module* (Code: 3AFE64485733 [English]).	4
	RRIA-SLOT1	Communication active. Module type: RRIA. Connection interface: option slot 1 of the drive.	5
	RRIA-SLOT2	Communication active. Module type: RRIA. Connection interface: option slot 2 of the drive.	6
	RRIA-DDCS	Communication active. Module type: RRIA. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set at 16. For directions, see *RRIA-01 Resolver Interface Module User's Manual* [3AFE68570760 (English)].	7
	RTAC03-SLOT1	Communication active. Module type: RTAC. Connection interface: option slot 1 of the drive.	8
	RTAC03-SLOT2	Communication active. Module type: RTAC. Connection interface: option slot 2 of the drive.	9
	RTAC03-DDCS	Communication active. Module type: RTAC. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set at 16. For directions, see *RRIA-01 Resolver Interface Module User's Manual* [3AFE68570760 (English)].	10
98.02	COMM MODULE	Activates the external serial communication and selects the interface. See 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 group 51 MASTER ADAPTER.	2
	ADVANT	The drive communicates with an ABB Advant OCS system via CH0 on the RDCO board (optional). See also group 70 DDCS CONTROL.	3

No.	Name/Value	Description	FbEq
	STD MODBUS	The drive communicates with a Modbus controller via the Modbus Adapter Module (RMBA) in option slot 1 of the drive. See also group 52 STANDARD MODBUS.	4
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.	
	NDIO	Communication active. Module type: NDIO module. Connection interface: Fibre optic DDCS link. DI7 and DI8 are from this module. DI9 and DI10 are from a second module. **Note:** Module node number must be set to 2. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* (Code: 3AFY58919730 [English]).	1
	NO	Inactive.	2
	RDIO-SLOT1	Communication active. Module type: RDIO. Connection interface: Option slot 1 of the drive. DI7 through DI9 are from this module. DI10 is from a second module.	3
	RDIO-SLOT2	Communication active. Module type: RDIO. Connection interface: Option slot 2 of the drive. DI7 through DI9 are from this module. DI10 is from a second module.	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. DI7 through DI9 are from this module. DI10 is from a second module. **Note:** Module node number must be set to 2. For directions, see *User's Manual for RDIO Module* (Code: 3AFE64485733 [English]).	5
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.	
	NDIO	Communication active. Module type: NDIO module. Connection interface: Fibre optic DDCS link. If 98.03 DI/O EXT MODULE 1 is an NDIO, DI9 and DI10 are from this module, otherwise only DI10 is. **Note:** Module node number must be set to 3. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* (Code: 3AFY58919730 [English]).	1
	NO	Inactive.	2
	RDIO-SLOT1	Communication active. Module type: RDIO. Connection interface: Option slot 1 of the drive.	3
	RDIO-SLOT2	Communication active. Module type: RDIO. Connection interface: Option slot 2 of the drive.	4
	RDIO-DDCS	Communication active. Module type: RDIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 3. For directions, see *User's Manual for RDIO Module* (Code: 3AFE64485733 [English]).	5

No.	Name/Value	Description	FbEq
98.06	AI/O EXT MODULE 1	Activates the communication to an optional Analog I/O Extension Module. **Note:** Before setting the drive parameters, ensure the module hardware settings are OK: - The module node number is set to 5. - The input signal type selections matches the actual signals (mA/V). - The operation mode selection matches the applied input signals (unipolar/bipolar).	
	NAIO	Communication active. Module type: NAIO. Connection interface: Fibre optic DDCS link. **Note:** Module node number must be set to 5. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* (Code: 3AFY58919730 [English]).	1
	NO	Communication inactive.	2
	RAIO-SLOT1	Communication active. Module type: RAIO. Connection interface: Option slot 1 of the drive.	3
	RAIO-SLOT2	Communication active. Module type: RAIO. Connection interface: Option slot 2 of the drive.	4
	RAIO-DDCS	Communication active. Module type: RAIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 5. For directions, see *User's Manual for RAIO Module* (Code: 3AFE64484567 [English]).	5
98.07	AI/O EXT MODULE 2	Activates the communication to an optional Analog I/O Extension Module. **Note:** Before setting the drive parameters, ensure the module hardware settings are OK: - The module node number is set to 6. - The input signal type selections matches the actual signals (mA/V). - The operation mode selection matches the applied input signals (unipolar/bipolar).	
	NAIO	Communication active. Module type: NAIO. Connection interface: Fibre optic DDCS link. **Note:** Module node number must be set to 5. For directions, see *Installation and Start-up Guide for NTAC-0x/NDIO-0x/NAIO-0x Modules* (Code: 3AFY58919730 [English]).	1
	NO	Communication inactive.	2
	RAIO-SLOT1	Communication active. Module type: RAIO. Connection interface: Option slot 1 of the drive.	3
	RAIO-SLOT2	Communication active. Module type: RAIO. Connection interface: Option slot 2 of the drive.	4
	RAIO-DDCS	Communication active. Module type: RAIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 6. For directions, see *User's Manual for RAIO Module* (Code: 3AFE64484567 [English]).	5
98.09	DI DEBOUNCE FILT	Digital input de-bounce filter. Prevents unwanted ON/OFF switching of the digital inputs.	
	0…1000 ms	Setting range.	1 = 1 ms

No.	Name/Value	Description	FbEq
98.10	AI/O EXT AI1 FUNC	Defines the signal type for input 1 of the first analog I/O extension module. The setting must match the signal connected to the module. **Note:** The communication must be activated by 98.06 AI/O EXT MODULE 1.	
	UNIPOL XTAI1	Unipolar.	1
	BIPOL XTAI1	Bipolar.	2
98.11	AI/O EXT AI2 FUNC	Defines the signal type for input 2 of the first analog I/O extension module. The setting must match the signal connected to the module. **Note:** The communication must be activated by 98.06 AI/O EXT MODULE 1.	
	UNIPOL XTAI2	Unipolar.	1
	BIPOL XTAI2	Bipolar.	2
98.12	AI/O EXT AI3 FUNC	Defines the signal type for input 1 of the second analog I/O extension module. The setting must match the signal connected to the module. **Note:** The communication must be activated by 98.07 AI/O EXT MODULE 2.	
	UNIPOL XTAI3	Unipolar.	1
	BIPOL XTAI3	Bipolar.	2
98.13	AI/O EXT AI4 FUNC	Defines the signal type for input 2 of the second analog I/O extension module. The setting must match the signal connected to the module. **Note:** The communication must be activated by 98.07 AI/O EXT MODULE 2.	
	UNIPOL XTAI4	Unipolar.	1
	BIPOL XTAI4	Bipolar.	2
99 START-UP DATA		Drive set-up	
99.01	LANGUAGE	Selects the display language.	
	ENGLISH	British 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	11
	POLSKI / LOC1	Polish	12
	PO RUS / LOC2	Russian	13

No.	Name/Value	Description	FbEq
99.02	APPLICATION MACRO	Selects the application macro. See chapter *Application macros for more information.* **Note:** When you change the default parameter values of a macro, the new settings becomes 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 99.03 APPLIC RESTORE.	
	FACTORY	Enables the factory application.	1
	PCP	Enables the PCP application.	2
	ESP	Enables the ESP application.	3
99.03	APPLIC RESTORE	Restores the original settings of the active application macro (99.02 APPLICATION MACRO). Exceptions: Group 99 parameters and motor model remain unchanged.	
	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. **Note:** Not available in ESP.	0
	SCALAR	Scalar control is suitable in cases where the DTC cannot be applied. The scalar mode is recommended: - for multi-motor drives with variable number of motors. - when the nominal current is less than 1/6 of the nominal output current of the drive (inverter). **Note:** Not available in PCP.	65535
99.05	MOTOR NOM VOLTAGE	Defines the nominal motor voltage. Must be equal to the value on the motor rating plate.	
	½…2 x U_N	Voltage. Allowed range is 1/2…2 · U_N 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.	
	1/6…2 x I_{2hd}	Allowed range: 1/6…2 · I_{2hd} of ACS800.	10 = 1 A
99.07	MOTOR NOM FREQ	Defines the nominal motor frequency.	
	8…300 Hz	Nominal frequency (50 or 60 Hz typically).	100 = 1 Hz
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 99.08 is changed, the speed limits in group 20 LIMITS change automatically as well.	
	1…18000 rpm	Nominal motor speed.	1 = 1 rpm
99.09	MOTOR NOM POWER	Defines the nominal motor power. Set exactly as on the motor rating plate.	
	0…9000 kW 0…12064 Hp	Nominal motor power.	10 = 1 kW 10 = 1 Hp

No.	Name/Value	Description	FbEq
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 chapter *Start-up*. **Note:** The ID Run (STANDARD) should be selected.	
	NO	No ID Run. The motor model is calculated at first start by magnetizing the motor for 20 to 60 sec. at zero speed.	1
	STANDARD	Standard ID Run. Guarantees the best possible control accuracy. The ID Run takes about one minute. **Note:** The motor must be de-coupled from the driven equipment. **Note:** Check the direction of rotation of the motor before starting the ID Run. During the run, the motor will rotate in the forward direction. **WARNING!** The motor will run at up to approximately 50…80% of the nominal speed during the ID Run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	2
	REDUCED	Reduced ID Run. Should be selected instead of the Standard ID Run: - If mechanical losses are higher than 20% (i.e. the motor cannot be de-coupled from the driven equipment) - If flux reduction is not allowed while the motor is running (i.e. in case of a motor with an integrated brake supplied from the motor terminals). **Note:** Check the direction of rotation of the motor before starting the ID Run. During the run, the motor will rotate in the forward direction. **WARNING!** The motor will run at up to approximately 50…80% of the nominal speed during the ID Run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	3
99.11	CALC MOTOR TORQUE	Nominal motor torque. Automatically calculated from Group 99 parameters.	10 = 1 Nm 10 = 1 lbft

