ACS800

Firmware Manual
Crane Control Program (+N697)

Special application guides

(available on request)

Fieldbus Control Application Guide
3AUA0000046481 (English)

Load Speed Control Application Guide
3AUA0000046482 (English)

Functional Specification for Conical Motor Function
3AUA0000046480 (English)

The special application guides as well as this manual can be found and downloaded from ABB IHMM.

Crane Control Program (+N697)

Firmware Manual

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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 ACS800 Crane control program (+N697) version AQCR7XXX. This software supports the RMIO-01/02 and RMIO-11/12 Motor and I/O Control Boards. See parameter *33.01* SOFTWARE VERSION.

The Crane control program version AQCR7xxxx is also compatible with the ACS800 Anti-sway control program version A9XRxxx. For more information, see *ACS800 Anti-sway Control Program (+N816) Supplement* (3AUA0000094750 [English]).

With the DriveWindow PC tool version 2.xx, it is possible create a full back-up of the software (*.bpg file). You can use the back-up file, for example, when replacing the RMIO-xx board or a whole drive.

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 relevant 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 section describing the related user-adjustable parameters.

Reader

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

Contents

The manual consists of the following chapters:

- *Start-up and control through the I/O interface* instructs in setting up the control program, and how to start, stop and regulate the speed of the drive.
- *Quick start-up guide* describes the quick start-up procedure while using different control schemes and a different drive configuration.
- *Control panel* gives instructions on using the panel.
- *Program features* contains the feature descriptions and the reference lists of the user settings and diagnostic signals.
- *Application macros, control location EXT1/EXT2* contains a short description of each macro together with a connection diagram and also short descriptions of the control locations and modes.
- *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.
- *Adaptive Programming examples for crane control* includes examples of Adaptive Programming (AP) for Crane control program (+N697).
- *Analogue Extension Module* describes the communication between the drive and the analogue I/O extension (optional).
- *Additional data: actual signals and parameters* contains more information on the actual signals and parameters.
- *Control block diagrams*
- *DriveWindow* contains a screenshot of DriveWindow connected to the ACS800 RMIO/RDCO board and channel CH3.

Start-up and control through the I/O interface

Chapter overview

The chapter instructs how to:

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

How to start-up the drive

You can perform a limited start-up. The drive gives no guidance: go through the very basic settings by following the instructions given in the manual.

- **If you want to perform the limited start-up**, follow the instructions given in section *How to perform the limited start-up (covers only the basic settings)* on page *18*.

Note! Start the drive in the following order:

- First, select values for parameter group 99, that is, enter the motor data and create the DTC motor model.
- Only then, give values for parameter groups 10...98, that is, adjust the application parameters AFTER the DTC motor model is ready. Never give parameter groups 10...98 without having filled in parameter group 99 first.

Note: Once the ID run has been completed successfully, group 99 is locked to prevent resetting the ID run results. The group can be reopened, if required, by entering pass code 584 into parameter *16.03* PASS CODE.

How to perform the limited start-up (covers only the basic settings)

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

SAFETY

The start-up may only be carried out by a qualified electrician.

The safety instructions must be followed during the start-up procedure. See the appropriate hardware manual for safety instructions.

☐	Check the installation. See the installation checklist in the appropriate hardware/installation manual.	
☐	Check that the starting of the motor does not cause any danger. **De-couple the driven machine** if: - there is a risk of damage in case of incorrect direction of rotation, or - a Standard ID run needs to be performed during the drive start-up. (ID run is essential only in applications which require the ultimate in motor control accuracy.)	
	POWER-UP	
☐	Apply mains power. The control panel first shows the panel identification data …	`CDP312 PANEL Vx.xx` `.......`
	… then the Identification Display of the drive …	`ACS800` `ID NUMBER 1`
	… then the Actual Signal Display …	`1 -> 0.0 rpm O` `FREQ 0.00 Hz` `CURRENT 0.00 A` `POWER 0.00 %` `1 -> 0.0 rpm O`
	The drive is now ready for the limited start-up.	`1 -> 0.0 rpm O` `FREQ 0.00 Hz` `CURRENT 0.00 A` `POWER 0.00 %`
	ENTERING START-UP DATA MANUALLY (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. - Press ***ENTER*** to activate the setting of a new value. - Use the arrow keys (or) to change the value. For fast change use 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. The default value is CRANE.	`1 -> 0.0 rpm O` `99 START-UP DATA` `02 APPLICATION MACRO` `[ ]`

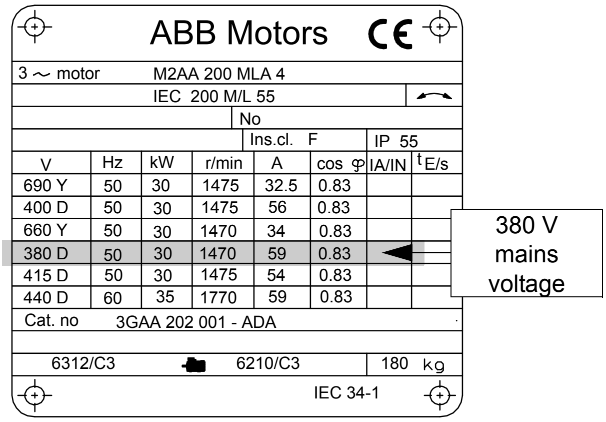
☐ Select the motor control mode. The general parameter setting procedure is given above.

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

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

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

☐ Enter the motor data from the motor nameplate:



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

- motor nominal voltage

Allowed range: 1/2 · U_N … 2 · U_N of ACS800. (U_N refers to the highest voltage in each of the nominal voltage ranges: 415 V AC for 400 V AC units, 500 V AC for 500 V AC units and 690 V AC for 600 V AC units.)