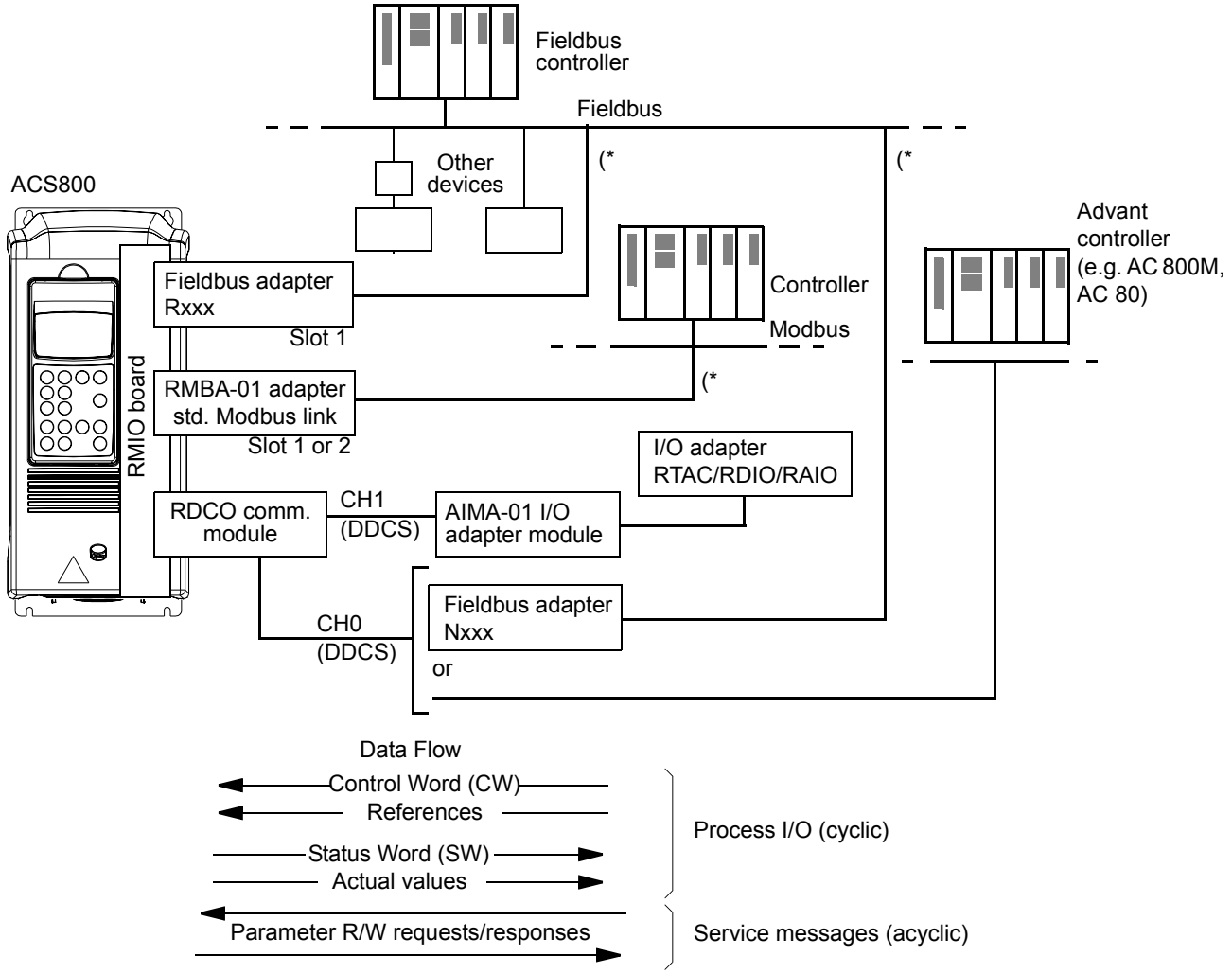
Fieldbus control

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. The drive can be set to receive all of its control information through the external control interface, or the control can be distributed between the external control interface and other available sources, for example digital and analog inputs. The following diagram shows the control interfaces and I/O connections of the drive.

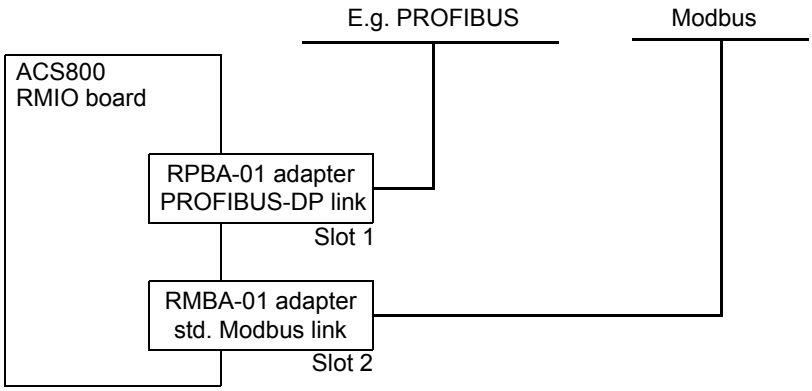


(* Either an Rxxx **or** Nxxx, **and** an RMBA-01 adapter can be connected to the drive simultaneously.

Redundant fieldbus control

It is possible to connect two fieldbuses to the drive with the following adapter configuration:

- Type Rxxx fieldbus adapter module (not RMBA-01) is installed in drive slot 1.
- RMBA-01 Modbus Adapter module is installed in drive slot 2.



The control (i.e. the Main Reference data set, see section *The fieldbus control interface* on page 111) is activated by setting parameter 98.02 to FIELDBUS or STD MODBUS.

In case there is a communication problem with one fieldbus, the control can be switched to the other fieldbus. Switching between the buses can be controlled e.g. with adaptive programming. Parameters and signals can be read by both fieldbuses, but simultaneous cyclical writing to the same parameter is forbidden.

Setting up communication through a fieldbus adapter module

Fieldbus adapters for several communication protocols are available (e.g. PROFIBUS and Modbus). Rxxx type fieldbus adapter modules are mounted in expansion slot 1 of the drive. Nxxx type fieldbus adapter modules are connected to channel CH0 of the RDCO module.

Note: For instructions on setting up an RMBA-01 module, see section *Setting up communication through the Standard Modbus Link* on page 107.

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 following table lists the parameters which need to be defined when setting up communication through a fieldbus adapter.

Parameter	Alternative Settings	Setting for Fieldbus Control	Function/Information
COMMUNICATION INITIALISATION			
98.02	NO FIELDBUS ADVANT STD MODBUS	FIELDBUS	Initializes communication between drive and fieldbus adapter module. Activates module set-up parameters (Group 51).
ADAPTER MODULE CONFIGURATION			
51.01 MODULE TYPE	–	–	Displays the type of the fieldbus adapter module.
51.02 (FIELDBUS PARAMETER 2)… 51.26 (FIELDBUS PARAMETER 26)	These parameters are adapter module-specific. For more information, see the module manual. Note that not all of these parameters are necessarily visible.		
51.27 FBA PAR REFRESH*	**(0)** DONE **(1)** REFRESH	–	Validates any changed adapter module configuration parameter settings. After refreshing, the value reverts automatically to DONE.
51.28 FILE CPI FW REV*	xyz (binary coded decimal	–	Displays the required CPI firmware revision of the fieldbus adapter as defined in the configuration file stored in the memory of the drive. The CPI firmware version of the fieldbus adapter (refer to 51.32) must contain the same or a later CPI version to be compatible. **x** = major revision number; **y** = minor revision number; **z** = correction number. **Example: 107** = revision 1.07.
51.29 FILE CONFIG ID*	xyz (binary coded decimal)	–	Displays the fieldbus adapter module configuration file identification stored in the memory of the drive. This information is drive control program-dependent.

Parameter	Alternative Settings	Setting for Fieldbus Control	Function/Information
51.30 FILE CONFIG REV*	xyz (binary coded decimal)	–	Displays the fieldbus adapter module configuration file revision stored in the memory of the drive. **x** = major revision number; **y** = minor revision number; **z** = correction number. **Example: 1** = revision 0.01.
51.31 FBA STATUS*	**(0)** IDLE **(1)** EXEC. INIT **(2)** TIME OUT **(3)** CONFIG ERROR **(4)** OFF-LINE **(5)** ON-LINE **(6)** RESET	–	Displays the status of the adapter module. IDLE = Adapter not configured. EXEC. INIT = Adapter initialising. TIME OUT = A time out has occurred in the communication between the adapter and the drive. CONFIG ERROR = Adapter configuration error. The major or minor revision code of the CPI program revision in the drive is not the revision required by the module (refer to 51.32) or configuration file upload has failed more than five times. OFF-LINE = Adapter is off-line. ON-LINE = Adapter is on-line. RESET = Adapter performing a hardware reset.
51.32 FBA CPI FW REV*	–	–	Displays the CPI program revision of the module inserted in slot 1. **x** = major revision number; **y** = minor revision number; **z** = correction number. **Example: 107** = revision 1.07.
51.33 FBA APPL FW REV*	–	–	Displays the control program revision of the module inserted in slot 1. **x** = major revision number; **y** = minor revision number; **z** = correction number. **Example: 107** = revision 1.07.

*Parameters 51.27 to 51.33 are only visible when type Rxxx fieldbus adapter is installed.

After the module configuration parameters in group 51 have been set, the drive control parameters (section *The fieldbus control interface* on page 111) must be checked and adjusted where necessary.

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

Setting up communication through the Standard Modbus Link

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

Before configuring the drive for Modbus 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 following table lists the parameters, which need to be defined when setting up communication through the standard Modbus link.

Parameter	Alternative Settings	Setting for Control through Standard Modbus Link	Function/Information
COMMUNICATION INITIALIZATION			
98.02	NO FIELDBUS ADVANT STD MODBUS	STD MODBUS	Initialises communication between drive (Standard Modbus Link) and Modbus-protocol controller. Activates communication parameters in group 52.
COMMUNICATION PARAMETERS			
52.01	1…247	–	Specifies the station number of the drive on the Standard Modbus Link.
52.02	600 1200 2400 4800 9600 19200	–	Defines the communication speed for the Standard Modbus Link.
52.03	ODD EVEN NONE1STOPBIT NONE2STOPBIT	–	Selects the parity setting for the Standard Modbus Link.

After the communication parameters in group 52 have been set, the drive control parameters (section *The fieldbus control interface* on page 111) must 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		**Data from Drive to Fieldbus Controller**	
Address	**Contents**	**Address**	**Contents**
40001	Control Word	40004	Status Word
40002	Reference 1	40005	Actual 1
40003	Reference 2	40006	Actual 2
40007	Reference 3	40010	Actual 3
40008	Reference 4	40011	Actual 4
40009	Reference 5	40012	Actual 5

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

Setting up communication through Advant controller

The Advant controller is connected via DDCS link to channel CH0 of the RDCO module.

AC 800M Advant Controller

DriveBus connection

CI858 DriveBus Communication Interface required. See CI858 DriveBus Communication Interface User's Manual, [3AFE 68237432 (English)].

Optical ModuleBus connection

TB811 (5 MBd) or TB810 (10 MBd) Optical ModuleBus Port Interface required. See table below.

For more information, see *AC 800M Controller Hardware Manua*l [3BSE027941 (English)], *AC 800M/C Communication, Protocols and Design Manual* [3BSE028811 (English),] ABB Industrial Systems, Västerås, Sweden.

AC 80 Advant Controller

Optical ModuleBus connection

TB811 (5 MBd) or TB810 (10 MBd) Optical ModuleBus Port Interface required. See table below.

CI810A Fieldbus Communication Interface (FCI)

Optical ModuleBus connection

TB811 (5 MBd) or TB810 (10 MBd) Optical ModuleBus Port Interface required.

The TB811 Optical ModuleBus Port Interface is equipped with 5 MBd optical components and the TB810 is equipped with 10 MBd components. All optical components on a fibre optic link must be of the same type since 5 MBd components do not match with 10 MBd components. The choice between TB810 and TB811 depends on the equipment it is connected to. With RDCO Communication Option Module, the Interface is selected as follows:

Optional ModuleBus Port Interface	DDCS Communication Option Module		
	RDCO-01	RDCO-02	RDCO-03
TB811		×	×
TB810	×		

If branching unit NDBU-85/95 is used with CI810A, TB810 Optical ModuleBus Port Interface must be used.

The following table lists the parameters which need to be defined when setting up communication between the drive and Advant controller.

Table 1 Setting up communication

Parameter	Alternative Settings	Setting for Control Through CH0	Function/Information
COMMUNICATION INITIALIZATION			
98.02	NO FIELDBUS ADVANT STD MODBUS	ADVANT	Initializes communication between drive (fibre optic channel CH0) and Advant controller. The transmission speed is 4 Mbit/s.
70.01	0…254	AC 800M ModuleBus ⏏ 1…125 AC 80 ModuleBus ⏏ 17…125 FCI (CI810A) ⏏ 17…125	Defines the node address for DDCS channel CH0.

After the communication initialization parameters have been set, the drive control parameters must be checked and adjusted where necessary.

In an Optical ModuleBus connection, 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.

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 Winder Program supports the use of six data sets, three in each direction.

Table 2 Default connections for the cyclical fieldbus communication.

Data from Fieldbus Controller to Drive					Data from Drive to Fieldbus Controller			
***Index**	**Word**	**Contents**	**Selector**	**Scaling**	***Index**	**Word**	**Contents**	**Selector**
Main Reference Data Set DS1					**Main Actual Signal Data Set DS2**			
1	1st word	Command Word	(Fixed)	See *Table 3* on page 113.	4	1st word	Actual 1	92.01
2	2nd word	Ext ref1	(Fixed)	20000 = 11.04 EXT REF1 MAXIMUM	5	2nd word	Actual 2	92.02
3	3rd word	Ext2 ref 2	(Fixed)	20000 = 11.07 EXT REF2 MAXIMUM	6	3rd word	Actual 3	92.03
Auxiliary Reference Data Set DS3					**Auxiliary Actual Signal Data Set DS4**			
7	1st word	Pump Command	(Fixed)		10	1st word	Not used	
8	2nd word	Not used	(Fixed)		11	2nd word	Not used	
9	3rd word	Not used	(Fixed)		12	3rd word	Not used	

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

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 is set to FIELDBUS.

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 section *Communication profiles* on page 113 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.

Reference handling

The control of rotation direction is configured using the parameters in group 10. Fieldbus references are bipolar, i.e. they can be negative or positive.

Notes:

- 100% reference is defined by parameter 11.04 and 11.07.
- External reference scaling parameter 11.03 and 11.06 are also in effect.

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 chapter *Actual signals and parameters*.

Communication profiles

Table 3 DataSet 1 Word 1 - Command Word (Actual Signal 06.01)

Bit	Name	STATE/Description
0	DRIVE ENABLE	See chapter *Actual signals and parameters*, parameter 10.04.
1	*Reserved*	
2	*Reserved*	
3	START COMMAND	See chapter *Actual signals and parameters*, parameters 10.01 and 10.02.
4	DIRECTION	See chapter *Actual signals and parameters*, parameter 10.03.
5	CONSTANT SPD 1 ACT	See chapter *Actual signals and parameters*, parameter 12.01.
6	CONSTANT SPD 2 ACT	See chapter *Actual signals and parameters*, parameter 12.01.
7	FAULT RESET	See chapter *Actual signals and parameters*, parameter 16.01.
8	*Reserved*	
9	*Reserved*	
10	REMOTE CMD (Profibus only)	
11	*Reserved*	
12	*Reserved*	
13	*Reserved*	
14	COMM HEARTBEAT	
15	*Reserved*	

Table 4 DataSet 3 Word 1 - Pump Command (Actual Signal 06.04)

Bit	Name	Description
0	EXT1 / EXT2 SELECTION	See chapter *Actual signals and parameters*, parameter 11.01.
1	PUMP ENABLE	See chapter *Actual signals and parameters*, parameter 71.02.
2	PUMP FAULT RESET	See chapter *Actual signals and parameters*, parameter 71.08.
3	RUNTIME RESET	See chapter *Actual signals and parameters*, parameter 71.09.
4	FLUID LEVEL PI ENABLE	See chapter *Actual signals and parameters*, parameter 72.19.
5… 15	*Reserved*	

Table 5 Main Status Word (Actual Signal 08.01)

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. Valid in both rotation directions regardless of limit value.
		0	Actual frequency or speed value is within supervision limit.
11	FAULT^{-1} Inverse of bit 3	1	No fault
		0	Fault active
12	EXT RUN ENABLE	1	External Run Enable signal received.
		0	No External Run Enable received.
13	EXT CTRL LOC	1	External Control Location 2 (EXT2) selected.
		0	External Control Location 1 (EXT1) selected.
14	HEARTBEAT	1	500 ms square wave.
		0	(send back on Main Cmd Word bit 14)
15	*Reserved*		

Table 6 Pump Status Word 4 (Actual Signal 08.02)

Bit	Name	Description
0	HIGH PRESSURE	See chapter *Actual signals and parameters*, parameter 72.01.
1	HIGH DISCHARGE PRESS	See chapter *Actual signals and parameters*, parameter 72.06.
2	ROD TORQUE 1 LIMIT	See chapter *Actual signals and parameters*, parameter 72.08.
3	ROD TORQUE 2 LIMIT	See chapter *Actual signals and parameters*, parameter 72.13.
4	ROD TORQUE 2 SPD ACT	See chapter *Actual signals and parameters*, parameter 72.16.
5	BACKSPIN LIMIT	See chapter *Actual signals and parameters*, parameter 71.03.
6	UNDERLOAD	See chapter *Actual signals and parameters*, parameter 73.01.
7	HIGH PUMP TEMP	See chapter *Actual signals and parameters*, parameter 73.09.
8	ACS800 UNDERTEMP	ACS800 cabin undertemp limit reached
9	MOTOR STALL WARNING	Motor stall active; shutdown process will occur
10	EXTERNAL FAULT	See chapter *Actual signals and parameters*, parameter 30.25.
11	AI<MIN	See chapter *Actual signals and parameters*, parameter 30.23.
12	KEYPAD LOSS	See chapter *Actual signals and parameters*, parameter 30.24.
13	RELAY OUT 1 STATUS	Relay output 1 active
14	RELAY OUT 2 STATUS	Relay output 2 active
15	RELAY OUT 3 STATUS	Relay output 3 active

Table 7 Fault Word 1 (Actual Signal 09.01).

Bit	Name	Description
0	SHORT CIRCUIT	For possible causes and remedies, see chapter *Fault tracing*.
1	OVERCURRENT	
2	DC OVERVOLT	
3	ACS800 TEMP	
4	EARTH FAULT	
5	MOT TEMP	
6	MOTOR TEMP	
7	SYSTEM FAULT	
8	UNDERLOAD	
9	OVER FREQUENCY	
10	LINE CONVERTER	
11	CH2 COMM LOSS	
12… 15	*Reserved*	

Table 8 Fault Word 2 (Actual Signal 09.02)

Bit	Name	Description
0	SUPPLY FAULT	For possible causes and remedies, see chapter *Fault tracing*.
1	NO MOTOR DATA	
2	DC UNDERVOLT	
3	EXTERNAL FAULT	
4	RUN DISABLE	
5	ENCODER FAULT	
6	IO FAULT	
7	CABIN TEMP FAULT	
8	AI<MIN	
9	OVER SWITCH FREQ	
10	KEYPAD LOSS FAULT	
11	PPCC LINK FAULT	
12	CH0 COMM LOSS	
13	PANEL LOSS FAULT	
14	MOTOR STALL	
15	MOTOR PHASE FAULT	

Table 9 Alarm Word 1 (Actual Signal 09.03).

Bit	Name	Description
0	*Reserved*	
1	LIMITING	For the possible causes and remedies, see chapter *Fault tracing*.
2	MOT TEMP	
3	*Reserved*	
4	UNDER TEMP	For the possible causes and remedies, see chapter *Fault tracing*.
5	AI<MIN WARN	
6	TEMP MEAS WARN	
7	I/O ALARM	
8	KEYPAD LOSS WARN	
9	EXT DIO1 ALM	
10	EXT DIO2 ALM	
11	EXT AIO1 ALM	
12	EXT AIO2 ALM	
13	EXT AIO3 ALM	
14	EARTH FAULT	
15	*Reserved*	

Table 10 Limit Word (Actual Signal 09.04).

Bit	Name	Description
0	TORQ MOTOR LIM	Pull-out torque limit.
1	SPD_TOR_MIN_LIM	Speed control torque at MIN limit.
2	SPD_TOR_MAX_LIM	Speed control torque at MAX limit.
3	TORQ_USER_CURR_LIM	User-defined current limit.
4	TORQ_INV_CUR_LIM	Internal current limit.
5	TORQ_MIN_LIM	Inclusive torque MIN limit.
6	TORQ_MAX_LIM	Inclusive torque MAX limit.
7	TREF_TORQ_MIN_LIM	Torque reference at MIN limit.
8	TREF_TORQ_MAX_LIM	Torque reference at MAX limit.
9	FLUX_MIN_LIM	Flux reference at MIN limit.
10	FREQ_MIN_LIMIT	Speed/Frequency at MIN limit.
11	FREQ_MAX_LIMIT	Speed/Frequency at MAX limit.
12	DC_UNDERVOLT	DC Bus < Under-voltage limit.
13	DC_OVERVOLT	DC Bus > Over-voltage limit.
14	TORQUE LIMIT	Inclusive torque limit (MAX or MIN).
15	FREQ_LIMIT	Inclusive speed/frequency limit (MAX or MIN).

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 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.

The fault logger collects 64 of the latest faults. When the drive power is switched off, 16 of the latest faults are stored.

See chapter *Control panel* for more information.

Warning messages generated by the drive

Warning	Cause	What to Do
ACS800 TEMP (4210) 09.03 AW 1 bit 04	Drive IGBT temperature is excessive. Fault trip limit is 100%.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
BACKSPN LIM 08.02 PUMP STATUS WORD bit 05	Motor speed is less than limit and drive is modulating, due to stopping condition.	Check settings in parameter 71.03.
BACKUP USED (FFA3)	PC stored backup of drive parameters is downloaded into use.	Wait until download is completed.
BATT FAILURE (5581)	APBU branching unit memory backup battery error caused by - incorrect APBU switch S3 setting - too low battery voltage.	With parallel connected inverters, enable backup battery by setting actuator 6 of switch S3 to ON. Replace backup battery.
BC OVERHEAT (7114)	Brake chopper overload	Stop drive. Let chopper cool down. Check parameter settings of resistor overload protection function. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
BR OVERHEAT (7112)	Brake resistor overload	Stop drive. Let resistor cool down. Check parameter settings of resistor overload protection function. Check that braking cycle meets allowed limits.
CALIBRA DONE (FF37)	Calibration of output current transformers is completed.	Continue normal operation.
CALIBRA REQ **(FF36)**	Calibration of output current transformers is required. Displayed at start if drive is in scalar control and scalar fly start feature is on.	Calibration starts automatically. Wait for a while.
COMM MODULE (7510) 09.03 AW 1 bit 12 (programmable Fault Function 70.03…70.04)	Cyclical communication between drive and master is lost.	Check status of fieldbus communication. See chapter *Fieldbus control*, or appropriate fieldbus adapter manual. Check parameter settings: - group 51 MASTER ADAPTER (for fieldbus adapter) - group 52 STANDARD MODBUS (for Standard Modbus Link). Check Fault Function parameters. Check cable connections. Check if master can communicate.

Warning	Cause	What to Do
CUR UNBAL xx (2330) 09.03 AW1 bit 14 (programmable Fault Function 30.20)	Drive has detected excessive output current unbalance in inverter unit of several parallel connected inverter modules. This can be caused by external fault (ground fault, motor, motor cabling, etc.) or internal fault (damaged inverter component). xx (2…12) refers to inverter module number.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check that there is no ground fault in motor or motor cables: measure insulation resistances of motor and motor cable. If no earth fault can be detected, contact your local ABB representative.
DC BUS LIM (3211)	Drive limits torque due to too high or too low intermediate circuit DC voltage.	Informative alarm Check Fault Function parameters.
DISCHARG FLT 08.02 PUMP STATUS WORD bit 01	Discharge pressure has exceeded the limit.	Check for problem in discharge pipe. Check fault function setting in parameter 72.05.
ENC CABLE (7310)	Pulse encoder phase signal is missing.	Check pulse encoder and its wiring. Check pulse encoder interface module and its wiring.
ENCODER A<>B (7302)	Pulse encoder phasing is wrong: Phase A is connected to terminal of phase B and vice versa.	Interchange connection of pulse encoder phases A and B.
ENCODER ERR (7301) 09.03 AW 1 bit 05	Communication fault between pulse encoder and pulse encoder interface module and between module and drive	Check pulse encoder and its wiring, pulse encoder interface module and its wiring, parameter group 50 PULSE ENCODER settings.
EXT FAULT 08.02 PUMP STATUS WORD bit 10	Fault in external device.	Check external device(s) for fault(s). Check fault function setting in parameter 30.25.
FAN OTEMP (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.
HIGH PRESS 08.02 PUMP STATUS WORD bit 00	High pressure switch input is open, or the discharge pressure has exceeded the limit.	Check for problem in measurement device. Check for high gas content. Check fault function setting in parameter 72.01.
HW RECONF RQ (FF38)	Inverter type (e.g. sr0025_3) has been changed. Inverter type is usually changed at factory or during drive implementation.	Wait until alarm POWEROFF! activates and switch control board power off to validate inverter type change.
ID DONE (FF32)	Drive has performed motor identification magnetization and is ready for operation. This warning belongs to normal start-up procedure.	Continue drive operation.
ID MAGN (FF31)	Motor identification magnetization is on. This warning belongs to normal start-up procedure.	Wait until drive indicates that motor identification is completed.