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

- motor nominal current

Allowed range: approx. 1/6 · I_{2hd} … 2 · I_{2hd} of ACS800 (0 … 2 · I_{2hd} if parameter 99.04 = SCALAR))

```
 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

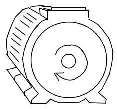
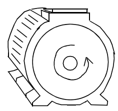
```
 1   ->  0.0 rpm   O
99 START-UP DATA
08 MOTOR NOM SPEED
[ ]
```

-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, two displays (warning and information) start to alternate. Move to next step without pressing any key.	1 -> 0.0 rpm O ACS800 ** WARNING ** ID MAGN REQ 1 L-> 0.0 rpm I *** Information *** Press green button to start ID MAGN
	Note: The POWER ON acknowledge (DI_L) must be active (closed) before the drive is ready to continue with the next steps. The drive is ready when “0” appears in the upper right corner of the control panel display. For more information, see section *Power ON acknowledge and internal fault reset* on page *90*.	
	Note: The mechanical brake is controlled as default from the RMIO board relay output RO1. For more information, see section *Control of a mechanical brake* on page *112*.	
☐	Select the motor identification method. The default value ID MAGN (ID Magnetisation) is suitable for most applications. It is applied in this basic start-up procedure. If your selection is ID Magnetisation, move to next step without pressing any key. The ID run (STANDARD) should be selected if: - the operation point is near zero speed, and/or - operation at torque range above the motor nominal torque within a wide speed range and without any measured speed feedback is required. **Note:** If STANDARD ID run is selected, the brake is opened when the Start command is given and remains open until the STANDARD ID run is completed. If ID MAGN is selected, the brake is kept closed during the ID run sequence. If your selection is ID run, continue by following the separate instructions given a few pages ahead in section *How to perform the ID run* on page *24*.	
	IDENTIFICATION MAGNETISATION (with Motor ID run selection ID MAGN)	
☐	Press the ***LOC/REM*** key to change to local control (L shown on the first row). Press to start the identification magnetisation. The motor is magnetised at zero speed for 20 to 60 s. Three warnings are displayed: The first warning is displayed when the magnetisation starts. The second warning is displayed while the magnetisation is on. The third warning is displayed after the magnetisation is completed.	1 L -> 1242.0 rpm I ** WARNING ** MOTOR STARTS 1 L-> 0.0 rpm I ** WARNING ** ID MAGN 1 L-> 0.0 rpm O ** WARNING ** ID DONE

	DIRECTION OF ROTATION OF THE MOTOR	
☐	Check the direction of rotation of the motor. **Note**: In the crane application, - the forward direction (positive) must be the UP direction. - the reverse direction (negative) must be the DOWN direction. This is important because the torque memory uses the positive direction in starts. - Press ***ACT*** to get the status row visible. - Increase the speed reference from zero to a small value by pressing ***REF*** and then the arrow keys (, , or). - Press to start the motor. - Check that the motor is running in the desired direction. - Stop the motor by pressing .	`1 L->[xxx] rpm I` `FREQ xxx Hz` `CURRENT xx A` `POWER xx %`
☐	To change the direction of rotation of the motor: - Disconnect mains power from the drive, and wait 5 minutes for the intermediate circuit capacitors to discharge. Measure the voltage between each input terminal (U1, V1 and W1) and earth with a multimeter to ensure that the frequency converter is discharged. - Exchange the position of two motor cable phase conductors at the motor terminals or at the motor connection box. - Verify your work by applying mains power and repeating the check as described above.	 forward direction  reverse direction
	SPEED LIMITS AND ACCELERATION/DECELERATION TIMES	
☐	Set the minimum speed. This value will be used as the speed limit in the reverse direction.	`1 L-> 0.0 rpm O` `20 LIMITS` `01 MINIMUM SPEED` `[ ]`
☐	Set the maximum speed. This value will be used as the speed limit in the forward direction.	`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 ACCEL TIME 1` `[ ]`
☐	Set the acceleration time 2.	`1 L-> 0.0 rpm O` `22 ACCEL/DECEL` `04 ACCEL TIME 2` `[ ]`

☐	Set the deceleration time 1.	1 L-> 0.0 rpm O 22 ACCEL/DECEL 03 DECEL TIME 1 [ ]
☐	Set the deceleration time 2. **Note:** The default setting of acceleration and deceleration selection is ACC/DEC DIR, where the acceleration time 1 and deceleration time 1 are used if the motor is running in the forward direction, and acceleration time 2 and deceleration time 2 are used if the motor is running in the reverse direction.	1 L-> 0.0 rpm O 22 ACCEL/DECEL 05 DECEL TIME 2 [ ]
The drive is now ready for use.		

How to control the drive through the I/O interface

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

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

PRELIMINARY SETTINGS	
Ensure the Crane macro is active.	See parameter *99.02*.
The crane is normally operated in both the forward and reverse direction and therefore the default setting of the parameter *10.03* is REQUEST.	
Ensure that the control connections are wired according to the connection diagram given for the Crane macro.	See chapter *Application macros, control location EXT1/EXT2*.
Ensure that the drive is in external control. Press the ***LOC/REM*** key to switch between external and local control.	In External control, there is no L visible on the first row of the panel display.
STARTING IN FORWARD DIRECTION AND CONTROLLING THE SPEED OF THE MOTOR	
Start in the forward direction by switching the digital input DI1 ON. DI2 should be OFF. **Note:** The default setting for forward direction start digital input is DI1 and reverse direction start digital input is DI2.	`1 -> 0.0 rpm I` `FREQ 0.00 Hz` `CURRENT 0.00 A` `POWER 0.00 %`
Regulate the speed by adjusting the voltage of the analogue input AI1.	`1 -> 500.0 rpm I` `FREQ 16.66 Hz` `CURRENT 12.66 A` `POWER 8.33 %`
STARTING IN REVERSE DIRECTION AND CONTROLLING THE SPEED OF THE MOTOR	
Start in the reverse direction by switching the digital input DI2 ON. DI1 should be OFF. **Note:** The default setting for reverse direction start digital input is DI2 and forward direction start digital input is DI1.	`1 <- 0.0 rpm I` `FREQ 0.00 Hz` `CURRENT 0.00 A` `POWER 0.00 %`
Regulate the speed by adjusting the voltage of the analogue input AI1.	`1 <- 500.0 rpm I` `FREQ 16.66 Hz` `CURRENT 12.66 A` `POWER 8.33 %`
STOPPING THE MOTOR	
Switch OFF digital input DI1 if in forward condition, or DI2 if in reverse condition.	`1 -> 500.0 rpm O` `FREQ 0.00 Hz` `CURRENT 0.00 A` `POWER 0.00 %`

How to perform the ID run

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

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

ID run procedure

Note: If parameter values (Group 10 … 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
- 20.03 MAXIMUM CURRENT ≥ 100% · I_{hd}
- 20.04 TORQ MAX LIM1 > 50%

- Ensure that the panel is in the local control mode (L displayed on the status row). Press the ***LOC/REM*** key to switch between modes.
- Change the ID run selection to STANDARD.

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

- Press ***ENTER*** to verify the selection. The following message is displayed:

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

- If brake control is active, the brake is opened when STANDARD ID run is selected.
- To start the ID run, press the key. The Run Enable signal must be active (see parameter *16.01* RUN ENABLE).

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

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 ( ).
- After the STANDARD ID run is completed, the brake is closed.
- After the motor STANDARD ID run is successfully completed, the speed controller parameters (Group 23 SPEED CTRL) are updated to optimized settings for the crane applications. Parameter *23.01* GAIN is set to 15 and parameter *23.02* INTEGRATION TIME to 0.5 s. You can change these settings afterwards manually.

Note: If parameter group 99 gets locked, the following warning message is displayed: WRITE ACCESS DENIED. PARAMETER SETTING NOT POSSIBLE.

- Group 99 gets locked once the ID run is completed successfully. The group can be unlocked, if required, by entering pass code 584 into parameter *16.03* PASS CODE.

Note: Actual signal 03.03 bit 7 (IDENTIF RUN DONE) is displayed if the STANDARD ID run is done (the motor ID run is successfully completed).

Quick start-up guide

Chapter overview

This chapter describes the quick start-up procedure while using different control schemes and a different drive configuration.

Crane macro

This section describes the checklist for configuring the drive in different control schemes, as well as the other various configuration settings to be done for the crane application.

Control configuration

This section explains how the drive can be configured in different control schemes.

Checklist for controlling the drive from the keypad

- Power up the drive and wait for 10 seconds to ensure that all the boards are powered and the application is running.
- Press the Local/Remote button on the CDP to put the drive in local mode.
- Select the Crane macro (Par. *99.02*).
- Enter the motor name plate data into group 99.
- Select the direction to Request (Par. *10.03*).
- Open the group 99 read-only lock using passcode 584 (Par. *16.03*).
- Perform the ID run (Par. *99.10*).
- After the ID run, check the direction of rotation of the motor: Forward direction (positive) must be the UP direction.
- Select the keypad ref. selection (Par. *11.01*).
- Set the speed, torque, and current limits in group 20.

Checklist for controlling the drive from digital inputs and the potentiometer

- Power up the drive and wait for a period of power on reset time delay (Par. *16.12*) to ensure that all the boards are powered and the application is running.
- Press the Local/Remote button on the CDP to put the drive in Remote mode.
- Select the Crane macro (Par. *99.02*).
- Enter the motor name plate data into group 99.
- Open the group 99 read-only lock using passcode 584 (Par. *16.03*).
- Perform the ID run (Par. *99.10*).

- After the ID run, check the direction of rotation of the motor: Forward direction (positive) must be the UP direction.
- Select the external control location EXT1 / EXT2 (Par. *11.02*). For example: EXT1 selected.
- Select the start/stop control (Par. *10.01*). For example: DI1 F, DI2 R.
- Select the direction control (Par. *10.03*).
- Select the drive referencing control (Par. *11.03*). For example: AI1/JOYSTICK.
- Enter the minimum reference limit (Par. *11.04*).
- Enter the maximum reference limit (Par. *11.05*).
- Set the analog input scaling and limits (group 13).
- Set the speed, torque, and current limits in group 20.

Checklist for controlling the drive from the joystick

- Power up the drive and wait for a period of power on reset time delay (Par. *16.12*) to ensure that all the boards are powered and the application is running.
- Press the Local/Remote button on the CDP to put the drive in Remote mode.
- Select the Crane macro (Par. *99.02*).
- Enter the motor name plate data into group 99.
- Open the group 99 read-only lock using passcode 584 (Par. *16.03*).
- Perform the ID run (Par. *99.10*).
- After the ID run, check the direction of rotation of the motor: Forward direction (positive) must be the UP direction.
- Select the external control location EXT1 / EXT2 (Par. *11.02*). For example: EXT1 selected.
- Select the start/stop control (Par. *10.01*). For example: PARAM 10.04.
- Select the direction control (Par. *10.03*).
- Select the ZERO POS PTR (Par. *10.16*).
- Select the drive referencing control (Par. *11.03*). For example: AI1/JOYSTICK for unipolar, and AI1 BIPOLAR for a bipolar signal.
- Enter the minimum reference limit (Par. *11.04*).
- Enter the maximum reference limit (Par. *11.05*).
- Set the analog input scaling and limits (group 13).
- Set the joystick warning time delay (Par. *11.13*).
- Set the speed, torque, and current limits in group 20.

Checklist for controlling the drive from digital inputs and motorized potentiometer

- Power up the drive and wait for a period of power on reset time delay (Par. *16.12*) to ensure that all the boards are powered and the application is running.

- Press the Local/Remote button on the CDP to put the drive in Remote mode.
- Select the Crane macro (Par. *99.02*).
- Enter the motor name plate data into group 99.
- Open the group 99 read-only lock using passcode 584 (Par. *16.03*).
- Perform the ID run (Par. *99.10*).
- After the ID run, check the direction of rotation of the motor: Forward direction (positive) must be the UP direction.
- Select the external control location EXT1 / EXT2 (Par. *11.02*). For example: EXT1 selected.
- Select the start/stop control (Par. *10.01*). For example: DI1 F, DI2 R.
- Select the direction control (Par. *11.03*).
- Select the drive referencing control (Par. *11.03*). For example: DI3U,4D.
- Enter the minimum reference limit (Par. *11.04*).
- Enter the maximum reference limit (Par. *11.05*).
- Set the speed, torque, and current limits in group 20.

Checklist for controlling the drive using Step reference

- Power up the drive and wait for a period of power on reset time delay (Par. *16.12*) to ensure that all the boards are powered and the application is running.
- Press the Local/Remote button on the CDP to put the drive in Remote mode.
- Select the Crane macro (Par. *99.02*).
- Enter the motor name plate data into group 99.
- Open the group 99 read-only lock using passcode 584 (Par. *16.03*).
- Perform the ID run (Par. *99.10*).
- After the ID run, check the direction of rotation of the motor: Forward direction (positive) must be the UP direction.
- Select the external control location EXT1 / EXT2 (Par. *11.02*). For example: EXT1 selected.
- Select the start/stop control (Par. *10.01*). For example: DI1 F, DI2 R.
- Select the direction control (Par. *10.03*).
- Select the step reference setting (Par. *12.01*).
- Set the step reference (Par. *12.02*, *12.03*, *12.04*, *12.05*).
- Set the speed, torque, and current limits in group 20.

Checklist for controlling the drive in the fieldbus mode

- Power up the drive and wait for a period of power on reset time delay (Par. *16.12*) to ensure that all the boards are powered and the application is running.
- Press the Local/Remote button on the CDP to put the drive in Remote mode.

- Select the Crane macro (Par. *99.02*).
- Enter the motor name plate data into group 99.
- Open the group 99 read-only lock using passcode 584 (Par. *16.03*).
- Perform the ID run (Par. *99.10*).
- After the ID run, check the direction of rotation of the motor: Forward direction (positive) must be the UP direction.
- Select the external control location EXT1 / EXT2 (Par. *11.02*). For example: EXT1 selected.
- Select the start/stop control as COMM.CW (Par. *10.01*).
- Select the direction control as REQUEST (Par. *10.03*).
- Select the drive referencing control as COMM.REF (Par. *11.03*).
- Enter the minimum reference limit (Par. *11.04*).
- Enter the maximum reference limit (Par. *11.05*).
- Set the speed, torque, and current limits in group 20.
- Select the communication interface (Par. *98.02*).
- Select the communication profile (Par. *98.07*).
- Set the communication adapter if it is used (group 51).
- Set the modbus control if modbus is used (group 52).
- Set the CH0 address if ADVANT communication is used via modulebus (Par. *70.01*).
- Set the CH0 topology if ADVANT communication is used via modulebus (Par. *70.04*).