Warning	Cause	What to Do
ID MAGN REQ (FF30)	Motor identification is required. This warning belongs to normal start-up procedure. Drive expects user to select how motor identification should be performed: By Identification Magnetization or by ID Run.	Start Identification Magnetization by pressing Start key, or select ID Run and start (parameter 99.10).
ID N CHANGED (FF68)	Drive ID number has been changed from 1.	Change ID number back to 1. See chapter *Control panel*.
ID RUN (FF35)	Motor identification Run is on.	Wait until drive indicates that motor identification Run is completed.
ID RUN SEL (FF33)	Motor Identification Run is selected, and drive is ready to start ID Run. This warning belongs to ID Run procedure.	Press Start key to start Identification Run.
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.
INV CUR LIM (2212)	Internal inverter current or power limit has been exceeded.	Reduce load or increase ramp time. Limit inverter actual power or decrease line-side converter reactive power generation reference value (parameter 95.06). Check Fault Function parameters.
INV DISABLED (3200)	Optional DC switch has opened while unit was stopped.	Close DC switch. Check AFSC-0x Fuse Switch Controller unit.
INV OVERTEMP (4290)	Converter module temperature is excessive.	Check ambient temperature. If it exceeds 40°C, ensure that load current does not exceed derated load capacity of drive. See appropriate hardware manual. Check that ambient temperature setting is correct (parameter 95.10). Check converter module cooling air flow and fan operation. Cabinet installation: Check cabinet air inlet filters. Change when necessary. See appropriate hardware manual. Modules installed in cabinet by user: Check that cooling air circulation in cabinet has been prevented with air baffles. See module installation instructions. Check inside of cabinet and heatsink of converter module for dust pick-up. Clean when necessary.
IO CONF	Input or output of optional I/O extension or fieldbus module has been selected as signal interface in the control program but communication to appropriate I/O extension module has not been set accordingly.	Check Fault Function parameters. Check parameter group 98 OPTION MODULES.

Warning	Cause	What to Do
MACRO CHANGE (FF69)	Macro is restoring or User macro is being saved.	Wait until drive has finished task.
MOD BOARD T (FF88)	Overtemperature in AINT board of inverter module.	Check inverter fan. Check ambient temperature.
MOD CHOKE T (FF89) 02.17 AW 3 bit 13	Overtemperature in choke of liquid cooled R8i inverter module.	Check inverter fan. Check ambient temperature. Check liquid cooling system.
MOT CUR LIM (2300)	Drive limits motor current according to current limit defined by parameter 20.04.	Reduce load or increase ramp time. Increase parameter 20.04 value. Check Fault Function parameters.
MOTOR STALL 08.02 PUMP STATUS WORD bit 09	Motor is operating in stall region due to e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check Fault Function parameters.
MOTOR STARTS (FF34)	Motor Identification Run starts. This warning belongs to ID Run procedure.	Wait until drive indicates that motor identification is completed.
MOTOR TEMP (4310) 09.03 AW 1 bit 03 (programmable Fault Function 30.01…30.12)	Motor temperature is too high (or appears to be too high) due to excessive load, insufficient motor power, inadequate cooling or incorrect start-up data.	Check motor ratings, load and cooling. Check start-up data. Check Fault Function parameters.
MOTOR 1 TEMP (4312)	Measured motor temperature has exceeded alarm limit set by parameter 30.04.	Check value of alarm limit. Check that actual number of sensors corresponds to value set by parameter. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc.
OVERTEMP 08.02 PUMP STATUS WORD bit 07	Pump temperature has exceeded the limit, or the Klixon input is open.	Check for problem in measurement device. Check for problem in temperature measurement circuit. Check well and discharge pressures (excessive pressure can cause heating). Check fault function setting in parameters 73.09…73.14.
PANEL LOSS (5300)	Control panel selected as active control location for drive has ceased communicating.	Check panel connection (see appropriate hardware manual). Check control panel connector. Replace control panel in mounting platform. Check Fault Function parameters.
POINTER ERROR (FFD0)	Source selection (pointer) parameter points to non existing parameter index.	Check source selection (pointer) parameter settings.

Warning	Cause	What to Do
->POWEROFF! (FF39)	Inverter type (e.g. sr0025_3) has been changed. Inverter type is usually changed at factory or during drive implementation.	Switch control board power off to validate inverter type change.
PP OVERLOAD (5482)	Excessive IGBT junction to case temperature. This can be caused by excessive load at low frequencies (e.g. fast direction change with excessive load and inertia).	Increase ramp time. Reduce load.
REPLACE FAN (4280)	Running time of inverter cooling fan has exceeded its estimated life time.	Replace fan. Reset fan run time counter.
ROD TORQ LIM 08.02 PUMP STATUS WORD bit 02	Motor load and speed is too low, or motor load is too high and speed is too low due to, for example, binding in the driven equipment.	Check for problem in driven equipment. Check fault function setting in parameter 72.08.
SLEEP MODE	Sleep function has entered sleeping mode.	Check fault function setting in parameter 71.11.
START INHIBI (FF7A) 09.03 AW 1 bit 0	Optional start inhibit hardware logic is activated.	Check start inhibit circuit (AGPS board).
START INTERL (FF8D)	No Start Interlock signal received.	Check circuit connected to Start Interlock input on RMIO board.
SYNCRO SPEED (FF87)	Value of motor nominal speed set to parameter 99.08 is not correct: Value is too near synchronous speed of motor. Tolerance is 0.1%. This warning is active only in DTC mode.	Check nominal speed from motor rating plate and set parameter 99.08 exactly accordingly.
TEMP DIF xx y (4380)	Excessive temperature difference between several parallel connected inverter modules. xx (1…12) refers to inverter module number and y refers to phase (U, V, W). Alarm is indicated when temperature difference is 15 °C. Fault is indicated when temperature difference is 20 °C. Excessive temperature can be caused e.g. by unequal current sharing between parallel connected inverters.	Check cooling fan. Replace fan. Check air filters.
THERMISTOR (4311) 02.15 AW 1 bit 02 (programmable Fault Function 30.02…30.01)	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.
TORQ 2 SPD 08.02 PUMP STATUS WORD bit 04	Motor load is too low due to, for example, a release mechanism in driven equipment, or too high due to, for example, the well having “sanded in.”	Check for problem in driven equipment. Check that the pump is not “sanded in.” Check fault function setting in parameter 72.13.

Warning	Cause	What to Do
TORQ 2 LIM 08.02 PUMP STATUS WORD bit 03	Drive has entered TORQ 2 SPD condition too frequently within 2 hours.	Check for problem in driven equipment. Check that the pump is not “sanded in.” Check fault function setting in parameters 72.13 and 72.18.
T MEAS ALM (FF91) 02.15 AW 1 bit 06	Motor temperature measurement is out of acceptable range.	Check connections of motor temperature measurement circuit. See chapter *Program features* for circuit diagram.
UNDRLOAD 08.02 PUMP STATUS WORD bit 06	Motor load is too low due to, for example, a release mechanism in the driven equipment.	Check for problem in driven equipment. Check for problem in rod string. Check fault function setting in parameter 73.01.
UNDERTEMP LIM 08.02 PUMP STATUS WORD bit 08 09.03 AW 1 bit 04	Drive IGBT temperature is excessively low (too cold).	Check ambient conditions.

Warning messages generated by the control panel

Warning	Cause	What to Do
DOWNLOADING FAILED	Download function of panel has failed. No data has been copied from panel to drive.	Make sure panel is in local mode. Retry (there might be interference on link). Contact ABB representative.
DRIVE IS RUNNING DOWNLOADING NOT POSSIBLE	Downloading is not possible while motor is running.	Stop motor. Perform downloading.
NO COMMUNICATION (X)	Cabling problem or hardware malfunction on Panel Link	Check Panel Link connections. Press RESET key. Panel reset may take up to half a minute, please wait.
	(4) = Panel type not compatible with drive control program version	Check panel type and drive control program version. Panel type is printed on panel cover. Control program version is stored in 04.07 APPL SW VERSION.
NO FREE ID NUMBERS ID NUMBER SETTING NOT POSSIBLE	Panel Link already includes 31 stations.	Disconnect another station from link to free ID number.
NOT UPLOADED DOWNLOADING NOT POSSIBLE	No upload function has been performed.	Perform upload function before downloading. See chapter *Control panel*.
UPLOADING FAILED	Upload function of panel has failed. No data has been copied from drive to panel.	Retry (there might be interference on link). Contact ABB representative.

Warning	Cause	What to Do
WRITE ACCESS DENIED PARAMETER SETTING NOT POSSIBLE	Certain parameters do not allow changes while motor is running. If tried, no change is accepted, and warning is displayed. Parameter lock is on.	Stop motor, then change parameter value. Open parameter lock (see parameter 16.02).

Fault messages generated by the drive

Fault	Cause	What to Do
ACS800 TEMP (4210) 09.01 FW 1 bit 03	Drive IGBT temperature is excessive. Fault trip limit is 100%.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
ACS TEMP xx y (4210) 09.01 FW 1 bit 03	Excessive internal temperature in inverter unit of several parallel connected inverter modules. xx (1…12) refers to inverter module number and y refers to phase (U, V, W).	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
BACKUP ERROR (FFA2)	Failure when restoring PC stored backup of drive parameters.	Retry. Check connections. Check that parameters are compatible with drive.
BC OVERHEAT (7114)	Brake chopper overload	Let chopper cool down. Check parameter settings of resistor overload protection function. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
BC SHORT CIR (7113)	Short circuit in brake chopper IGBT(s)	Replace brake chopper. Ensure brake resistor is connected and not damaged.
BR BROKEN (7110)	Brake resistor is not connected or it is damaged. Resistance rating of brake resistor is too high.	Check resistor and resistor connection. Check that resistance rating meets specifications. See appropriate drive hardware manual.
BR OVERHEAT (7112)	Brake resistor overload	Let resistor cool down. Check parameter settings of resistor overload protection function. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
BR WIRING (7111)	Wrong connection of brake resistor	Check resistor connection. Ensure brake resistor is not damaged.
CHOKE OTEMP (FF82)	Excessive temperature of drive output filter. Supervision is in use in step-up drives.	Let drive cool down. Check ambient temperature. Check filter fan rotates in correct direction and air flows freely.

Fault	Cause	What to Do
COMM MODULE (7510) 09.02 FW 2 bit 12 (programmable Fault Function 70.03…70.04)	Cyclical communication between drive and master is lost.	Check status of fieldbus communication. See chapter *Fieldbus control*, or appropriate fieldbus adapter manual. Check parameter settings: - group 51 MASTER ADAPTER (for fieldbus adapter), or - group 52 STANDARD MODBUS (for Standard Modbus Link). Check Fault Function parameters. Check cable connections. Check if master can communicate.
CTRL B TEMP (4110) 09.02 FW 2 bit 07	Control board temperature is above 88°C.	Check ambient conditions. Check air flow. Check main and additional cooling fans.
CURR MEAS (2211)	Current transformer failure in output current measurement circuit	Check current transformer connections to Main Circuit Interface Board, INT.
CUR UNBAL xx (2330) 09.01 FW 1 bit 04 (programmable Fault Function 30.20)	Drive has detected excessive output current unbalance in inverter unit of several parallel connected inverter modules. This can be caused by external fault (earth fault, motor, motor cabling, etc.) or internal fault (damaged inverter component). xx (1…12) refers to inverter module number.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check that there is no earth fault in motor or motor cables: measure insulation resistances of motor and motor cable. If no earth fault can be detected, contact your local ABB representative.
DC HIGH RUSH (FF80)	Drive supply voltage is excessive. When supply voltage is over 124% of unit voltage rating (415, 500 or 690 V), motor speed rushes to trip level (40% of nominal speed).	Check supply voltage level, drive rated voltage and allowed voltage range of drive.
DC OVERVOLT (3210) 09.01 FW 1 bit 02	Excessive intermediate circuit DC voltage. DC overvoltage trip limit is $1.3 \cdot U_{1max}$, where U_{1max} is maximum value of mains voltage range. For: 400 V units, U_{1max} is 415 V 500 V units, U_{1max} is 500 V. Actual voltage in intermediate circuit corresponding to mains voltage trip level is: 728 VDC for 400 V units and 877 VDC for 500 V units.	Check that overvoltage controller is on (see parameter 30.22). Check mains for static or transient overvoltage. Check brake chopper and resistor (if used). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit frequency converter with brake chopper and brake resistor.

Fault	Cause	What to Do
DC UNDERVOLT (3220) 09.02 FW 2 bit 02	Intermediate circuit DC voltage is not sufficient due to missing mains phase, blown fuse or rectifier bridge internal fault. DC undervoltage trip limit is 0.6 · U_{1min}, where U_{1min} is minimum value of mains voltage range. For: 400 V and 500 V units, U_{1min} is 380 V 690 V units, U_{1min} is 525 V. Actual voltage in intermediate circuit corresponding to mains voltage trip level is: 307 VDC for 400 V and 500 V units, and 425 VDC for 690 V units.	Check mains supply and fuses.
DISCHARG FLT 08.02 PUMP STATUS WORD bit 01	Discharge pressure has exceeded the limit.	Check for problem in discharge pipe. Check fault function setting in parameter 72.05.
ENCODER A<>B (7302)	Pulse encoder phasing is wrong: Phase A is connected to terminal of phase B and vice versa.	Interchange connection of pulse encoder phases A and B.
ENCODER ERR (7301) 09.01 FW 2 bit 05	Communication fault between pulse encoder and pulse encoder interface module and between module and drive	Check pulse encoder and its wiring, pulse encoder interface module and its wiring and group 50 PULSE ENCODER settings.
EXT FAULT 08.02 PUMP STATUS WORD bit 10	Fault in external device.	Check external device(s) for fault(s). Check fault function setting in parameter 30.25.
GD DISABLED (FF53)	AGPS power supply of parallel connected R8i inverter module has been switched off during run. X (1…12) refers to inverter module number.	Check Prevention of Unexpected Start-up circuit. Replace AGPS board of R8i inverter module.
GROUND FAULT (2330) 09.01 FW 1 bit 4 (programmable Fault Function 30.20)	Drive has detected load unbalance typically due to ground fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check that there is no ground fault in motor or motor cables: measure insulation resistances of motor and motor cable. If no ground fault can be detected, contact your local ABB representative.
HIGH PRESS 08.02 PUMP STATUS WORD bit 00	High pressure switch input is open, or the discharge pressure has exceeded the limit.	Check for problem in measurement device. Check for high gas content. Check fault function setting in parameter 72.01.
ID RUN FAIL (FF84)	Motor ID Run is not completed successfully.	Check maximum speed (20.02). It should be at least 80% of motor nominal speed (99.08).

Fault	Cause	What to Do
IN CHOKE TEMP (FF81)	Excessive input choke temperature	Stop drive. Let it cool down. Check ambient temperature. Check that fan rotates in correct direction and air flows freely.
INT CONFIG (5410)	Number of inverter modules is not equal to original number of inverters.	Check status of inverters. Check fibre optic cables between APBU and inverter modules.
INV DISABLED (3200)	Optional DC switch has opened while unit was running or start command was given.	Close DC switch. Check AFSC-0x Fuse Switch Controller unit.
INV OVERTEMP (4290)	Converter module temperature is excessive.	Check ambient temperature. If it exceeds 40°C, ensure that load current does not exceed derated load capacity of drive. See appropriate hardware manual. Check that ambient temperature setting is correct (parameter 95.10). Check converter module cooling air flow and fan operation. Cabinet installation: Check cabinet air inlet filters. Change when necessary. See appropriate hardware manual. Modules installed in cabinet by user: Check that cooling air circulation in cabinet has been prevented with air baffles. See module installation instructions. Check inside of cabinet and heatsink of converter module for dust pick-up. Clean when necessary. Reset and restart after problem is solved and let converter module cool down.
I/O COMM ERR (7000) 09.02 FW 2 bit 06	Communication error on 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 equipment. Check for highly emissive components nearby.
LINE CONV (FF51)	Fault on line side converter	Shift panel from motor side converter control board to line side converter control board. See line side converter manual for fault description.
MOD BOARD T (FF88)	Overtemperature in AINT board of inverter module.	Check inverter fan. Check ambient temperature.
MOD CHOKE T (FF89)	Overtemperature in choke of liquid cooled R8i inverter module.	Check inverter fan. Check ambient temperature. Check liquid cooling system.

Fault	Cause	What to Do
MOTOR PHASE (FF56) 09.02 FW 2 bit 15 (programmable Fault Function 30.19)	One of motor phases is lost due to fault in motor, motor cable, thermal relay (if used) or internal fault.	Check motor and motor cable. Check thermal relay (if used). Check Fault Function parameters. Disable this protection.
MOTOR STALL 08.02 PUMP STATUS WORD bit 09	Motor is operating in stall region due to e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check Fault Function parameters.
MOTOR TEMP (4310) 09.01 FW 1 bit 06 (programmable Fault Function 30.01…30.12)	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 1 TEMP (4312)	Measured motor temperature has exceeded fault limit set by parameter 30.05.	Check value of fault limit. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc.
NO MOT DATA (FF52) 09.02 FW 2 bit 01	Motor data is not given or motor data does not match with inverter data.	Check motor data parameters 99.05…99.09.
OVERCURR xx (2310) 09.01 FW 1 bit 01	Overcurrent fault in inverter unit of several parallel connected inverter modules. xx (1…12) refers to inverter module number.	Check motor load. Check acceleration time. Check motor and motor cable (including phasing). Check encoder cable (including phasing). Check motor nominal values from group 99 START-UP DATA to confirm that motor model is correct. Check that there are no power factor correction or surge absorbers in motor cable.
OVERCURRENT (2310) 09.01 FW 1 bit 01	Output current exceeds trip limit.	Check motor load. Check acceleration time. Check motor and motor cable (including phasing). Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing).

Fault	Cause	What to Do
OVERFREQ (7123) 09.01 FW 1 bit 09	Motor is turning faster than highest allowed speed due to incorrectly set minimum/ maximum speed, insufficient braking torque or changes in load when using torque reference. Trip level is 40 Hz over operating range absolute maximum speed limit (Direct Torque Control mode active) or frequency limit (Scalar Control active). Operating range limits are set by 20.01 and 20.02 (DTC mode active) or 29.03 and 29.02 (Scalar Control active).	Check minimum/maximum speed settings. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
OVER SWFREQ (FF55) 09.02 FW 2 bit 09	Switching frequency is too high.	Check motor parameter settings (parameter group 99 START-UP DATA) Ensure that ID run has been completed successfully.
OVERTEMP 08.02 PUMP STATUS WORD bit 07	Pump temperature has exceeded the limit, or the Klixon input is open.	Check for problem in measurement device. Check for problem in temperature measurement circuit. Check well and discharge pressures (excessive pressure can cause heating). Check fault function setting in parameters 73.09…73.14.
PANEL LOSS (5300) 09.02 FW 2 bit 13	Control panel or DriveWindow selected as active control location for drive has ceased communicating.	Check panel connection (see appropriate hardware manual). Check control panel connector. Replace control panel in mounting platform. Check Fault Function parameters. Check DriveWindow connection.
PARAM CRC (6320)	CRC (Cyclic Redundancy Check) error	Switch control board power off and on again. Reload firmware to control board. Replace control board.
POWERFAIL (3381)	INT board powerfail in several inverter units of parallel connected inverter modules.	Check that INT board power cable is connected. Check that POW board is working correctly. Replace INT board.
POWERF INV xx (3381)	INT board powerfail in inverter unit of several parallel connected inverter modules. xx (1…12) refers to inverter module number.	Check that INT board power cable is connected. Check that POW board is working correctly. Replace INT board.
PPCC LINK (5210) 09.02 FW 2 bit 11	Fibre optic link to INT board is faulty.	Check fibre optic cables or galvanic link. With frame sizes R2-R6 link is galvanic. If RMIO is powered from external supply, ensure that supply is on.
PPCC LINK xx (5210) 09.02 FW 2 bit 11	INT board fibre optic connection fault in inverter unit of several parallel connected inverter modules. xx refers to inverter module number.	Check connection from inverter module Main Circuit Interface Board, INT to PPCC Branching Unit, PBU. (Inverter module 1 is connected to PBU INT1 etc.)

Fault	Cause	What to Do
PP OVERLOAD (5482)	Excessive IGBT junction to case temperature. This fault protects IGBT(s) and it can be activated by short circuit at output of long motor cables.	Check motor cables.
ROD TORQ LIM 08.02 PUMP STATUS WORD bit 02	Motor load and speed is too low, or motor load is too high and speed is too low due to, for example, binding in the driven equipment.	Check for problem in driven equipment. Check fault function setting in parameter 72.08.
RUN DISABLED (FF54) 09.02 FW 2 bit 04	No Run enable signal received.	Check setting of parameter 10.04. Switch on signal or check wiring of selected source.
SC INV xx y (2340) 09.01 FW 1 bit 04.	Short circuit in inverter unit of several parallel connected inverter modules. xx (1…12) refers to inverter module number and y refers to phase (U, V, W).	Check motor and motor cable. Check power semiconductors (IGBTs) of inverter module.
SHORT CIRC (2340) 09.01 FW 1 bit 00	Short-circuit in motor cable(s) or motor Output bridge of converter unit is faulty.	Check motor and motor cable. Check there are no power factor correction capacitors or surge absorbers in motor cable. Contact ABB representative.
SLOT OVERLAP (FF8A)	Two option modules have same connection interface selection.	Check connection interface selections in group 98 OPTION MODULES.
START INHIBI (FF7A)	Optional start inhibit hardware logic is activated.	Check start inhibit circuit (AGPS board).
SUPPLY PHASE (3130) 09.02 FW 2 bit 00	Intermediate circuit DC voltage is oscillating due to missing mains phase, blown fuse or rectifier bridge internal fault. Trip occurs when DC voltage ripple is 13% of DC voltage.	Check mains fuses. Check for mains supply imbalance.
TEMP DIF xx y (4380)	Excessive temperature difference between several parallel connected inverter modules. xx (1…12) refers to inverter module number and y refers to phase (U, V, W). Alarm is indicated when temperature difference is 15 °C. Fault is indicated when temperature difference is 20 °C Excessive temperature can be caused e.g. by unequal current sharing between parallel connected inverters.	Check cooling fan. Replace fan. Check air filters.
THERMAL MODE (FF50)	Motor thermal protection mode is set to DTC for high-power motor.	See parameter 30.01.

Fault	Cause	What to Do
THERMISTOR (4311) 09.01 FW 1 bit 05 (programmable Fault Function 30.02…30.01)	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.
TORQ 2 LIM 08.02 PUMP STATUS WORD bit 03	Drive has entered TORQ 2 SPD condition too frequently within 2 hours.	Check for problem in driven equipment. Check that the pump is not “sanded in.” Check fault function setting in parameters 72.13 and 72.18.
UNDRLOAD 08.02 PUMP STATUS WORD bit 06	Motor load is too low due to, for example, a release mechanism in the driven equipment.	Check for problem in driven equipment. Check for problem in rod string. Check fault function setting in parameter 73.01.
USER MACRO (FFA1)	No User Macro saved or file is defective.	Create User Macro.

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 link (Add 4000 in FMS Mode).
FbEq	Fieldbus equivalent: The scaling between the value shown on the panel and the integer used in serial communication.
Absolute Maximum Frequency	Value of 29.02 MAXIMUM FREQ, or 29.03 MINIMUM FREQ if the absolute value of the minimum limit is greater than the maximum limit.
Absolute Maximum Speed	Value of parameter 20.02 MAXIMUM SPEED, or 20.01 MINIMUM SPEED if the absolute value of the minimum limit is higher than the maximum limit.

Fieldbus addresses

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

See the appropriate fieldbus adapter module User's Manual.