See also chapter *Fieldbus control* for more information.

Safety Control configuration

This section explains how the safety controls like Slowdown, End limits, and Fast stop have to be configured.

Checklist for safety control configuration

- Select the Slowdown input (Par. *10.09*). There can be either parallel inputs wired as a single input to the drive (For example: DI4 configured using selection Par. *10.19*) or separate inputs (For example: DI3 F, DI5 R).
- Setting the Slowdown reference (Par. *11.12*).
- Select the fast stop input (Par. *10.10*).
- Setting the fast stop deceleration time (Par. *22.10*).
- Select the highend input (Par. *10.12*).
- Select the lowend input (Par. *10.13*).
- Set the emergency stop time (Par. *22.07*).

- Select the acceleration/deceleration function (Par. *22.10*).
- Set the acceleration times (Par. *22.02*, *22.04*).
- Set the deceleration times (Par. *22.03*, *22.05*).

Brake control configuration

This section explains how the brake control configuration has to be done.

Checklist for the brake control configuration

- Select the brake control (Par. *42.01*).
- Select the brake acknowledge function (Par. *42.02*).
- Set brake open and close delays (Par. *42.03*, *42.04*).
- Set the brake closing speed (Par. *42.05*).
- Select the brake fault function (Par. *42.06*).
- Select Torque proving (Par. *76.01*).
- Set the torque prove fault delay (Par. *76.02*).
- Select start torque reference (Par. *42.07*, *42.08*).
- Set the motor slip speed (Par. *42.11*).
- Set the slip fault delay (Par. *42.12*).
- Set the brake long flt delay (Par. *42.13*)
- Set the brake reopen delay (Par. *42.16*)
- Set the brake chopper if it is used (group 27).

See section *Control of a mechanical brake* for more information.

Master/Follower configuration

This section explains how to configure the drive as a Master or a Follower. A maximum of four Followers can be configured on a Master drive using the CH 2 communication link. The Master/Follower configuration has to be used with EXT2 control. If the Master/Follower configuration is used with EXT1 control, the drive acts as a stand-alone drive.

Checklist for Master/Follower configuration

- Switch off the power from the drives to be configured as Master/Follower, and build the optic fibre link using the communication channel 2. The link should be made in a ring topology.
- Switch on the power for the drive.
- Select the drive as a Master or a Follower (Par. *60.01*).

Set the following parameters in the Master drive.

- Select the control location as EXT2 (Par. *11.02*)
- Select the drive as a Master (Par. *60.01*).

- Select the drive mode as speed/torque (Par. *60.02*).
- Select the number of Followers attached to the drive (Par. *60.10*).
- Select the mode of the Follower drives (Par. *60.11*).
- Select the signal to be sent to the Follower as reference 1 (Par. *60.07*). For example: 202 for speed.
- Select the signal to be sent to the Follower as reference 2 (Par. *60.08*). For example: 213 for torque.
- Select the CH2 link topology as ring (Par. *70.05*).

Set the following parameters in the Follower drive.

- Select the control location as EXT2 (Par. *11.02*)
- Select the drive as a Follower (Par. *60.01*).
- Select the drive mode as speed/torque (Par. *60.02*). The torque mode should be selected if the Follower is to run in the load sharing mode.
- Select the control location as EXT2(Par. *11.02*).
- Select the Start/Stop control as COMM.CW if the Master command is to be used (Par. *10.02* for EXT2).
- Select the direction control as REQUEST (Par. *10.03*).
- Select the drive reference control as COMM.REF/FAST COMM. (Par. *11.06* in EXT2). The FAST COMM selection should be used if the load sharing parameter (Par. *60.09*) is to be functional.
- Set the load sharing factor (Par. *60.09*).
- Set the minimum reference limits (Par. *11.07* for EXT2).
- Set the maximum reference limits (Par. *11.08* for EXT2).
- Select the CH2 communication link topology as ring (Par. *70.05*).

For hoist applications, both the Master and the Follower should have the pulse encoder in use for speed feedback. Set the following parameters for encoder configuration:

- Select the encoder module type (Par. *98.01*).
- Set the encoder PPR (Par. *50.01*).
- Select the speed measurement mode (Par. *50.02*).
- Select the speed feedback selection as ENCODER (Par. *50.06*).
- Configure the encoder fault (Par. *50.03*).

See section *Master/Follower use of several drives (Only in EXT2 Control)* for more information.

Shaft synchronisation configuration

This section explains how to configure the drive as a Master or a Follower in the Shaft synchronisation mode. A maximum of four Followers can be used in synchronisation with a Master drive using the CH2 communication link. The Shaft synchronisation works only when the drive is in EXT2 control.

Checklist for Master/Follower configuration in Shaft synchronisation mode

- Switch off the power for the drives to be configured as Master/Follower and build the optic fibre link using the communication channel 2. The link should be made in a ring topology.
- Switch on the power for the drive.
- Select the drive as a Master or a Follower (Par. *60.01*).

Since Shaft synchronisation is used for actual position synchronisation, both the Master and the Follower should have the pulse encoder is use for speed feedback. The encoder counts are used to calculate the actual position in mm.

Set the following parameters for encoder configuration:

- Select the encoder module type (Par. *98.01*).
- Set the encoder PPR (Par. *50.01*).
- Select the speed measurement mode (Par. *50.02*).
- Select the speed feedback selection as ENCODER (Par. *50.06*).
- Configure the encoder fault (Par. *50.03*).

Set the following parameters in the Master drive.

- Select Synchro control as ON (Par. *78.01*).
- Select the control location as EXT2 (Par. *11.02*)
- Select the drive as a Master (Par. *60.01*).
- Select the drive mode as speed (Par. *60.02*).
- Select the number of Followers attached to the drive (Par. *60.10*).
- Select the mode of the Follower drives as speed (Par. *60.11*).
- Select the signal to be sent to the Follower as reference 2 as 202 (Speed) (Par. *60.08*).
- Select the CH2 link topology as ring (Par. *70.05*).
- Select Synchro control as ON (Par. *78.01*).
- Select the synchro input (Par. *10.14* and Par. *10.17*).
- Set the position scaling factor (Par. *78.04*).

Set the following parameters in the Follower drive.

- Select the control location as EXT2 (Par. *11.02*)
- Select the drive as a Follower (Par. *60.01*).
- Select the drive mode as speed (Par. *60.02*).

- Select the start/stop control as COMM.CW, if the Master command is to be used (Par. 10.02).
- Select the direction control as REQUEST (Par. 10.03).
- Select the drive reference control as COMM.REF(Par. 11.06).
- Set the minimum reference limits (Par. 11.07).
- Set the maximum reference limits (Par. 11.08).
- Select the CH2 link topology as ring (Par. 70.05). Select the Synchro control as ON (Par. 78.01).
- Select the synchro input (Par. 10.14).
- Set the synchro gain (Par. 78.02).
- Set the shaft scaling factor for the scaling of speed reference received from the Master (Par. 78.03).
- Set the position scaling factor (Par. 78.04).
- Set the maximum position correction limit in mm (Par. 78.05).
- Set the minimum position correction limit in mm (Par. 78.06).
- Set the synchronisation error limit for the Follower drive (Par. 78.09).
- Set the synchro correction scale in terms of rpm equivalent to 1 mm position error (Par. 78.08).
- Set the synchro correction mode (Par. 78.12)
- Set the position hysteresis value (Par. 78.13)

Load speed control configuration

This section explains how the Load speed control function parameters have to be configured. See section *Load speed control* for detailed explanation.

Checklist for Load speed control configuration

- Activate the Load speed control function (Par. 77.01).
- Set the motor base speed (Par. 77.20). This is the speed at which the actual motor current is checked with the load for calculating the maximum allowed speed.
- Set the hold ramp time period (Par. 77.03). The speed reference is on hold at the base speed for this period. The motor current at the base speed is checked after this time period.
- Set the current values for the forward direction (Par. 77.04, 77.06, 77.08 and 77.10). Par. 77.04 can be set with the empty hook current at the base speed when running in the forward direction. Par. 77.10 can be set with the maximum load current at the base speed in the forward direction. These parameters are to be entered in the increasing order in the above sequence. For more details, see section *Load speed control*.

- Set the speed limit values for the forward direction (Par. *77.05*, *77.07*, *77.09* and *77.11*). Par. *77.05* can be set with the maximum allowed speed in empty hook condition in the forward direction. Par. *77.11* can be set with the minimum allowed speed in maximum load condition, in the forward direction. These parameters are to be entered in the decreasing order in the above sequence. For more details, see section *Load speed control*.
- Set the current values for the reverse direction (Par. *77.12*, *77.14*, *77.16* and *77.18*). Par. *77.12* can be set with the empty hook current at the base speed when running in the reverse direction. Par. *77.18* can be set with the maximum load current at the base speed, in the reverse direction. These parameters are to be entered in the increasing order in the above sequence. For more details, see section *Load speed control*.
- Set the speed limit values for the reverse direction (Par. *77.13*, *77.15*, *77.17* and *77.19*). Par. *77.13* can be set with the maximum allowed speed in empty hook condition in the reverse direction. Par. *77.19* can be set with the minimum allowed speed in maximum load condition, in the reverse direction. These parameters are to be entered in the decreasing order in the above sequence. For more details, see section *Load speed control*.

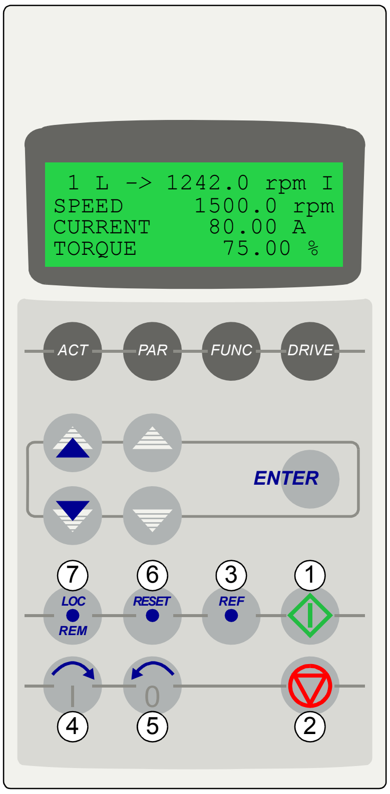
Control panel

Chapter overview

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

The same control panel is used with all ACS800 series drives, so the instructions given apply to all ACS800 types.

Overview of the panel



The LCD type display has 4 lines of 20 characters.

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

The control panel has four operation modes:

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

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

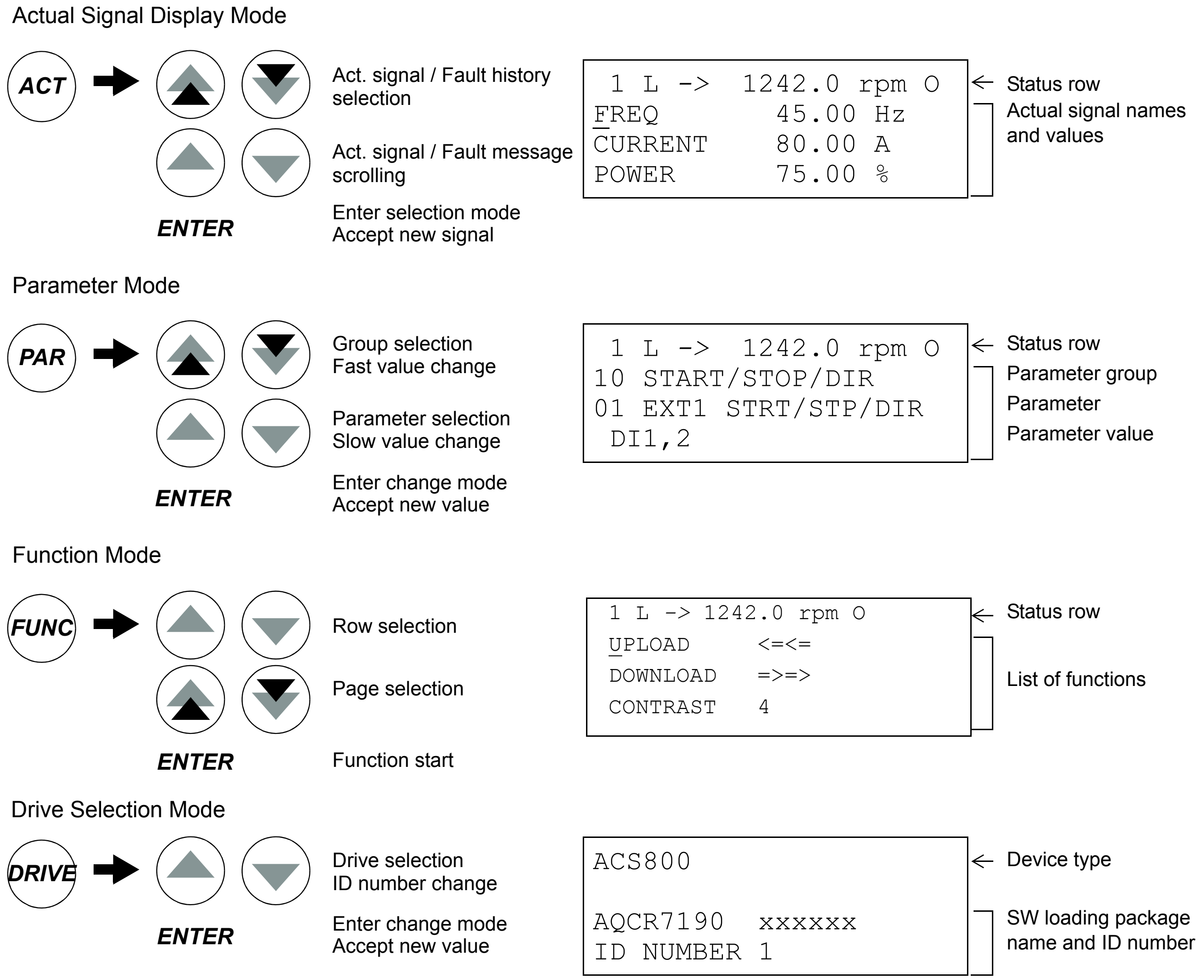
The drive control keys are:

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

For more information, see *Panel operation mode keys and displays* on *page 38* and *Status row – How to read the drive status at a glance* on *page 39*.

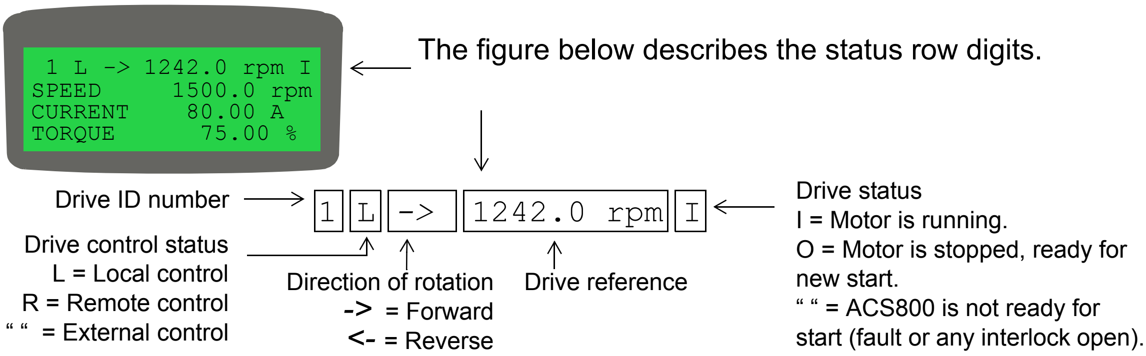
Panel operation mode keys and displays

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



Status row – How to read the drive status at a glance

The top line of the LCD display shows the basic status information of the drive.



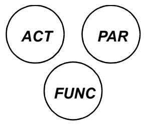
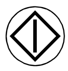
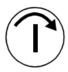
Drive control with the panel

You can control the drive with the panel as follows:

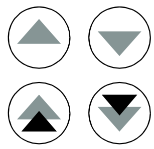
- start, stop, and change direction of the motor
- give the motor speed reference or torque reference
- reset the fault and warning messages
- change between local and external drive control.

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

How to start, stop and change direction

Step	Action	Press Key	Display
1.	To show the status row.		`1   ->1242.0 rpm  I` `FREQ       45.00 Hz` `CURRENT    80.00 A` `POWER      75.00 %`
2.	To switch to local control. (only if the drive is not under local control, that is, 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.	ACT PAR FUNC	`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, that is, there is no L on the first row of the display.)	LOC REM	`1 L ->1242.0 rpm  I` `FREQ        45.00 Hz` `CURRENT     80.00 A` `POWER       75.00 %`
3.	To enter the Reference Setting function.	REF	`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 %`

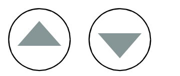
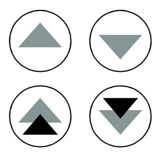
Actual signal display mode

In the Actual Signal Display Mode, you can:

- have 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 you press the ***ACT*** key, or if you do not press any key within one minute.

How to select actual signals to the display

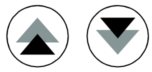
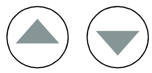
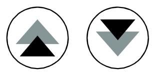
Step	Action	Press key	Display
1.	To enter the Actual Signal Display Mode.	ACT	1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
2.	To select a row (a blinking cursor indicates the selected row).		1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %
3.	To enter the actual signal 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 5.b	To accept the selection and to return to the Actual Signal Display Mode. To cancel the selection and keep the original selection. The selected keypad mode is entered.	***ENTER*** ACT PAR FUNC DRIVE	1 L -> 1242.0 rpm I FREQ 45.00 Hz TORQUE 70.00 % POWER 75.00 % 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** ACT	1 L -> 1242.0 rpm I FREQUENCY CURRENT POWER
2.	To return to the Actual Signal Display Mode.	**Release** ACT	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.	ACT	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.	 RESET	1 L -> 1242.0 rpm I 2 LAST FAULT +OVERVOLTAGE 1121 H 1 MIN 23 S 1 L -> 1242.0 rpm I 2 LAST FAULT H MIN S
4.	To return to the Actual Signal Display Mode.		1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %

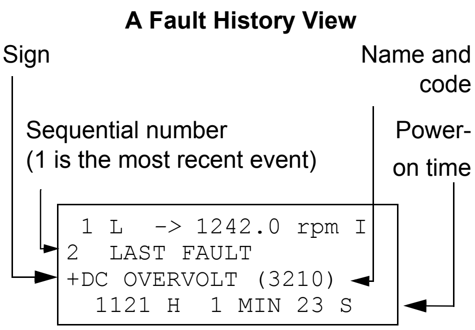
How to display and reset an active fault

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

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

About the fault history

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



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

Parameter mode

In the Parameter Mode, you can:

- view the parameter values
- change the parameter settings.

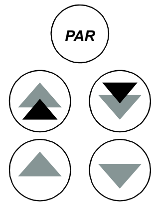
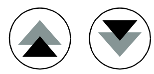
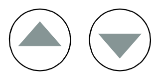
The panel enters the Parameter Mode when you press the ***PAR*** key.

How to select a parameter and change the value

Step	Action	Press key	Display
1.	To enter the Parameter Mode.	PAR	`1 L -> 1242.0 rpm O` `10 START/STOP/DIR` `01 EXT1 STRT/STP/DIR` `DI1,2`
2.	To select a group.	▲ ▼	`1 L -> 1242.0 rpm O` `11 REFERENCE SELECT` `01 KEYPAD REF SEL` `REF1 (rpm)`
3.	To select a parameter within a group.	▲ ▼	`1 L -> 1242.0 rpm O` `11 REFERENCE SELECT` `03 EXT REF1 SELECT` `AI1`
4.	To enter the parameter setting function.	***ENTER***	`1 L -> 1242.0 rpm O` `11 REFERENCE SELECT` `03 EXT REF1 SELECT` `[AI1]`
5.	To change the parameter value. - (slow change for numbers and text) - (fast change for numbers only)	▲ ▼ ▲ ▼	`1 L -> 1242.0 rpm O` `11 REFERENCE SELECT` `03 EXT REF1 SELECT` `[AI2]`
6a.	To save the new value.	***ENTER***	`1 L -> 1242.0 rpm O` `11 REFERENCE SELECT` `03 EXT REF1 SELECT` `AI2`
6b.	To cancel the new setting and keep the original value, press any of the mode selection keys. The selected mode is entered.	ACT PAR FUNC DRIVE	`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 control 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	 *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)]		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*	

1)