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

NPBA-12 Profibus Adapter:

All versions

- see column PB in the tables below.

Version 1.5 or later

- see *NPBA-12 PROFIBUS Adapter Installation and Start-Up Guide* [3BFE64341588 (English)].

NIBA-01 InterBus-S Adapter:

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

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

- 4xxyy, where xxyy = drive parameter number

Actual signals

Index	Name	Short Name	FbEq	Unit	Range	PB
01	**ACTUAL SIGNALS**					
01.01	MOTOR SPEED FILT	SPD FILT	200 = 1%	rpm		1
01.02	SPEED ESTIMATED	SPD ESTI	200 = 1%	rpm		2
01.03	SPEED MEASURED	SPD MEAS	200 = 1%	rpm		3
01.04	ACTUAL MTR FLUX	ACT FLUX	10 = 1%	%		4
01.05	FREQUENCY	FREQ	100 = 1 Hz	Hz		5
01.06	MOTOR CURRENT	CURRENT	10 = 1 A	A		6
01.07	MOTOR TORQUE FILT	TORQFILT	100 = 1%	%		7
01.08	MOTOR TORQUE	TORQUE	100 = 1%	%		8
01.09	MOTOR POWER	POWER	10 = 1%	%		9
01.10	DC BUS VOLTAGE	DC VOLT	1 = 1 VDC	VDC		10
01.11	MOTOR VOLTAGE	MTR VOLT	1 = 1 VAC	VAC		11
01.12	ACS800 TEMP	ACS TEMP	1 = 1 °C	°C		12
01.13	OP HOUR COUNTER	OP HOUR	1 = 1 h	h		13
01.14	KILOWATT HOURS	KW hrs	1 = 100 kWh	kWh		14
01.15	MOTOR 1 TEMP	MTR1 TMP	10 = 1 °C	°C		15
01.16	MOTOR 2 TEMP	MTR2 TMP	10 = 1 °C	°C		16
01.17	MOTOR TEMP EST	TEMP EST	1 = 1 °C	°C		17
01.18	DI6-1 STATUS	DI6-1			0…65535 (Decimal)	18
01.19	R03-1 STATUS	R03-1			0…65535 (Decimal)	19
01.20	AI1 [V]	AI1 [V]	1000 = 1 V	V		20
01.21	AI2 [mA]	AI2 [mA]	1000 = 1 mA	mA		21
01.22	AI3 [mA]	AI3 [mA]	1000 = 1 mA	mA		22
01.23	AO1 [mA]	AO1 [mA]	1000 = 1 mA	mA		23
01.24	AO2 [mA]	AO2 [mA]	1000 = 1 mA	mA		24
01.25	XTDI6-1 STATUS	XTDI6-1			0…65535 (Decimal)	25
01.26	XTRO6-1 STATUS	XTRO6-1			0…65535 (Decimal)	26
01.27	XT AI1 [V]	XT AI1	100 = 1 V	V		27
01.28	XT AI2 [V]	XT AI2	100 = 1 V	V		28
01.29	XT AO1 [mA]	XT AO1	1000 = 1 mA	mA		29
01.30	XT AO2 [mA]	XT AO2	1000 = 1 mA	mA		30
01.31	CTRL LOCATION	CTRL LOC	0 = EXT1 1 = EXT2		EXT1, EXT2	31
02	**ACTUAL SIGNALS**					
02.01	SPEED REF 2	S REF 2	200 = 1%	rpm		51
02.02	SPEED REF 3	S REF 3	200 = 1%	rpm		52
02.03	SPEED REF 4	S REF 4	200 = 1%	rpm		53
02.04	TORQUE REF 1	TQ REF 1	100 = 1%	%		54
02.05	TORQUE REF 2	TQ REF 2	100 = 1%	%		55
02.06	TORQUE REF 3	TQ REF 3	100 = 1%	%		56
02.07	TORQUE REF 4	TQ REF 4	100 = 1%	%		57
02.08	TORQUE REF 5	TQ REF 5	100 = 1%	%		58
02.09	TORQUE USED	TQ USED	100 = 1%	%		59
02.10	SPEED USED REF	SP USED	200 = 1%	rpm		60
04	**INFORMATION**					
04.01	SW PACKAGE VER	PCKG VER				-
04.07	APPLIC SW VERSION	APPL VER				-
04.09	APPLIC RELEASE DATE	APPL REL				-
04.10	BOARD TYPE					-
05	**PUMP ACTUALS**					
05.01	MOTOR T0RQUE	MTR TORQ	1 = 1 Nm 1 = 1 lbft	Nm lbft		-
05.02	MAX MOTOR TORQUE	MAX TORQ	1 = 1 Nm 1 = 1 lbft	Nm lbft		-
05.03	POWER	POWER	1 = 1 kW 1 = 1 Hp	kW Hp		-

Index	Name	Short Name	FbEq	Unit	Range	PB
05.04	ROD TORQUE	ROD TORQ	1 = 1 Nm 1 = 1 lbft	Nm lbft		-
05.05	ROD SPEED	ROD SPD	1 = 1 rpm	rpm		-
05.06	RUNTIME HOURS	RUNTIME	1 = 1 h	h		-
05.07	BACKSPIN SPD REF	BSPN REF	1 = 1 rpm	rpm		-
05.08	BACKSPIN OPERATION	BACKSPIN	0 = INACTIVE 1 = ACTIVE		INACTIVE, ACTIVE	-
05.09	WELL FLUID LEVEL	WELL LVL	10 = 1 m 10 = 1 JNTS	m JNTS		-
05.10	DISCHARGE PRESSURE	DCHRG PR	1 = 1 kPa 1 = 1 psi	kPa psi		-
05.11	MEASURED TEMP	MSD TEMP	1 = 1 °C	°C		-
05.12	ROD SPD REF	ROD REF	10 = 1 Prpm	Prpm		-
06	**CH0 DATASETS IN**					
06.01	COMMAND WORD	CMD WRD			- 32768…32767	-
06.02	SPEED REF1	SPD REF1			- 32768…32767	-
06.03	SPEED REF2	SPD REF2			- 32768…32767	-
06.04	PUMP COMMAND	PMP CMD			- 32768…32767	-
07						
07.01	AI1 SCALED	AI1 SCAL	2000 = 1 V		0…2000	-
07.02	AI2 SCALED	AI2 SCAL	1000 = 1 mA		0…2000	-
07.03	AI3 SCALED	AI3 SCAL	1000 = 1 mA		0…2000	-
07.04	AI5 SCALED	AI5 SCAL	1000 = 1 mA		0…2000	-
07.05	AI6 SCALED	AI6 SCAL	1000 = 1 mA		0…2000	-
07.06	LCU ACT SIGNAL1					-
07.07	LCU ACT SIGNAL2					-
08	**STATUS WORDS**					
08.01	MAIN STATUS WORD	MN STAT			0…65535 (Decimal)	-
08.02	PUMP STATUS WORD	PMP STAT			0…65535 (Decimal)	-
09	**ACTUAL SIGNALS**					
09.01	FAULT WORD 1	FLT WRD1			0…65535 (Decimal)	-
09.02	FAULT WORD 2	FLT WRD2			0…65535 (Decimal)	-
09.03	ALARM WORD 1	ALM WRD1			0…65535 (Decimal)	-
09.04	LIMIT WORD	LIM WORD			0…65535 (Decimal)	-

Parameters

Index	Name/Selection	FACTORY	PCP	ESP	PB
10	**START/STOP/DIR**				
10.01	START / STOP 1	DI1	DI1	DI1	101
10.02	START / STOP 2	NOT SELECT	NOT SELECT	NOT SELECT	102
10.03	DIRECTION	FORWARD	FORWARD	FORWARD	103
10.04	RUN ENABLE	YES	YES	YES	104
10.05	EMERG STOP INPUT	NOT SELECT	NOT SELECT	NOT SELECT	105
10.06	STRT/STP 1 PTR	+.000.000.00	+.000.000.00	+.000.000.00	106
10.07	STRT/STP 2 PTR	+.000.000.00	+.000.000.00	+.000.000.00	107
10.08	RUN ENABLE PTR	+.000.000.00	+.000.000.00	+.000.000.00	108
10.09	E-STOP PTR	+.000.000.00	+.000.000.00	+.000.000.00	109
11	**REFERENCE SELECT**				
11.01	EXT1 EXT2 SEL	NOT SELECT	NOT SELECT	NOT SELECT	126
11.02	EXT REF1 SELECT	AI1	AI1	AI1	127
11.03	EXT REF1 MINIMUM	0.0 rpm	0.0 rpm	0.0 Hz	128
11.04	EXT REF1 MAXIMUM	1500.0 rpm	1500.0 rpm	50.0 Hz	129
11.05	EXT REF2 SELECT	AI1	AI1	AI1	130
11.06	EXT REF2 MINIMUM	0.0 rpm	0.0 rpm	0.0 Hz	131
11.07	EXT REF2 MAXIMUM	1500.0 rpm	1500.0 rpm	50.0 Hz	132
11.08	EXT1/EXT2 PTR	+.000.000.00	+.000.000.00	+.000.000.00	133
11.09	EXT1 REF1 PTR	+.000.000.00	+.000.000.00	+.000.000.00	134
11.10	EXT1 REF2 PTR	+.000.000.00	+.000.000.00	+.000.000.00	135
12	**CONSTANT SPEEDS**				
12.01	RAMPED SPEED SEL	NOT SELECT	NOT SELECT	NOT SELECT	151
12.02	RAMPED SPD 1	0.0 rpm	0.0 rpm	0.0 rpm	152
12.03	RAMPED SPD 2	0.0 rpm	0.0 rpm	0.0 rpm	153
13	**ANALOG INPUTS**				
13.01	MINIMUM AI1	0 V	0 V	0 V	176
13.02	SCALE AI1	100	100	100	177
13.03	FILTER AI1 ms	100	100	100	178
13.04	MINIMUM AI2	0 mA	0 mA	0 mA	179
13.05	SCALE AI2	100	100	100	180
13.06	FILTER AI2 ms	100	100	100	181
13.07	MINIMUM AI3	0 mA	0 mA	0 mA	182
13.08	SCALE AI3	100	100	100	183
13.09	FILTER AI3 ms	100	100	100	184
13.10	ZERO XT AI1	0 V	0 V	0 V	185
13.11	SCALE XT AI1	100	100	100	186
13.12	FILTER XT AI1 ms	100	100	100	187
13.13	ZERO XT AI2	0 V	0 V	0 V	188
13.14	SCALE XT AI2	100	100	100	189
13.15	FILTER XT AI2 ms	100	100	100	190
13.16	SCALE XT AI3	100	100	100	191
13.17	SCALE XT AI4	100	100	100	192
14	**RELAY OUTPUTS**				
14.01	RO1 POINTER	+.008.001.01	+.008.001.01	+.008.001.01	201
14.03	RO1 TON DELAY	0.01 s	0.01 s	0.01 s	203
14.04	RO1 TOFF DELAY	0.01 s	0.01 s	0.01 s	204
14.05	RO2 POINTER	+.008.001.02	+.008.001.02	+.008.001.02	205
14.07	RO2 TON DELAY	0.01 s	0.01 s	0.01 s	207
14.08	RO2 TOFF DELAY	0.01 s	0.01 s	0.01 s	208
14.09	RO3 POINTER	+.008.001.03	+.008.001.03	+.008.001.03	209
14.11	RO3 TON DELAY	0.01 s	0.01 s	0.01 s	211
14.12	RO3 TOFF DELAY	0.01 s	0.01 s	0.01 s	212
14.13	XTRO1 POINTER	+.008.001.01	+.008.001.01	+.008.001.01	213
14.14	XTRO2 POINTER	+.008.001.02	+.008.001.02	+.008.001.02	214
14.15	XTRO3 POINTER	+.008.000.00	+.008.000.00	+.008.000.00	215

Index	Name/Selection	FACTORY	PCP	ESP	PB
14.16	XTRO4 POINTER	+.000.000.00	+.000.000.00	+.000.000.00	216
15	**ANALOG OUTPUTS**				
15.01	ANALOG OUTPUT 1	+.001.006.00	+.001.006.00	+.001.006.00	226
15.03	MINIMUM A01	0 mA	0 mA	0 mA	228
15.04	FILTER AO1 ms	500	500	500	229
15.05	SCALE AO1	20000	20000	20000	230
15.06	ANALOG OUTPUT 2	+.001.001.00	+.001.001.00	+.001.001.00	231
15.08	MINIMUM AO2	0 mA	0 mA	0 mA	233
15.09	FILTER AO2 ms	500	500	500	234
15.10	SCALE AO2	20000	20000	20000	235
15.11	XT ANALOG OUTPUT 1	+.001.006.00	+.001.006.00	+.001.006.00	236
15.13	MINIMUM XT AO1	0 mA	0 mA	0 mA	238
15.14	FILTER XT AO1 ms	500	500	500	239
15.15	SCALE XT AO1	20000	20000	20000	240
15.16	XT ANALOG OUTPUT 2	+.001.001.00	+.001.001.00	+.001.001.00	241
15.18	MINIMUM XT AO2	0 mA	0 mA	0 mA	243
15.19	FILTER XT AO2 ms	500	500	500	244
15.20	SCALE XT AO2	20000	20000	20000	245
16	**SYSTEM CTR INPUTS**				
16.01	FAULT RESET SEL	NOT SELECT	NOT SELECT	NOT SELECT	251
16.02	PARAMETER LOCK	OPEN	OPEN	OPEN	252
16.03	PASS CODE	0	0	0	253
16.04	LOCAL LOCK	OFF	OFF	OFF	254
16.05	PARAMETER SAVE	DONE	DONE	DONE	255
17	**DC HOLD**				
17.01	DC HOLD ACTIVE	NO	NO	(not visible)	276
17.02	DC HOLD SPEED	5 rpm	5 rpm	(not visible)	277
17.03	DC HOLD CURRENT	30.0%	30.0%	(not visible)	278
20	**LIMITS**				
20.01	MINIMUM SPEED	-1500 rpm	-1500 rpm	-1500 rpm	351
20.02	MAXIMUM SPEED	1500 rpm	1500 rpm	1500 rpm	352
20.04	MAXIMUM CURRENT	200.0%	200.0%	200.0%	354
20.05	SPC TORQMAX	100%	100%	100%	355
20.06	SPC TORQMIN	-100%	0.0%	0.0%	356
20.07	FREQ TRIP MARGIN	50.00 Hz	50.00 Hz	50.00 Hz	357
21	**START/STOP**				
21.01	START FUNCTION	AUTO	AUTO	AUTO	376
21.02	CONST MAGN TIME	500.0 ms	500.0 ms	500.0 ms	377
21.03	FREE DIRECT MAGN	OFF	OFF	OFF	378
21.04	STOP FUNCTION	RAMP STOP	RAMP STOP	COAST STOP	379
21.05	EME STOP MODE	STOP RAMPING	STOP RAMPING	STOP RAMPING	380
21.06	ESTOP COAST DELAY	5 s	5 s	5 s	381
22	**ACCEL/DECEL**				
22.01	ACCEL TIME	20.00 s	20.00 s	20.00 s	401
22.02	DECEL TIME	20.00 s	20.00 s	20.00 s	402
22.03	EM STOP RAMP TIME	1.0 s	1.0 s	1.0 s	403
22.04	RAMP SHAPE TIME	0.00 s	0.00 s	0.00 s	404
23	**SPEED REFERENCES**				
23.01	SPEED REF	0.0 rpm	0.0 rpm	0.0 Hz	426
24	**SPEED CTRL TUNE**				
24.01	PI TUNE	OFF	OFF	OFF	451
24.02*	DAMPENING COEF	2	2	2	452
24.03	P-GAIN	10.0	10.0	10.0	453
24.04*	P-GAIN MIN	10	10	10	454
24.05*	P-GAIN WEAKPOINT	0%	0%	0%	455
24.06*	P-GAIN WP FILT TIME	100 ms	100 ms	100 ms	456
24.09	INTEGRATION TIME	2.50 s	2.50 s	2.50 s	459

Index	Name/Selection	FACTORY	PCP	ESP	PB
24.10	INTEG INIT VALUE	0.00%	0.00%	0.00%	460
24.11	DROOP RATE	0.0%	0.0%	0.0%	461
24.12	DERIVATION TIME	0.0 ms	0.0 ms	0.0 ms	462
24.13	DERIV FILT TIME	8.0 ms	8.0 ms	8.0 ms	463
24.14	ACC COMP DERV	0.00 s	0.00 s	0.00 s	464
24.15	ACC COMP FILT	8.00 ms	8.00 ms	8.00 ms	465
24.16	SLIP GAIN	100.0%	100.0%	100.0%	466
24.17*	KPS TIS MIN FREQ	5 Hz	5 Hz	5 Hz	467
24.18*	KPS TIS MAX FREQ	11.7 Hz	11.7 Hz	11.7 Hz	468
24.19*	KPS VAL MIN FREQ	100%	100%	100%	469
24.20*	TIS VAL MIN FREQ	100%	100%	100%	470
24.21	SPEED FDBK FILT	8.0 ms	8.0 ms	8.0 ms	471
27	**FLUX CONTROL**				
27.01	FLUX OPTIMIZATION	NO	NO	NO	526
27.02	FLUX BRAKING	YES	YES	YES	527
27.03	FLUX REFERECE	100%	100%	100%	528
27.04	FS METHOD	OFF	OFF	OFF	529
29	**SCALAR CONTROL**				
29.01	FREQUENCY REF	(not visible)	(not visible)	0.00 Hz	576
29.02	MAXIMUM FREQ	(not visible)	(not visible)	50.00 Hz	577
29.03	MINIMUM FREQ	(not visible)	(not visible)	-50.00 Hz	578
29.04	IR COMPENSATION	(not visible)	(not visible)	0.0%	579
30	**FAULT FUNCTIONS**				
30.01	MOT THERM P MODE	DTC	DTC	DTC	601
30.02	MOTOR THERM PROT	NO	NO	NO	602
30.03	MOT1 TEMP AI1 SEL	NOT IN USE	NOT IN USE	NOT IN USE	603
30.04	MOT1 TEMP ALM	110	110	110	604
30.05	MOT1 TEMP FLT	120	120	120	605
30.09	MOTOR THERM TIME	x.x s	x.x s	x.x s	609
30.10	MOTOR LOAD CURVE	100.0%	100.0%	100.0%	610
30.11	ZERO SPEED LOAD	74.0%	74.0%	74.0%	611
30.12	BREAK POINT	45.0 Hz	45.0 Hz	45.0 Hz	612
30.13	STALL FUNCTION	NO	NO	NO	613
30.14	STALL FREQ HI	20.0 Hz	20.0 Hz	20.0 Hz	614
30.15	STALL TIME	20.00 s	20.00 s	20.00 s	615
30.19	MOTOR PHASE LOSS	NO	NO	NO	619
30.20	GROUND FAULT	FAULT	FAULT	FAULT	620
30.21	UNDERVOLTAGE	ON	ON	ON	621
30.22	OVERVOLTAGE	ON	ON	ON	622
30.23	AI<MIN FUNC	NO	NO	NO	623
30.24	KEYPAD LOSS FUNC	FAULT	FAULT	FAULT	624
30.25	EXTERNAL FAULT	NOT SELECT	NOT SELECT	NOT SELECT	625
34	**AUTO FILT RESET**				
34.01	OVERVOLTAGE CTRL	OFF	OFF	OFF	701
34.02	UNDERVOLTAGE CTRL	OFF	OFF	OFF	702
34.03	ROD TORQ CTRL	OFF	OFF	OFF	703
34.04	AI<MIN CTRL	OFF	OFF	OFF	704
34.05	UNDERLOAD CTRL	OFF	OFF	OFF	705
34.06	NUMBER OF TRIALS	0	0	0	706
34.07	OFF DELAY TIME	5.0 s	5.0 s	5.0 s	707
34.08	TRIAL TIME	3600.0 s	3600.0 s	3600.0 s	708
34.09	PRESS SWITCH CTRL	OFF	OFF	OFF	709
34.10	LINE CONV CTRL	OFF	OFF	OFF	710
50	**PULSE ENCODER**				
50.01	ENCODER PULSE NR	2048	2048	2048	1001
50.02	SPEED MEAS MODE	A_-_B_-_	A_-_B_-_	A_-_B_-_	1002
50.03	SPEED FDBK SEL	INTERNAL	INTERNAL	INTERNAL	1003

Index	Name/Selection	FACTORY	PCP	ESP	PB
50.04	ENCODER FAULT	ALARM	ALARM	ALARM	1004
50.05	NTAC FILTER	2 ms	2 ms	2 ms	1005
51	**FIELDBUS DATA**				
52	**STANDARD MODBUS**				
52.01	STATION NUMBER	1	1	1	1051
52.02	BAUDRATE	9600	9600	9600	1052
52.03	PARITY	ODD	ODD	ODD	1053
70	**DDCS CONTROL**				
70.01	CH0 NODE ADDR	1	1	1	1375
70.02	CH0 BAUD RATE	1 Mbit / s	1 Mbit / s	1 Mbit / s	1376
70.03	CH0 TIMEOUT	0 ms	0 ms	0 ms	1377
70.04	CH0 COM LOSS CONTROL	NO ERR CHK	NO ERR CHK	NO ERR CHK	1378
70.12	CHANNEL 3 ADDR	1	1	1	1386
71	**PUMP CONTROLS**				
71.01	MAX MOTOR TORQUE	(not visible)	(calculated)	(calculated)	1393
71.02	PUMP ENABLE	(not visible)	DISABLE	DISABLE	1394
71.03	BACKSPIN LIMIT	(not visible)	-100.00 rpm	-100.00 rpm	1395
71.04	ROD TORQ STOP LIM	(not visible)	2.0 lbft	2.0 lbft	1396
71.05	BACKSPIN ACCEL TIME	(not visible)	3.00 s	3.00 s	1397
71.06	BACKSPIN SPEED RANGE	(not visible)	0.00%	0.00%	1398
71.07	REDUCTION RATIO	(not visible)	1.00:1	1.00:1	1399
71.08	PUMP FLT RST SEL	(not visible)	PANEL RESET	PANEL RESET	1400
71.09	RUNTIME RESET	(not visible)	NOT SELECT	NOT SELECT	1401
71.10	SLEEP FUNCTION	(not visible)	NOT SELECT	NOT SELECT	1402
71.11	SLEEP AI SEL	(not visible)	AI1	AI1	1403
71.12	SLEEP DELAY TIME	(not visible)	10.00 s	10.00 s	1404
71.13	SLEEP LEVEL	(not visible)	0.00%	0.00%	1405
71.14	WAKE-UP LEVEL	(not visible)	0.00%	0.00%	1406
71.15	TORQUE UNITS	(not visible)	lbft	lbft	1407
71.16	PRESSURE UNITS	(not visible)	psi	psi	1408
71.17	DEPTH UNITS	(not visible)	JOINTS	JOINTS	1409
71.18	POWER UNITS	(not visible)	KW	KW	1410
71.19	SPEED REFERENCE	(not visible)	MOTOR SPEED	MOTOR SPEED	-
72	**PUMP SETUP**				
72.01	HIGH PRESSURE SEL	(not visible)	NOT SELECT	NOT SELECT	1411
72.02	PRESSURE LATCH	(not visible)	LATCHING	LATCHING	1412
72.03	DISCHRG FLT ENA	(not visible)	DISABLED	DISABLED	1413
72.04	DISCHRG PRESS	(not visible)	300.00 psi	300.00 psi	1414
72.05	DISCHRG PRESS SEL	(not visible)	NOT SELECT	NOT SELECT	1415
72.06	HIGH DISCHRG TIME	(not visible)	10.00 s	10.00 s	1416
72.07	ROD TORQ TIME ENA	(not visible)	DISABLED	DISABLED	1417
72.08	ROD TORQ 1 FUNC	(not visible)	NO	NO	1418
72.09	ROD TORQ 1 LIM	(not visible)	100.00 lbft	100.00 lbft	1419
72.10	ROD TORQ1 SPD LIM	(not visible)	5 rpm	5 rpm	1420
72.11	ROD TORQ 1 TIME	(not visible)	15.00 s	15.00 s	1421
72.12	ROD TORQ 2 SPD ENA	(not visible)	DISABLED	DISABLED	1422
72.13	ROD TORQ 2 FUNC	(not visible)	NO	NO	1423
72.14	ROD TORQ 2 LIMIT	(not visible)	100.00 lbft	100.00 lbft	1424
72.15	ROD TORQ 2 TIME	(not visible)	15.00 s	15.00 s	1425
72.16	ROD TORQ 2 SPEED	(not visible)	0.00 rpm	0.00 Hz	1426
72.17	ROD TQ2 SPD TIME	(not visible)	15.00 s	15.00 s	1427
72.18	ROD TQ2 LIM COUNT	(not visible)	0	0	1428
72.19	LEVEL CTRL ENABLE	(not visible)	DISABLE	DISABLE	-
72.20	FLUID LEVEL MAX	(not visible)	1000.00 JNTS	1000.00 JNTS	-
72.21	FLUID LEVEL SET	(not visible)	850.00 JNTS	850.00 JNTS	-
72.22	FLUID LEVEL SEL	(not visible)	NOT SELECT	NOT SELECT	-
72.23	FLUID LEVEL P_GAIN	(not visible)	1.00	1.00	-