```
 1 L ->1242.0 rpm O
84 ADAPTIVE PROGRAM
06 INPUT1
[±001.018.00]
```

Inversion field
Group field
Index field
Bit field

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 with 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, you can:

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

The panel enters the Function Mode when you press the ***FUNC*** key.

How to upload data from a drive to the panel

Note:

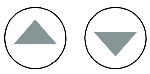
- Upload before downloading.
- Ensure the firmware of the destination drive is the same (for example, standard firmware).
- Before removing the panel from a drive, ensure the panel is in remote operating mode (change with the LOC/REM key).
- Stop the drive before downloading.

Before upload, repeat the following steps in each drive:

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

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

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

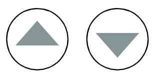
Step	Action	Press Key	Display
1.	Enter the Function Mode.	FUNC	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
2.	Select the upload function (a flashing cursor indicates the selected function).		1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
3.	Enter the upload function.	***ENTER***	1 L -> 1242.0 rpm O UPLOAD <=<=
4.	Switch to external control. (No L on the first row of the display.)	LOC REM	1 -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4

[1)] By default, the parameter groups 98, 99 and the results of the motor identification are not included. 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.

Step	Action	Press Key	Display
5.	Disconnect the panel and reconnect it to the drive into which the data will be downloaded.		

How to download data from the panel to a drive

Consider the notes in section *How to upload data from a drive to the panel* on page *47*.

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 contrast of the display

Step	Action	Press Key	Display
1.	Enter the Function Mode.	FUNC	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
2.	Select a function (a flashing cursor indicates the selected function).	▲ ▼	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 4
3.	Enter the contrast setting function.	***ENTER***	1 L -> 1242.0 rpm O CONTRAST [4]
4.	Adjust the contrast.	▲ ▼	1 L -> 1242.0 rpm CONTRAST [6]
5.a	Accept the selected value.	***ENTER***	1 L -> 1242.0 rpm O UPLOAD <=<= DOWNLOAD =>=> CONTRAST 6
5.b	Cancel the new setting and retain the original value by pressing any of the mode selection keys. The selected mode is entered.	ACT PAR FUNC DRIVE	1 L -> 1242.0 rpm I FREQ 45.00 Hz CURRENT 80.00 A POWER 75.00 %

Drive selection mode

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

In the Drive Selection Mode, you can:

- View the device type, drive SW loading package name and ID number
- Select the drive with which the panel communicates through the panel link
- Change the identification number of a drive connected to the panel link
- View the status of the drives connected on the panel link.

The panel enters the Drive Selection Mode when you press the ***DRIVE*** key.

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

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

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

Step	Action	Press key	Display
1.	To enter the Drive Selection Mode.	DRIVE	`ACS800` `AQCCXXXX xxxxxx` `ID NUMBER 1`
2.	To select the next drive/view. The ID number of the station is changed by first pressing ***ENTER*** (the brackets round the ID number appear) and then adjusting the value with arrow buttons. The new value is accepted with ***ENTER***. The power of the drive must be switched off to validate its new ID number setting. The status display of all devices connected to the Panel Link is shown after the last individual station. If all stations do not fit on the display at once, press the double-arrow up to view the rest of them.		`ACS800` `AQCCXXXX xxxxxx` `ID NUMBER 1` `1ↄ` Status Display Symbols: ↄ = Drive stopped, direction forward ↿= Drive running, direction reverse F = Drive tripped on a fault
3.	To connect to the last displayed drive and to enter another mode, press one of the mode selection keys. The selected mode is entered.	ACT PAR FUNC	`1 L -> 1242.0 rpm I` `FREQ 45.00 Hz` `CURRENT 80.00 A` `POWER 75.00 %`

Reading and entering packed boolean values on the display

Some actual values and parameters are packed boolean, that is, 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:

```
          Bit 15               Bit 0
Boolean   0000  0000  0001  1010
Hex          0     0     1     A
```

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.

Typical crane configuration

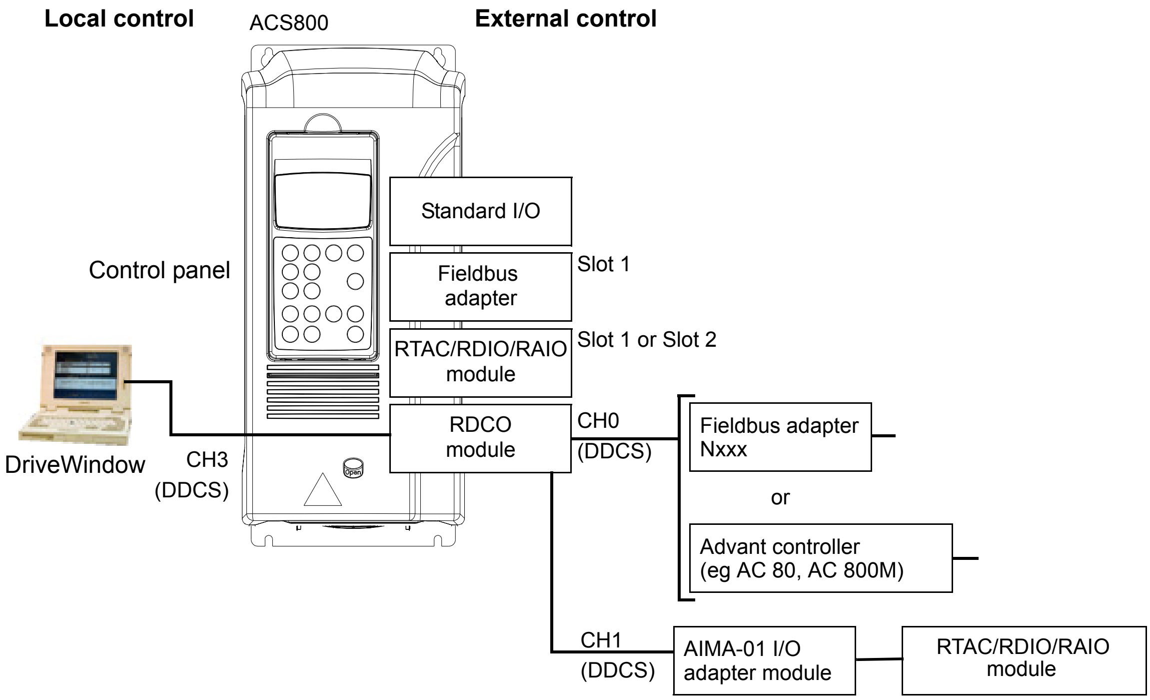
The Crane control program can be used, for example, in the following kinds of applications:

- Hoist drives: Closed-loop motor control with an incremental encoder for:
  - additional safety and performance
  - anti-sway control (hook position needed)
  - Master/Follower synchro control
- Trolley drives: Open-loop motor control without an incremental encoder
- Long travel drives: Open-loop motor control without an incremental encoder.

Local control vs. external control

The drive can receive Start, Stop and Direction commands and reference values from the control panel or through digital and analogue inputs. An optional fieldbus adapter module enables control over an open fieldbus link. A PC equipped with DriveWindow can also control the drive. DriveWindow is mainly used to select parameters and monitor signals. See page *333* for a screenshot of DriveWindow connected to an ACS800 drive with the Crane control program.

Note: The crane drive is not ready for start if the drive status displayed in the upper right corner of the control panel is not “0”.



Local control

Note: When you are using (L) local control, you are responsible for the application safety. If you are operating with a stand-alone crane and a Master/Follower, and if the control panel is transferred from the remote mode to the local mode on the Master or on the Follower, the application protections are not used.

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

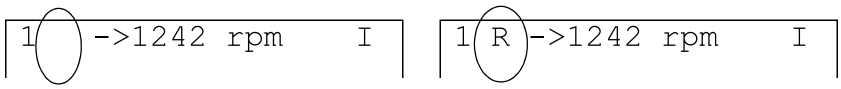
```
1 L ->1242 rpm    I
```

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

External control

When the drive is in external control, the commands are given through standard I/O terminals (digital and analogue inputs), optional I/O extension modules and/or the fieldbus interface. In addition, it is also possible to set the control panel as the source for the external control.

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

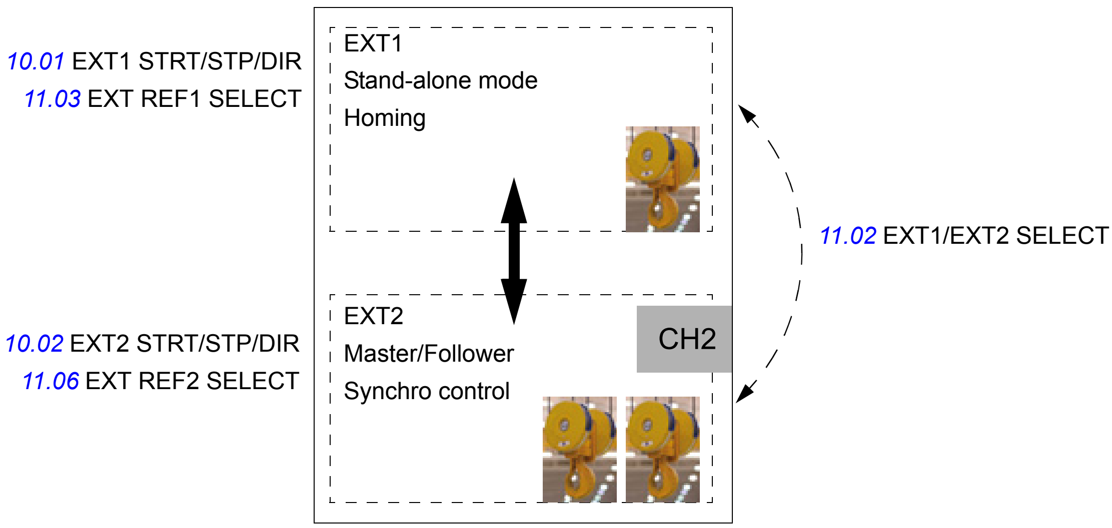


External control through the Input/ Output terminals, or through the fieldbus interfaces

External control by control panel

You can connect the control signals to two external control locations, EXT1 or EXT2. Depending on the selection, either one is active at a time. This function operates on a 20 ms time level.

The figure below illustrates the use of the external control locations.



Settings

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

Diagnostics

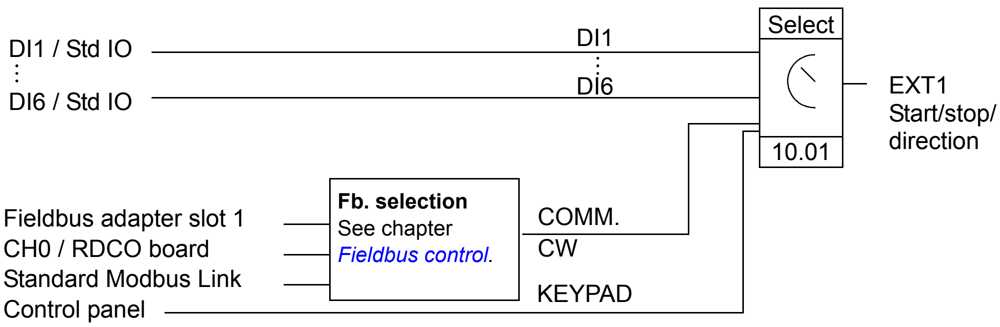
Actual signals	Additional information
01.11, *01.12*	EXT1 reference, EXT2 reference
03.02	EXT1 / EXT2 selection bit in a packed boolean word

Stand-alone mode (EXT1)

In the stand-alone mode, a speed-controlled crane is controlled in control location EXT1. Homing is also possible only from location EXT1. For more information, see section *Master/Follower use of several drives (Only in EXT2 Control)* on page *94* and a separate *Master/Follower Application Guide* [3AFE64590430 (English)].

Block diagram: start, stop, direction source for EXT1

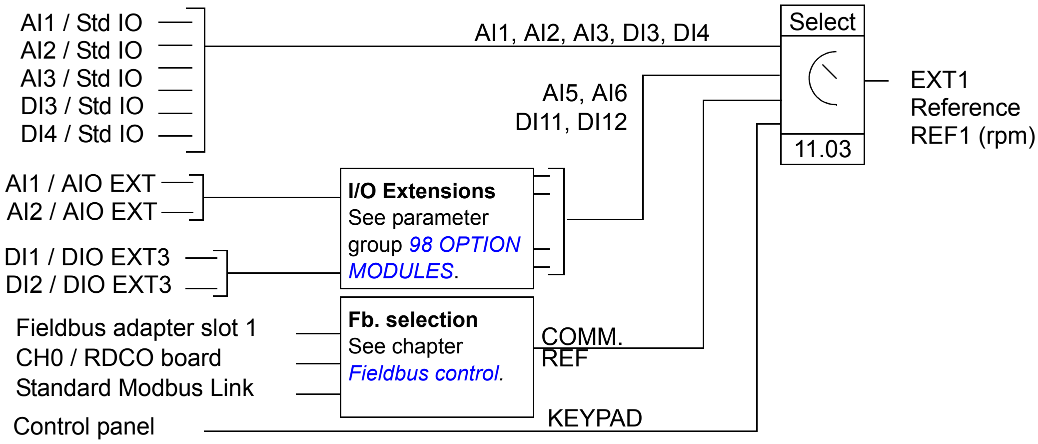
The figure below shows the parameters that select the interface for start, stop, and direction for external control location EXT1.



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

Block diagram: reference source for EXT1

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



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

AI1 / AIO ext = Analogue input AI1 on the analogue I/O extension module

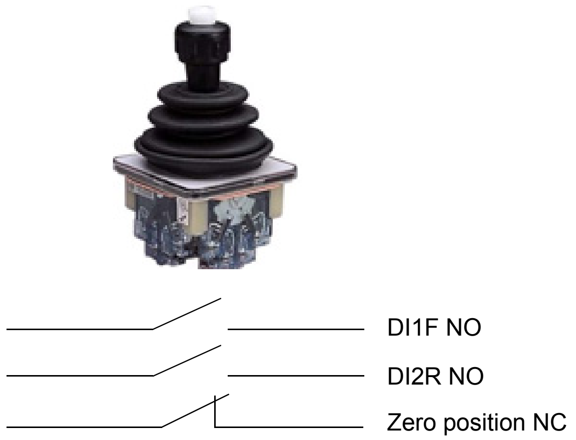
Master/Follower and Synchro control (EXT2)

A speed-controlled Master and a speed/torque-controlled or synchro-controlled Follower is controlled in control location EXT2. For more information, see section *Master/Follower use of several drives (Only in EXT2 Control)* on page 94 and a separate *Master/Follower Application Guide* [3AFE64590430 (English)].

Zero position of the joystick

The function supervises a *10.16* ZERO POSition PTR input in case of a stop or a trip. The input can be used either as a NO contact or as an NC contact depending on the configuration selected in the pointer value. The drive will check for a 1 -> 0 edge of this input before it activates the next start. The input must be zero for the Start command to be executed. If the drive does not accept the Start command because there is a sequence problem in the zero position input, it generates a ZERO POS WARN warning.

The following figure shows a connection diagram of the Zero position input for an NC configuration.



You can also use the Zero position input for a joystick error check when the reference is taken from a joystick. If the Zero position input is true, and the speed reference or torque reference is greater than +/- 10% of the minimum or maximum scaled value of the used joystick reference, a JOYSTICK CHECK warning is generated after a delay of *11.13* JOYSTICK WARN TD. If Start commands in both directions are true simultaneously, then it is also detected as a joystick hardware error.

Settings

Parameter	**Additional information**
10.16	Settings of the Zero position input
11.13	Settings of joystick error time delay

Diagnostics

Actual signal	**Additional information**
03.32	Bit 13, Zero position warning from joystick Zero position
Warning	**Additional information**
ZERO POS WARN	Incorrect start command or start command active with Zero position input ON
JOYSTICK CHECK	Joystick hardware error or simultaneous start command in forward and reverse directions

Reference types and processing

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

- The drive reference can be given with two digital inputs: One digital input increases the speed and the other decreases it.
- The drive accepts a bipolar analogue speed reference. This feature allows both the speed and the direction to be controlled with a single analogue input. The minimum signal is full speed reversed and the maximum signal is full speed forward.
- The drive can form a reference from the signal received through a communication interface.

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

Settings

Parameter	Additional information
Group *11 REFERENCE SELECT*	External reference source, type and scaling
Group *20 LIMITS*	Operating limits
Group *22 ACCEL/DECEL*	Speed reference acceleration and deceleration ramps
Group *24 TORQUE CTRL*	Torque reference ramp times

Diagnostics

Actual signal	Additional information
01.11, 01.12	Values of external references
Group *02 ACTUAL SIGNALS*	The reference values in different stages of the reference processing chain
Parameter	
Group *14 RELAY OUTPUTS*	Active reference / reference loss through a relay output
Group *15 ANALOGUE OUTPUTS*	Reference value

Programmable analogue inputs

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

The Crane control program supports unipolar and bipolar joystick configuration:

- Unipolar (AI1/JOYST), 0 ... 10 V for the reference and digital inputs for the sign and start (for example, DIF, DI2 R)
- Bipolar (AI1 BIPOLAR), -10 ... +10 V for the sign and reference and one digital input for main start (for example, DI1).

Update cycles in the Crane control program

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

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

Settings

Parameter	Additional information
Group *11 REFERENCE SELECT*	AI as a reference source
Group *13 ANALOGUE INPUTS*	Processing of the standard inputs
30.01	Supervision of AI loss
35.01	AI in a motor temperature measurement
42.07	AI in a mechanical brake control function
98.06	Activation of optional analogue inputs
98.13	Optional AI signal type definition (bipolar or unipolar)
98.14	Optional AI signal type definition (bipolar or unipolar)

Diagnostics

Actual signal	Additional information
01.18, *01.19*, *01.20*	Values of standard inputs
01.38, *01.39*	Value of optional inputs
Group *09 ACTUAL SIGNALS*	Scaled analogue input values (integer values for function block programming)

Programmable analogue outputs

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

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

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

Update cycles in the Crane control program

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

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

Settings

Parameter	Additional information
Group *15 ANALOGUE OUTPUTS*	AO value selection and processing (standard outputs)
30.22	Supervision of the use of optional AO
Group *35 MOT TEMP MEAS*	AO in motor temperature measurement
Group *96 EXTERNAL AO*	Optional AO value selection and processing
Group *98 OPTION MODULES*	Activation of optional I/O

Diagnostics

Actual signal	Additional information
01.22, *01.23*	Values of the standard outputs
01.28, *01.29*	Values of the optional outputs
Warning	
IO CONFIG	Improper use of optional I/O

Programmable digital inputs

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

Update cycles in the Crane control program

Input	Cycle
DI / standard	6 ms
DI / extension	20 ms

Settings

Parameter	Additional information
Group *10 START/STOP/ DIR*	DI as start, stop, direction
Group *11 REFERENCE SELECT*	DI in reference selection, or reference source
Group *12 STEP REFERENCING*	DI in step reference selection
Group *16 SYST CTRL INPUTS*	DI as external Run Enable, fault reset or user macro change signal
22.01	DI as acceleration and deceleration ramp selection signal
30.03	DI as external fault source
30.05	DI in motor overtemperature supervision function
30.22	Supervision of optional I/O use
42.02	DI as mechanical Brake Acknowledge signal
98.03…96.05	Activation of the optional digital I/O extension modules

Diagnostics

Actual signal	Additional information
01.17	Status of the standard digital inputs. **Example:** 0000001 = DI1 is on, DI2 to DI6 and DIL are off. Bit 6 5 4 3 2 1 0 Value 0 0 0 0 0 0 1 Input DIL DI6 DI5 DI4 DI3 DI2 DI1
01.40	Values of the optional digital inputs
Warning	
IO CONFIG	Improper use of optional I/O
Fault	
I/O COMM ERR	Communication loss to I/O

The Crane control program supports programmable digital inputs with a (PTR) logic with sign.group.index.bit (+.000.000.00).

Additional information for Digital Inputs and Pointers PTR

+001.017.00 Values of standard Digital Inputs on RMIO board
DIL D16-1 STATUS
RMIO DI1 = +001.017.00
RMIO DI2 = +001.017.01
RMIO DI3 = +001.017.02
RMIO DI4 = +001.017.03
RMIO DI5 = +001.017.04
RMIO DI6 = +001.017.05
RMIO DIL = +001.017.06 (Power ON acknowledge), programmable with parameter 97.18

+001.040.00 Values of optional Digital Inputs on RDIO board
DI15-7 STATUS
RDIO DI7 = +001.040.00
RDIO DI8 = +001.040.01
RDIO DI9 = +001.040.02
RDIO DI10 = +001.040.03
RDIO DI11 = +001.040.04
RDIO DI12 = +001.040.05
RDIO DI13 = +001.040.06
RDIO DI14 = +001.040.07
RDIO DI15 = +001.040.08

Programmable relay outputs

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

The standard relay output's RO1, RO2 and RO3 are configured to the brake open, running and inverted faults, respectively, as shown below.

Par. *14.01* RO PTR1 is configured default for brake open as +003.013.06 (Par. *03.13* bit 6)

Par. *14.02* RO PTR2 is configured default for running as +003.002.02 (Par. *03.02* bit 2)

Par. *14.03* RO PTR3 is configured default for inverted fault as -003.002.03 (Par. *03.03* bit 3)

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

Update cycles in the Crane control program

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