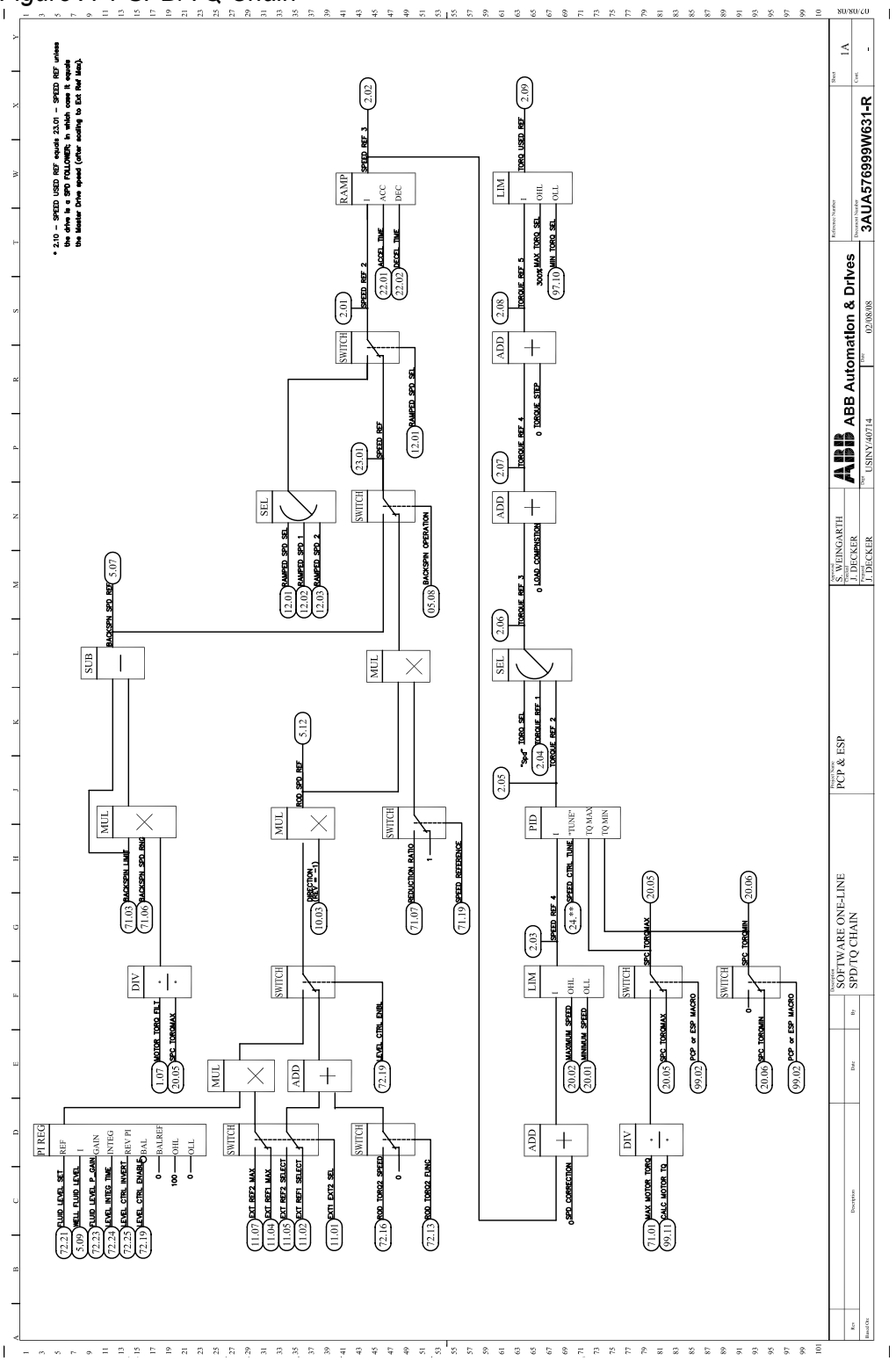
Index	Name/Selection	FACTORY	PCP	ESP	PB
72.24	LEVEL INTEG TIME	(not visible)	10.00 s	10.00 s	-
72.25	LEVEL CTRL INVERT	(not visible)	INVERT_PI	INVERT_PI	-
72.26	DSCH PRS TRIP LVL	(not visible)	300.00 psi	300.00 psi	-
73	**PUMP SETUP**				
73.01	UNDERLOAD FUNC	(not visible)	NO	NO	1429
73.02	ROD TORQUE 1	(not visible)	15.00 lbft	15.00 lbft	1430
73.03	ROD SPEED 1	(not visible)	1000.00 rpm	1000.00 rpm	1431
73.04	ROD TORQUE 2	(not visible)	15.00 lbft	15.00 lbft	1432
73.05	ROD SPEED 2	(not visible)	1000.00 rpm	1000.00 rpm	1433
73.06	ROD TORQUE 3	(not visible)	15.00 lbft	15.00 lbft	1434
73.07	ROD SPEED 3	(not visible)	1000.00 rpm	1000.00 rpm	1435
73.08	U-LOAD ACT TIME	(not visible)	10.00 s	10.00 s	1436
73.09	THERM PROT FUNC	(not visible)	NO	NO	1437
73.10	TEMP FDBK TYPE	(not visible)	KLIXON	KLIXON	1438
73.11	KLIXON DI SEL	(not visible)	XT DI2	XT DI2	1439
73.12	PUMP PT100 AI SEL	(not visible)	NOT SELECT	NOT SELECT	1440
73.13	ALARM TEMP	(not visible)	100.00 °C	100.00 °C	1441
73.14	FAULT TEMP	(not visible)	120.00 °C	120.00 °C	1442
83	**ADAPT PROG CTRL**				
83.01	ADAPT PROG CMD	EDIT	EDIT	EDIT	1609
83.02	EDIT COMMAND	NO	NO	NO	1610
83.03	EDIT BLOCK	0	0	0	1611
83.04	TIMELEVEL SEL	100 ms	100 ms	100 ms	1612
83.05	PASSCODE	0	0	0	1613
84	**ADAPTIVE PROGRAM**				
84.01	STATUS				1628
84.02	FAULTED PAR				1629
84.05	BLOCK1	NO	NO	NO	1630
84.06	INPUT1	0	0	0	1631
84.07	INPUT2	0	0	0	1632
84.08	INPUT3	0	0	0	1633
84.09	OUTPUT	0	0	0	1634
…	…				… 1644
84.79	OUTPUT	0	0	0	-
85	**USER CONSTANTS**				
85.01	CONSTANT1	0	0	0	1645
85.02	CONSTANT2	0	0	0	1646
85.03	CONSTANT3	0	0	0	1647
85.04	CONSTANT4	0	0	0	1648
85.05	CONSTANT5	0	0	0	1649
85.06	CONSTANT6	0	0	0	1650
85.07	CONSTANT7	0	0	0	1651
85.08	CONSTANT8	0	0	0	1652
85.09	CONSTANT9	0	0	0	1653
85.10	CONSTANT10	0	0	0	1654
85.11	STRING1	MESSAGE1	MESSAGE1	MESSAGE1	1655
85.12	STRING2	MESSAGE2	MESSAGE2	MESSAGE2	1656
85.13	STRING3	MESSAGE3	MESSAGE3	MESSAGE3	1657
85.14	STRING4	MESSAGE4	MESSAGE4	MESSAGE4	1658
85.15	STRING5	MESSAGE5	MESSAGE5	MESSAGE5	1659
92	**FIELDBUS OUTPUT**				
92.01	DATASET2 OUTPUT1	801	801	801	1771
92.02	DATASET2 OUTPUT2	102	102	102	1772
92.03	DATASET2 OUTPUT3	107	107	107	1773
95	**HARDWARE SPECIFIC**				
95.01	FAN SPD CTRL MODE	controlled	controlled	controlled	1825

Index	Name/Selection	FACTORY	PCP	ESP	PB
95.05	ENA INC SW FREQ	0	0	0	1829
95.06	LCU Q POW REF	0	0	0	1830
95.07	LCU DC REF [V]	0	0	0	1831
95.08	LCU PAR 1 SEL	106	106	106	1832
95.09	LCU PAR 2 SEL	110	110	110	1833
95.10	TEMP INV AMBIENT	40 °C	40 °C	40 °C	1834
98	**OPTION MODULES**				
98.01	ENCODER MODULE	NO	NO	NO	1901
98.02	COMM MODULE	NO	NO	NO	1902
98.03	DI/O EXT MODULE 1	NO	NO	NO	1903
98.04	DI/O EXT MODULE 2	NO	NO	NO	1904
98.06	AI/O EXT MODULE 1	NO	NO	NO	1906
98.07	AI/O EXT MODULE 2	NO	N/A	NO	1907
98.09	DI DEBOUNCE FILT	50	50	50	1909
98.10	AI/O EXT AI1 FUNC	UNIPOL XTAI1	UNIPOL XTAI1	UNIPOL XTAI1	1910
98.11	AI/O EXT AI2 FUNC	UNIPOL XTAI2	UNIPOL XTAI2	UNIPOL XTAI2	1911
98.12	AI/O EXT AI3 FUNC	UNIPOL XTAI3	UNIPOL XTAI3	UNIPOL XTAI3	1912
98.13	AI/O EXT AI4 FUNC	UNIPOL XTAI4	UNIPOL XTAI4	UNIPOL XTAI4	1913
99	**START-UP DATA**				
99.01	LANGUAGE	ENGLISH	ENGLISH	ENGLISH	1926
99.02	APPLICATION MACRO	FACTORY	PCP	ESP	1927
99.03	APPLIC RESTORE	NO	NO	NO	1928
99.04	MOTOR CTRL MODE	DTC	DTC	SCALAR	1930
99.05	MOTOR NOM VOLTAGE	0	0	0	1930
99.06	MOTOR NOM CURRENT	0	0	0	1931
99.07	MOTOR NOM FREQ	50	50	50	1932
99.08	MOTOR NOM SPEED	0	0	0	1933
99.09	MOTOR NOM PROWER	0	0	0	1934
99.10	MOTOR ID RUN	NO	NO	NO	1935
99.11	CALC MOTOR TORQUE	(calculated)	(calculated)	(calculated)	1936

* Indicates parameters that are visible only after entering proper code in 16.03 PASS CODE.

Appendix A: Software One-Line Diagrams

Figure A-1 SPD/TQ Chain



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