Settings

Parameter	Additional information
Group *14 RELAY OUTPUTS*	RO value selections and operation times
Group *42 BRAKE CONTROL*	RO in a mechanical brake control
Group *98 OPTION MODULES*	Activation of optional relay outputs

Diagnostics

Actual signal	Additional information
01.21	Standard relay output states
01.41	Optional relays output states

Actual signals

Several actual signals are available:

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

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

Settings

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

Diagnostics

Actual signal	Additional information
Group *01 ACTUAL SIGNALS* … *09 ACTUAL SIGNALS*	Lists of actual signals

Motor identification

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

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

In demanding applications a separate identification run can be performed.

Settings

Parameter *99.10* MOTOR ID RUN MODE

- ID MAGN: Identification with the motor at a standstill and the mechanical brake closed.
- STANDARD: Identification with a rotating motor and the mechanical brake open.

Diagnostics

Actual signal *03.03*.

- Bit 6: First start not done.
- Bit 7: STANDARD ID run done.

Start function: Constant DC magnetising

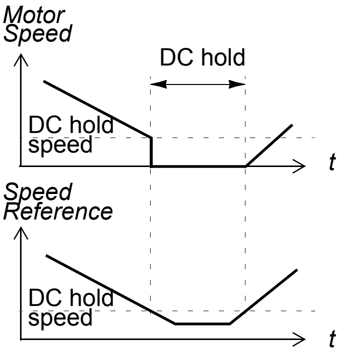
When DC magnetising is activated, the drive automatically magnetises the motor before starting. This feature guarantees the highest possible breakaway torque, up to 200% of motor nominal torque. In crane applications, this parameter is fixed to constant DC magnetising (CNST DC MAGN).

Settings

Parameters *21.01* and *21.02*.

DC hold

By activating the motor DC hold feature, you can 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.

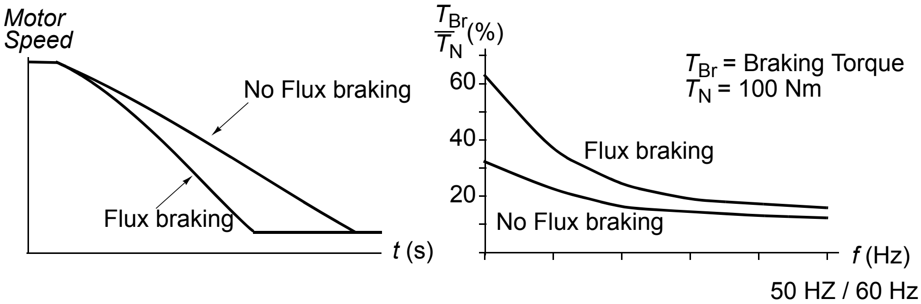


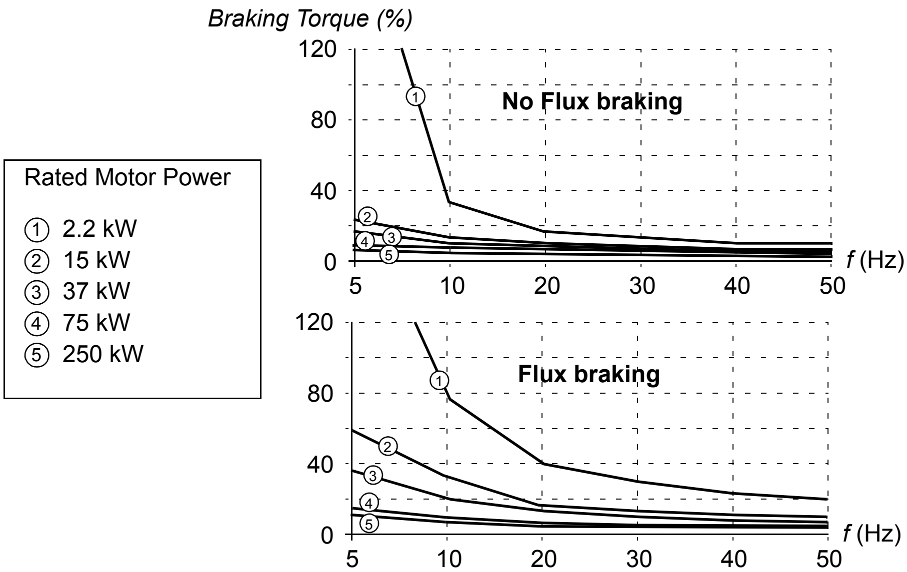
Settings

Parameters *21.04*, *21.05*, and *21.06*.

Flux braking

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





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

- The braking starts immediately after a stop command is given. The function does not need to wait for the flux reduction before it can start the braking.
- The cooling of the motor is efficient. The stator current of the motor increases during the Flux braking, not the rotor current. The stator cools much more efficiently than the rotor.

Settings

Parameter *26.02*.

Flux optimisation

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

Settings

Parameter *26.01*.

FS method

The Flux stabilization method improves the behaviour of open-loop trolley drives and long travel drives without speed feedback especially when the drive operates around the zero speed with high load. The method is active on frequencies below 10% of nominal frequency and when the torque exceeds 30%.

Settings

Parameter *26.07*.

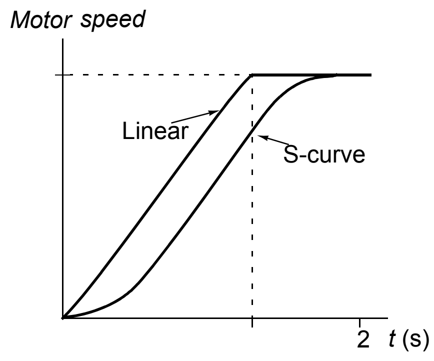
Acceleration and deceleration ramps

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

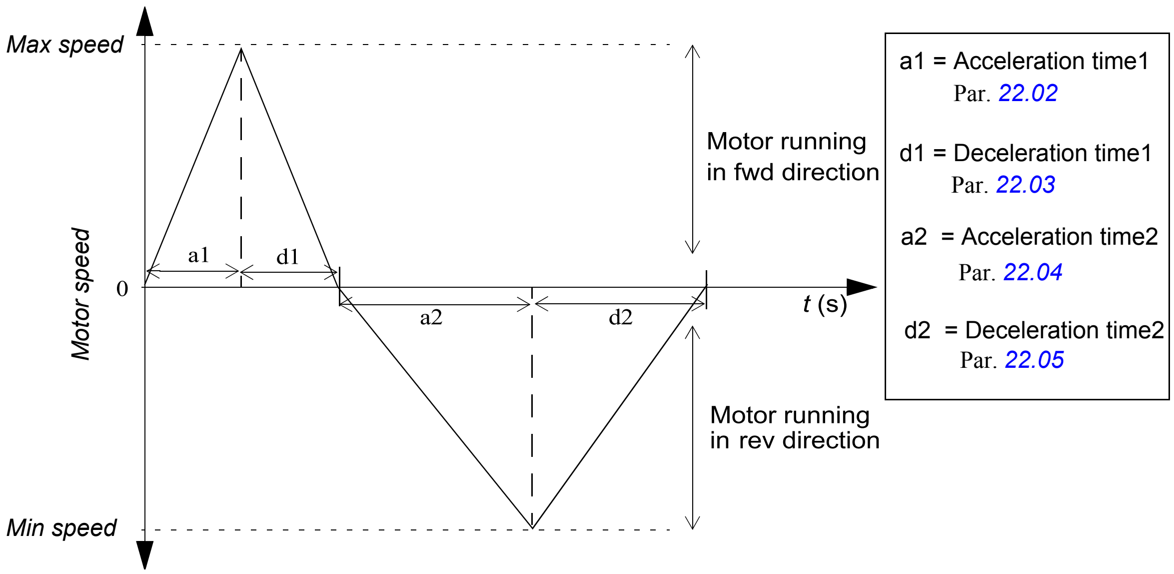
The available ramp shape alternatives are Linear and S-curve.

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

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



The default setting for Par. *22.01* ACCEL/DECEL acceleration/deceleration selection is ACC/DEC DIR for crane control. In this selection, acceleration time 1 and deceleration time 1 is used when the motor is running in the forward direction, while acceleration time 2 and deceleration time 2 is used when the motor is running in the reverse direction. The following figure shows how the acceleration and deceleration times are used according to the direction of the motor.



Settings

Parameter group *22 ACCEL/DECEL*.

Step referencing

It is possible to predefine four step references. The step references are selected with digital inputs. Step reference activation overrides the external speed reference.

This function operates on a 6 ms time level.

The four step references are based on a combination of three digital inputs, for example, DI3, DI4 and DI5.

DI3	DI4	DI5	Operation
0	0	0	STEP REF 1
1	0	0	STEP REF 2
1	1	0	STEP REF 3
1	1	1	STEP REF 4

If you need any other combination than three digital inputs, you can use the following parameters for defining the combination. For example, if you need two-step references with one digital input, you can set:

- Parameter *12.01* STEP REF SEL to STEP POINTER (Speed defined by pointer selections)
- Parameter *12.02* to, for example, 500 rpm
- Parameter *12.03* to, for example, 1000 rpm
- Parameter *12.06* to, for example, +.001.017.04 (= DI5)

After this:

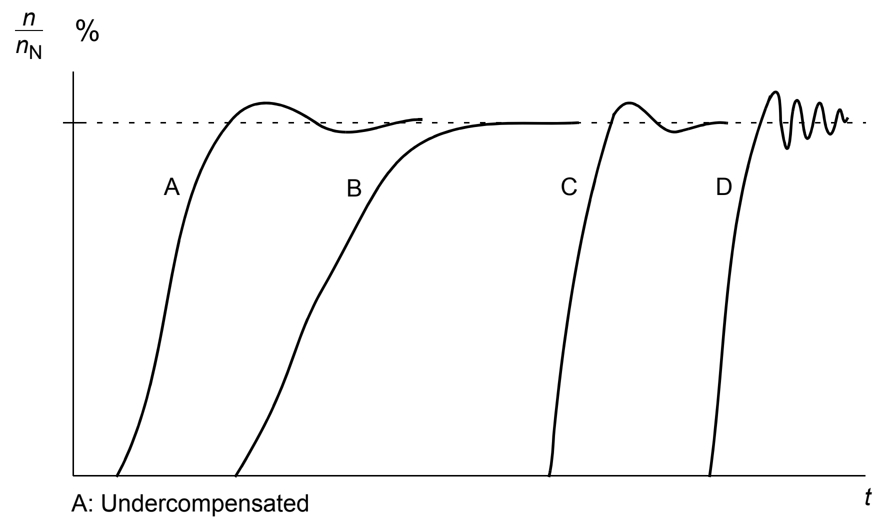
- If DI5 = 0, step reference 500 rpm is valid by par. 12.02.
- If DI5 = 1, step reference 1000 rpm is valid by par. 12.03.

Settings

Parameter group *12 STEP REFERENCING*.

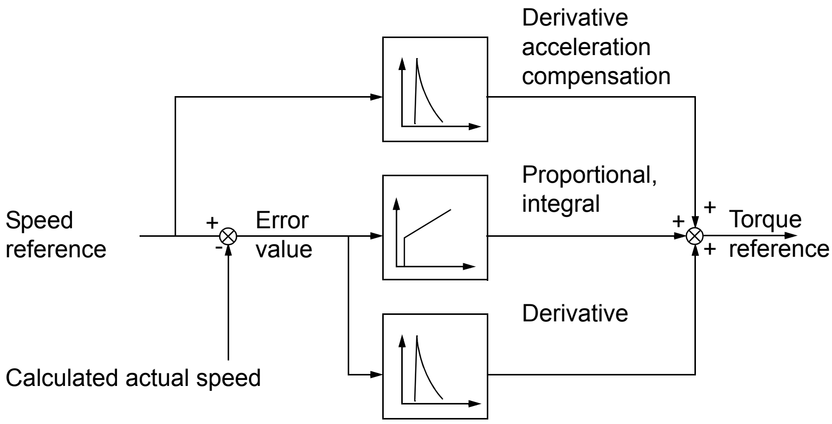
Speed controller tuning

During the motor identification, the speed controller is automatically tuned. It is, however, possible to manually adjust the controller gain, integration time and derivation time, or let the drive perform a separate speed controller Autotune Run. In Autotune Run, the speed controller is tuned based on the load and inertia of the motor and the machine. The following figure 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 following figure is a simplified block diagram of the speed controller. The controller output is the reference for the torque controller.



Settings

Parameter group *23 SPEED CTRL* and *20 LIMITS*.

Diagnostics

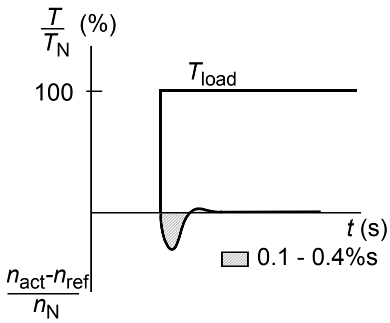
Actual signal *01.02*.

Speed control performance figures

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

Speed control	No pulse encoder	With pulse encoder
Static speed error, % of n_N	$\pm$ 0.1 to 0.5% (10% of nominal slip)	$\pm$ 0.01%
Dynamic speed error	0.4%s*	0.1%s*

*Dynamic speed error depends on speed controller tuning.



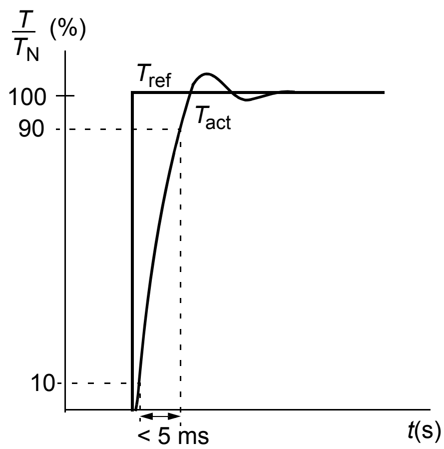
T_N = rated motor torque
n_N = rated motor speed
n_{act} = actual speed
n_{ref} = speed reference

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	$\pm$ 4%*	$\pm$ 3%
Repeatability error	$\pm$ 3%*	$\pm$ 1%
Torque rise time	1 to 5 ms	1 to 5 ms

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



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

Scalar control

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

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

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

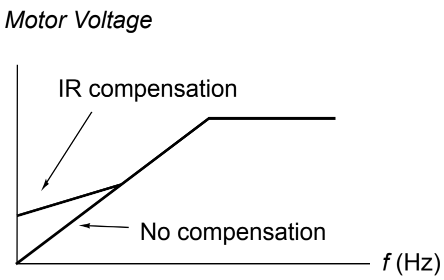
In the Scalar control mode, some standard features are not available.

Settings

Parameter *99.04*.

IR compensation for a scalar-controlled drive

IR compensation is active only when the motor control mode is Scalar (see section *Scalar control* on page *73*. When IR compensation is activated, the drive gives an extra voltage boost to the motor at low speeds. IR compensation is useful in applications that require high breakaway torque. In Direct torque control, no IR compensation is possible/needed.



Settings

Parameter *26.03*.

Hexagonal motor flux

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

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

Settings

Parameter *26.05*.

Programmable protection functions

AI<Min

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

Settings

Parameter *30.01*.

Panel loss

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

Settings

Parameter *30.02*.

External fault

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

Settings

Parameter *30.03*.

Motor thermal protection

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

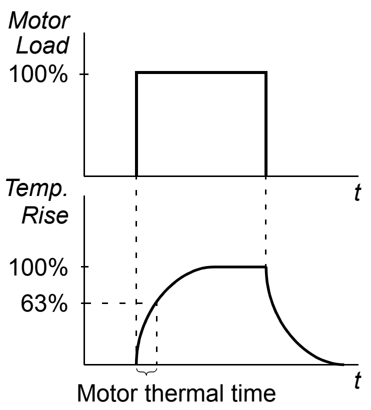
The Motor thermal protection modes are based either on a motor temperature thermal model or on an overtemperature indication from a motor thermistor.

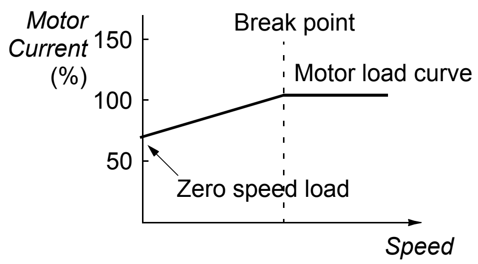
Motor temperature thermal model

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

1) The motor is at the estimated temperature (value of *01.37* 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 at the ambient temperature (30 °C).

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





Use of the motor thermistor

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

Settings

Parameters *30.04* to *30.09*.

Note: It is also possible to use the motor temperature measurement function. See sections *Motor temperature measurement through the standard I/O interface* on page *81* and *Motor temperature measurement through an analogue I/O extension* on page *83*.

Stall protection

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

The torque and current limits, which define the stall limit, must be set according to the maximum load of the used application.

Note: Stall limit is restricted by internal current limit TORQ_INV_CUR_LIM (*03.04* LIMIT WORD 1 bit 4).

When the application reaches the stall limit and the output frequency of the drive is below the stall frequency: Fault is activated after the stall time delay.

Settings

Parameters *30.10* to *30.12*.

Parameters *20.03*, *20.13* and *20.14* (Define the stall limit.)

Underload protection

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

Settings

Parameters *30.13* to *30.15*.

Motor phase loss

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

Settings

Parameter *30.16*.

Earth fault protection

The Earth fault protection detects earth faults in the motor or motor cable. The protection is based on sum current measurement.

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

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

Settings

Parameter *30.17*.

Communication fault

The Communication fault function supervises the communication between the drive and an external control device (for example, a fieldbus adapter module).

Settings

Parameters *30.18* to *30.21*.

Supervision of optional inputs/outputs

The function supervises the use of the optional analogue and digital inputs and outputs in the application program, and warns if the communication to the input/ output is not operational.

Settings

Parameter *30.22*.

Preprogrammed faults

Overcurrent

The Overcurrent trip limit is 3.5 * I_{hd} (nominal motor current for heavy duty use). There are several sources of the overcurrent trip:

- Software trip (time level 100 ms, level = 97% of measurement scale)
- Hardware level trip (97% of measurement scale for 35 ms)
- Hardware derivative trip (12.5% of measurement scale for 75 ms)
- Hardware level trip in parallel connected units by PBU logic (94% of measurement scale for 75 ms)

A fault "**OVERCURRENT**" is given during overcurrent condition.The current measurement is calibrated automatically during the start procedure.

DC overvoltage

The DC overvoltage trip limit is 1.3 * 1.35 * U_{1max}, where U_{1max} is the maximum value of the mains voltage range. For 400 V units, U_{1max} is 415 V. For 500 V units, U_{1max} is 500 V. For 690 V units, U_{1max} is 690 V.

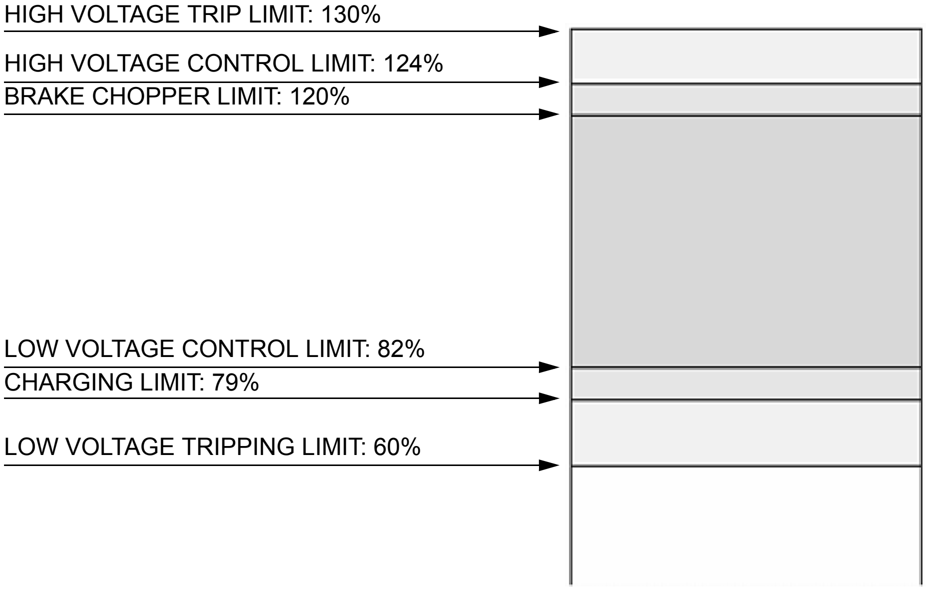
The actual voltage in the intermediate circuit corresponding to the mains voltage trip level is 728 V DC for 400 V units, 877 V DC for 500 V units, and 1210 V DC for 690 V units. See the following *Figure: DC voltage control and trip limits.*

DC undervoltage

The DC undervoltage trip limit is 0.6 *1.35 * U_{1min}, where U_{1min} is the minimum value of the mains voltage range. For 400 V and 500 V units, U_{1min} is 380 V. For 690 V units, U_{1min} is 525 V.

The actual voltage in the intermediate circuit corresponding to the mains voltage trip level is 307 V DC for 400 V and 500 V units, and 425 V DC for 690 V units. See the following *Figure: DC voltage control and trip limits.*

Figure: DC voltage control and trip limits.



According to the above figure, for a 400 V drive unit the voltage level at the intermediate circuit in the overload area should be 560 V DC corresponding to U_{1max} (415 V), while in the underload area it should be 513 V DC corresponding to U_{1min} (380 V).

- DC overvoltage trip limit will be 1.3 * 560 = 728 V DC
- DC undervoltage trip limit will be 0.6 * 513 = 307 V DC
- High voltage control limit will be 1.24 * 560 = 695 V DC
- Low voltage control limit will be 0.82 * 560 = 459 V DC
- Brake chopper limit will be 1.2 * 560 = 672 V DC
- Charging limit will be 0.79 * 560 = 442 V DC

Drive temperature

The drive supervises the inverter module temperature. There are two supervision limits: warning limit and fault trip limit. If the inverter module temperature exceeds 115 ^{o}C, the warning is generated, and if the temperature exceeds 125 ^{o}C, the fault is generated. Signal *01.10* can be used for monitoring the 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 mains cable connection status by detecting intermediate circuit ripple. If a phase is lost, the ripple increases. The drive is stopped and a fault indication is given if the ripple exceeds 13%.

Control board temperature

The drive supervises the control board temperature. A fault indication CTRL B TEMP is given, if the temperature exceeds 88 °C.

Overfrequency

If the drive output frequency exceeds the preset level, the drive is stopped and a fault indication is given. The preset level is 50 Hz over the operating range absolute maximum speed limit (the 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 drive hardware. For specific values, refer to the appropriate hardware manual.

Automatic resets

Automatic reset can created with the help of Adaptive Programming (AP), and connected to parameter *16.11* FAULT RESET PTR.

For more information, see *Adaptive Programming using the function blocks* on page *110*.

Parameter lock

You can prevent parameter adjustment by activating the parameter lock.

Settings

Parameters *16.02* and *16.03*.

Motor temperature measurement through the standard I/O interface

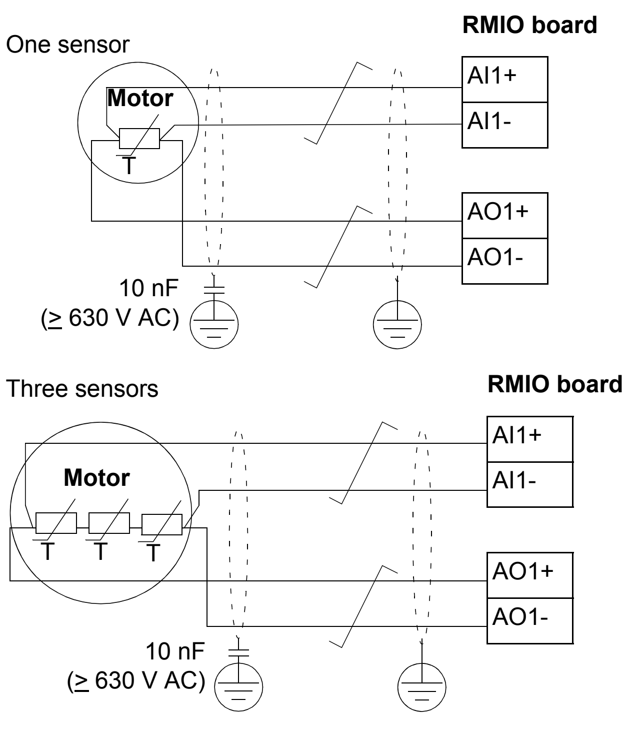
This section describes the temperature measurement of one motor when the RMIO drive control board is used as the connection interface.

WARNING! According to IEC 664, the connection of the motor temperature sensor to the RMIO board requires double or reinforced insulation between motor live parts and the sensor. Reinforced insulation entails a clearance and creepage distance of 8 mm (400 / 500 V AC 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.



The capacitor voltage rating must be 630 V AC at least.

See also section *Motor thermal protection* on page *75*.

Settings

Parameter	Additional information
15.01	Analogue output in a motor 1 temperature measurement. Set to M1 TEMP MEAS.
35.01…35.03	Settings of motor 1 temperature measurement
Other	
Parameters *13.01* to *13.05* (AI1 processing) and *15.02* to *15.05* (AO1 processing) are not effective.	
At the motor end, the cable shield should be earthed through a 10 nF capacitor. If this is not possible, the shield is to be left unconnected.	

Diagnostics

Actual signal	Additional information
01.35	Temperature value
Warnings	
MOTOR 1 TEMP	Measured motor temperature has exceeded the set alarm limit.
T MEAS ALM	Motor temperature measurement is out of acceptable range.
Faults	
MOTOR 1 TEMP	Measured motor temperature has exceeded the set fault limit.

Motor temperature measurement through an analogue I/O extension

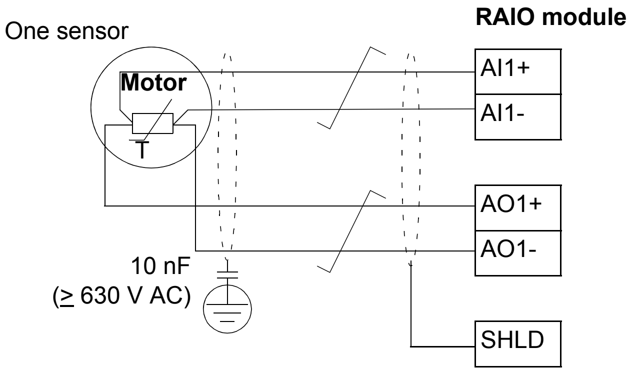
This section describes the motor temperature measurement of one motor when an optional analogue I/O extension module RAIO is used as the connection interface.

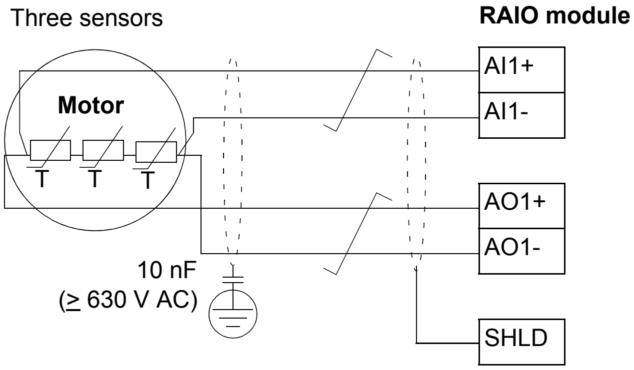
WARNING! According to IEC 664, the connection of the motor temperature sensor to the RAIO module requires double or reinforced insulation between motor live parts and the sensor. Reinforced insulation entails a clearance and creepage distance of 8 mm (400 / 500 V AC equipment). If the assembly does not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

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

Or

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





The capacitor voltage rating must be 630 V AC at least.

See also section *Motor thermal protection* on page 75.

Settings

Parameter	Additional information
35.01 … 35.03	Settings of motor 1 temperature measurement
98.12	Activation of optional analogue I/O for motor temperature measurement
Other	
Parameters *13.16* to *13.20* (AI1 processing) and *96.01* to *96.05* (AO1 signal selection and processing) are not effective.	
At the motor end, the cable shield should be earthed through a 10 nF capacitor. If this is not possible, the shield is to be left unconnected.	

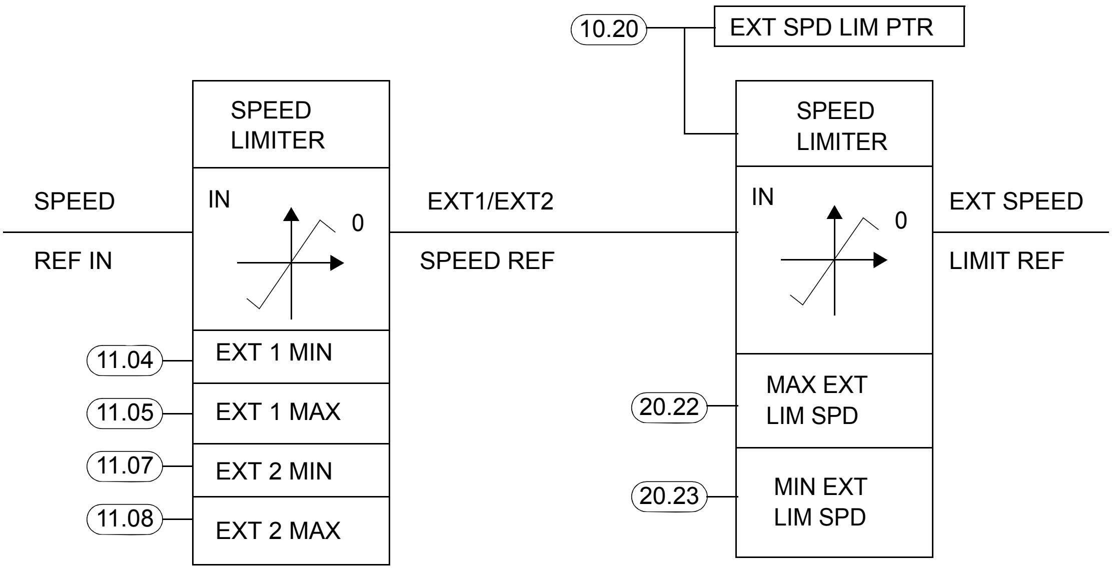
Diagnostics

Actual signal	Additional information
01.35	Temperature value
Warnings	
MOTOR 1 TEMP	Measured motor temperature has exceeded the set alarm limit
T MEAS ALM	Motor temperature measurement is out of acceptable range
Faults	
MOTOR 1 TEMP	Measured motor temperature has exceeded the set fault limit

External speed limitation

The External speed limitation function limits the speed reference to a predefined value when an external speed limit signal is activated. You can define the speed limits in parameters *20.22* MAX EXT LIM SPD and *20.23* MIN EXT LIM SPD, while the external speed limit signal has to be configured in parameter *10.20* EXT SPD LIM PTR. The speed limit signal is a pointer parameter, and hence, it can be configured to a DI, PLC DI using fieldbus communication or to any other signal bits.

When the speed limit signal is activated, the drive speed reference is limited to *20.22* MAX EXT LIM SPD if the motor is running in the forward direction or to *20.23* MIN EXT LIM SPD if the motor is running in the reverse direction. The limitation status can be monitored using bits *03.14 AUXILIARY STATUS WORD 4* bit 10 for maximum external speed limit and *03.14 AUXILIARY STATUS WORD 4* bit 11 for minimum external speed limit.



Settings

Parameter	Additional information
10.20	Configuring the external speed limit signal
20.22	Configuring the maximum external speed limit
20.23	Configuring the minimum external speed limit

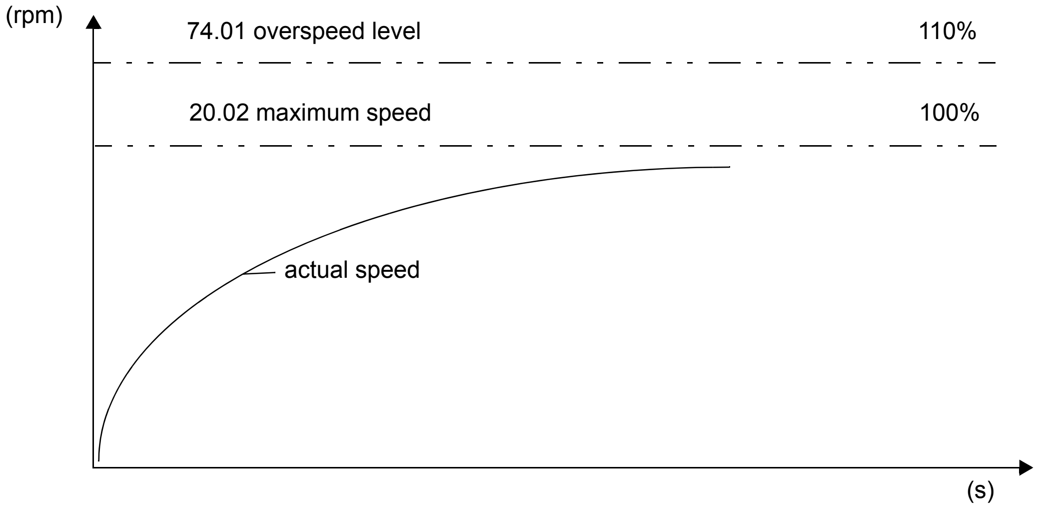
Diagnostics

Actual signal	Additional information
03.14 bit 10	Maximum speed limited with activation of external speed signal
03.14 bit 11	Minimum speed limited with activation of external speed signal

Speed monitor (internal overspeed protection)

The Speed monitor function is an internal overspeed protection function. It supervises the speed of the motor and trips the drive at motor overspeed. The function defines the motor overspeed level in percentage of the minimum (Par. *20.01*) or maximum speed (Par. *20.02*), as well as maximum external speed (Par. *20.22*) and minimum external speed (Par. *20.23*). The default value is 110%.

If the motor speed exceeds the limit defined with a parameter, the drive trips to a fault, the converter is switched off and the mechanical brake is controlled on.



Settings

Parameter	Additional information
74.01	Settings of motor overspeed level

Diagnostics

Actual signal	Additional information
03.33 bit 0	Motor over speed fault bit
Faults	
MOTOROVER SPD	Fault when the speed exceeds the allowed limit

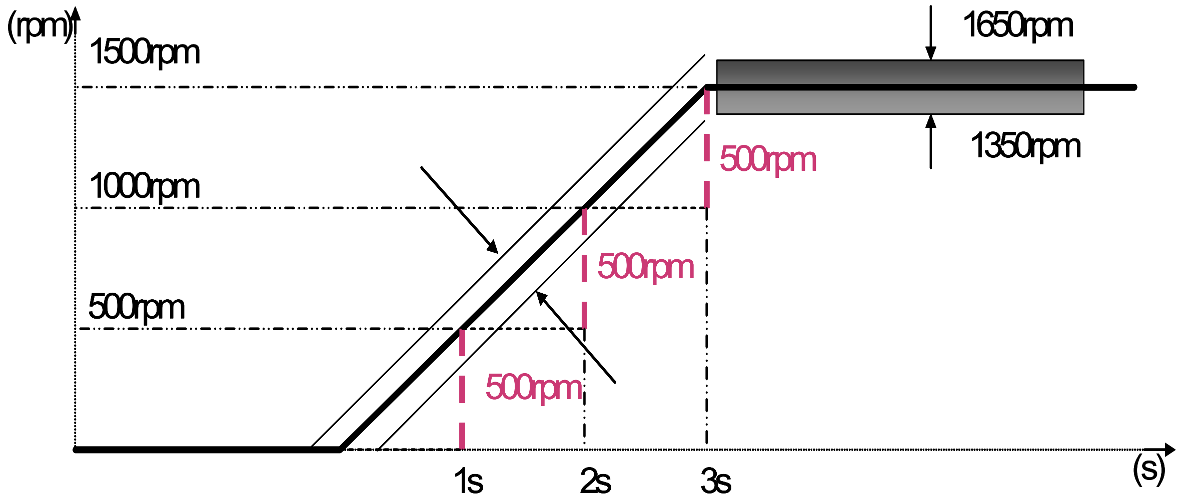
Speed matching (internal overload protection)

The Speed matching function is an internal overload protection function. It supervises the motor torque. The function checks that the motor follows the speed reference during acceleration and deceleration, and does not have an excessive speed error during acceleration, deceleration and when running at the constant speed.

There are two different parameters that can be used to define the speed matching deviation, one during acceleration/deceleration and the other during steady state. Parameter *75.02* SPD DEV LEV is used to check the deviation when the motor is running in the steady state or when the motor is not accelerating or decelerating. This is defined in terms of percentage of Par. *20.02* MAXIMUM SPEED.

Parameter *75.04* SPD CHG PER SEC, the rate of the actual speed change in % per second in terms of percentage of Par. *20.02* MAXIMUM SPEED, can be set so that the difference between the rate of change of the motor speed and the rate of change of the ramped speed reference is within this value during acceleration or deceleration. If the difference between the rate of change of the motor speed and the rate of change of the ramped speed reference is greater than the setting of Par. *75.04* for a period of Par. *75.03* SPD MATCH FLT TD, the drive trips on SPD MATCH FLT.

Example: Acceleration/deceleration ramp times are set to, for example, 3 seconds. The maximum speed is 1500 rpm. Therefore, the drive speed reference should ramp at 500 rpm/s or 33%/s. With SPD CHG PER SEC set to 2% / s (30 rpm/s), the drive does not trip on SPD MATCH FLT during acceleration/deceleration as long as the rate of change of the motor speed is within (31% to 35%). In the steady state, if the SPD DEV LEV is set to 10%, the drive will trip when the difference between the major speed and the ramped speed reference is greater than 150 rpm (10% of 1500 is 150 rpm). See the following figure. If the speed deviation is outside the window as shown in the figure, the drive will wait for the Par. *75.03* SPD MATCH FLT TD period and then trip on the SPD MATCH FLT fault.



The speed change must be within 31% (= 470 rpm/s) and 35% (= 530 rpm/s).

Settings

Parameter	Additional information
75.01	Activation of the function
75.02	Speed deviation limit
75.03	Delay for the fault trip
75.04	Speed change per second

Diagnostics

Actual signal	Additional information
03.33 bit 1	Speed match fault bit
Faults	
SPD MATCH FLT	Excessive speed error when running at set point or rate of change of actual speed is low

Torque proving (Crane system check)

Torque proving (Crane system check) consists of electrical and mechanical tests. Both functions are tested at the same time, and if the electrical test is accepted, the mechanical test is not continued. You can enable both functions with parameter *76.01* TORQ PROV SEL:

- electrical test with Torque proving (parameters *76.01* and *76.02* TORQ PROV FLT TD) to make sure that electrical components are healthy.
- mechanical test with brake slip (parameters *76.01*, *42.11* MOTOR SLIP SPD and *42.12* SLIP FAULT DELAY) to make sure that the motor brake is not slipping.

Torque proving ensures that the drive is able to produce torque before it releases the brake and starts the crane operation. The function is mainly intended for hoist drives, but it can also be used with drives that control other crane motions if they have the encoder feedback in use.

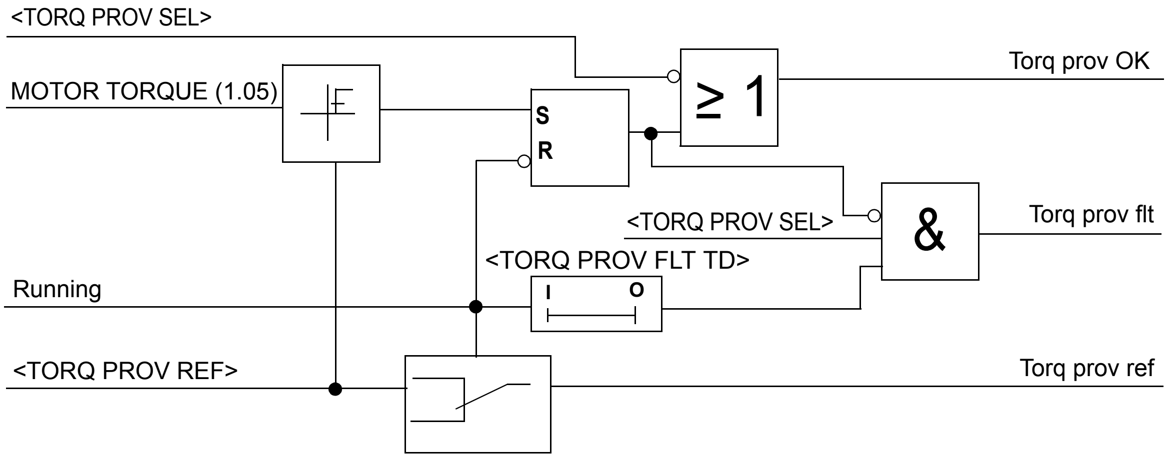
Torque proving gives a positive torque reference when the mechanical brake is still on. If the Torque proving is successful, in other words, the actual torque of the drive reaches the reference level, the drive allows the brake to open and initiates the next step in the starting sequence.

The time to execute the torque proving sequence is so short (executed in 20 ms cycle time) that the operator does not experience any time delay in the starting sequence. The maximum allowed time for the torque to be proved is set in parameter *76.02* TORQ PROV FLT TD. The drive waits for a time period of *76.02* for the torque to be proved. An unsuccessful torque proving will trip the drive on TORQ PROVE FLT.

The function operates as follows (see the block diagram below):

- Parameter *76.01* TORQ PROV SEL (= TRUE) activates the function.
- The output signal TORQ PROV OK is “0” until the Torque proving is performed.

- The torque proving sequence can start when the input signal RUNNING (B3 of actual signal *03.02*) is "1", in other words, when the converter is in operation. After a successful sequence, the output signal TORQ PROV OK changes to "1".
- If the function detects a fault during the sequence, it keeps the signal TORQ PROV OK in value "0", changes the signal TORQ PROVE FLT to "1" and trips the drive.
- Torque proving reference is fixed to 30% of the motor torque (signal TORQ PROV REF below).
- The torque proving reference is changed from 30 % to 10 % if the High-end limit (parameter *10.12* HIGHEND PTR) is true and the drive receives a new start signal given by the operator.
- The actual torque is read from the signal MOT TORQ (signal *01.05*).



Settings

Parameter	Additional information
76.01 ... *76.02*	Activates the monitoring
76.02	Fault delay time
Other	
Parameters *42.01* should be active.	

Diagnostics

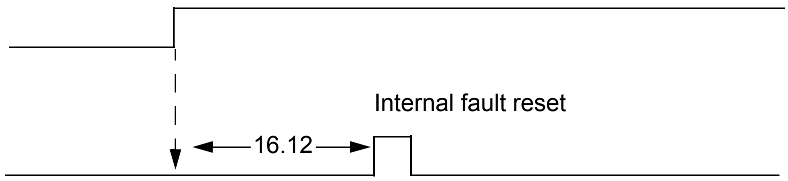
Actual signal	Additional information
03.33 bit 2	Torque prove fault bit
Faults	
TORQ PROVE FLT	Torque proving not successful

Power ON acknowledge and internal fault reset

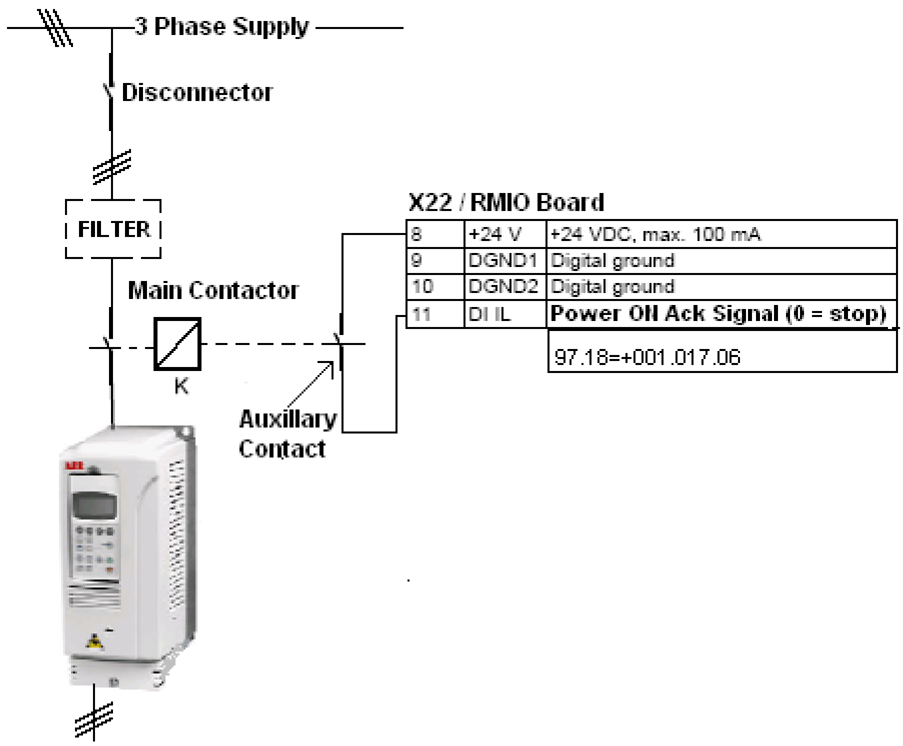
The Power ON Ack signal (usually from the main contactor auxiliary contact) is, by default, programmed to the DIL input on the RMIO board. For more information, see section *Programmable digital inputs* on page *62* and *Additional information for Digital Inputs and Pointers PTR* on page *63*.

If the Power ON Ack signal is not connected, the drive is not ready for start.

After the Power ON Ack signal is closed (digital input DIL is TRUE = 1), the drive generates one internal fault reset after the time defined with parameter *16.12* POWER ON RESET TD.



The wiring diagram for the Power ON acknowledge signal is shown below.



Settings

Parameters *16.12*, *97.18*.

Actual position configuration based on a motor encoder signal

Position

The Position function calculates the actual position of the hook. The Shaft synchro function uses the hook position when synchronising the Master and Follower drives. In addition, the position is used in anti-sway controlled trolley drives and long travel drives. The position is based on the encoder on the motor shaft. To enable the position calculation, you must define the factor that scales the encoder pulse to actual position units. See the following example.

The actual position value *02.21* POS ACT PPU is saved in the memory after the power is switched off/on in the RMIO board.

Example

If the hoist drive operates at 40 000 mm/min corresponding to the motor speed of 1500 rpm, and the encoder parameter *50.01* PULSE NR ppr is set to 2048, parameter *78.04* POS SCALE value equals to ((1500*2048) / 40 000) = 76.8 pulses/mm. The POS SCALE in pulses/mm can be calculated by multiplying the motor speed with the PPR and then dividing with the corresponding linear speed. The linear speed can be calculated using the equation shown in section *Calculating the linear rope speed* on page *103*. If the motor speed is 500 rpm, which corresponds to linear speed of 13333.33 mm/min, then the POS SCALE would be ((500 * 2048) / 13333.33) = 76.8 pulses/mm. The Shaft synchro function uses the actual position in the Master and Follower drives. That is why you should use the same measurement unit for the scaling factor in both drives, that is, mm.

If the parameters (gearbox ratio, diameter) used for calculating the linear speed are not available, the position scale can be calculated by the following procedure.

1. Set the encoder PPR in parameter *50.01* PULSE NR.
2. Monitor the shaft position signal *02.22* SHAFT POS, mark the rope with a marker and note the shaft position signal *02.22* SHAFT POS.
3. Start the drive and stop it after a few mm travel of the rope.
4. Check the shaft position signal *02.22* and the corresponding travel in mm.

Suppose the initial value in shaft position *02.22* was zero, after stopping it shows 2000, and this motion has resulted in the rope travel of 20 mm, then the position scale would be (2000 / 20) = 100 P/mm.

Note: The value range of actual position *02.21* POS ACT PPU is -8388608 to +8388608, but when the value is used in the fieldbus for data transfer, it is truncated to -32767 to +32767.

Settings

Parameter	Additional information
78.04	Settings of the position scale

Diagnostics

Actual signals	Additional information
02.21	Actual Position

Actual position reset

You can reset the actual position value (02.21 POS ACT PPU) by using the Homing sequence or manually through parameters.

Homing sequence

The Homing function is used to calibrate the actual position value 02.21 POS ACT PPU to a reference value. You have to do the homing sequence from the EXT1 control location. You have to configure parameter 10.21 HOMING SEL PTR to the homing activation input, homing acknowledgement signal in parameters 10.15 HOMING ACK SEL and 10.22 HOMING ACK PTR. When the homing signal is active and the drive is in EXT1, the message “HOMING ACTIVE” is displayed.

The homing reference has to be configured in parameter 11.14 HOMING REF. The sign of the homing reference is only considered when the Start command does not define the direction.

The Start command can be issued with the EXT1 start/stop control; you have to decide the direction according to the present position and the homing acknowledgement signal position 02.28. The homing sequence will be completed when the homing acknowledge signal gets activated and the drive stops automatically. The message “HOMING DONE” will be displayed when the homing is completed.

The actual position will be initialized to the position set in parameter 78.10 HOME POSITION. For initializing the position value via the fieldbus, see application control word *03.34 APPL CONTROL WORD* bit 1 on page 276.

Manual reset of actual position

Manual reset of actual position 02.21 POS ACT PPU (mm) without running the homing sequence:

- EXT1 mode selected (stand-alone)	
- Enable par 10.21 HOMING SEL PTR	+.000.000.00 -> C.1
- Enable par 10.15 HOMING ACK SEL	NOT SEL -> RESET

Actual position value 02.21 is defined with par 78.10 HOME POSITION (0 mm by default).

- Disable par 10.21 HOMING SEL PTR	C.1 -> +.000.000.00
- Disable par 10.15 HOMING ACK SEL	RESET -> NOT SEL

Settings

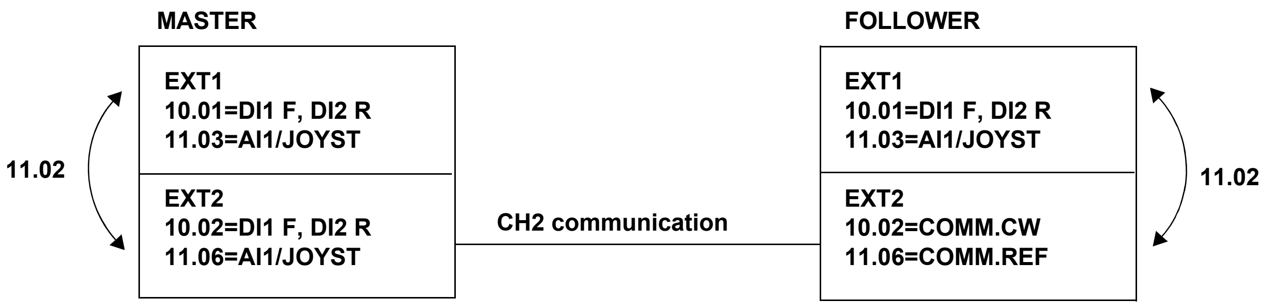
Parameter	Additional information
10.15	Homing acknowledge selection
10.21	Homing signal selection
10.22	Homing acknowledge signal selection
11.14	Homing reference to be used in homing sequence
78.10	Homing position value for initializing the actual position on completion of homing sequence.

Diagnostics

Actual signals	Additional information
02.21	Actual position in mm
Warnings	
HOMING ACTIVE	Homing sequence in progress
HOMING DONE	Homing sequence completed

Control location EXT1/EXT2 supervision mismatch

Before starting a Master/Follower Synchro control application, check that the Master and the Followers are in control location EXT2. If any of the Followers is in the EXT1 stand-alone mode, the Master indicates a CTRL LOC DIFF warning, and the start is prevented. For more information, see section *Master/Follower use of several drives (Only in EXT2 Control)* on page *94*. The control location selection *11.02* must be switched at the same time in the Master and the Followers.



Actual signal *03.36* M F STATUS WORD shows the different Master and Follower modes. For more information, see section *03.36 M F STATUS WORD* on page *276*.

Master/Follower use of several drives (Only in EXT2 Control)

In a Master/Follower application, the system is run by several drives, the motor shafts of which are coupled to each other. The Master and Follower drives communicate via a fibre optic link. For the Master/Follower configuration to work, the drive has to be in EXT2 control. If the Master/Follower configuration is used in EXT1, the drive works as a stand-alone drive.

The Master drive communicates with the Follower drive through channel 2. The channel 2 addresses are set internally in the Follower drives. The fault, torque prove OK, safety control bits and the drive ready bits of the Follower drives are used for the interlock in the Master drive. These interlocks work only when the drive is in EXT2 control. In EXT1 control none of these interlocks are checked and the drive works like a stand-alone drive. The Follower drive uses the data set 44 for transmitting the interlock status word. The Master also sends the interlock bits to the slave using data set 43. The Master monitors if any of the Follower drives goes into the fault or limit state and the FLWRx LIM/FLT message (where x is the Follower drive number) is displayed in such condition. The detailed description of the fault or limit will be available in the Follower drive.

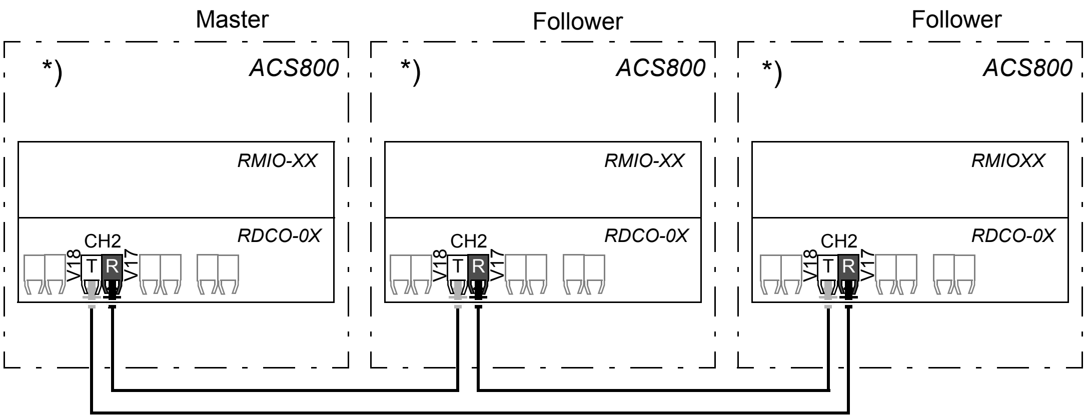
Note: Even though the Master/Follower interlock functions are checked only in EXT2 control, the Master/Follower communication link should be active in both EXT1 and EXT2 control. Otherwise the drives will trip on Communication fault.

The user defines the number of Follower drives in the Master drive. One Master drive can have a maximum of four Follower drives. Note that you must configure the Follower drives in a sequential order. In other words, if the configuration includes one Follower drive, it is configured as Follower 1, not as Follower 2, Follower 3, or Follower 4. Similarly, if the configuration includes two Follower drives, the correct configuration is Follower 1 and Follower 2, not Follower 2 and Follower 3, or any other combination. A follower drive is configured as Follower 4 only when the configuration includes four Follower drives.

The following figure illustrates data transmission in a Master/Follower application.

Note: Only the ring topology is supported.

T = Transmitter; R = Receiver; RMIO = I/O and Control Board
Please note that channels CH0/CH2/CH3 are located on the optional RDCO-0x board.



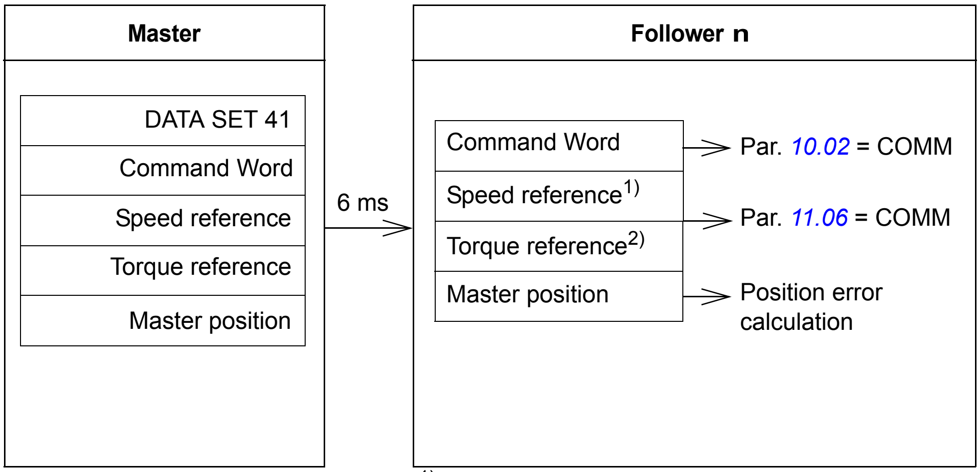
*) External 24 V to the RMIO board, support fast start-up and avoid communication error between drives.

For more information on the requirements for a redundant crane control application between Master, Followers and spare units, see section *Redundancy in Master/ Follower crane control* on page *304*.

Data set 41 is used for transmission of data from Master to Follower as follows. Data set 41 is updated on 6 ms.

- If the Master is in EXT2 and parameter *60.11* SLAVE MODE is TORQUE, then signal *03.11* FOLLOWER MCW is transferred using data set word 41.1. Signal *02.02* SPEED REF 3 is transferred using data set word 41.2 and signal *02.13* TORQ USED REF is transferred using data set word 41.3
- If the Master is in EXT2 and parameter *60.11* SLAVE MODE is SPEED and parameter *78.01* SYNCHRO CONTROL is ON, then signal *03.37* FLW CMD WITH POS is transferred using data set word 41.1. Signal *03.38* POSITION REM is transferred using data set word 41.2 and signal *02.02* SPEED REF 3 is transferred using data set word 41.3.
- If the Master is in EXT2 and parameter *60.11* SLAVE MODE is SPEED and parameter *78.01* SYNCHRO CONTROL is OFF, then signal *03.11* FOLLOWER MCW is transferred using data set word 41.1. Signal *02.02* SPEED REF 3 is transferred using data set word 41.2 and signal *02.02* SPEED REF 3 is transferred using data set word 41.3.

The figure below illustrates the data transmission from Master to Follower on channel 2 communication.



1) If Speed mode / Shaft synchro = Separate drums

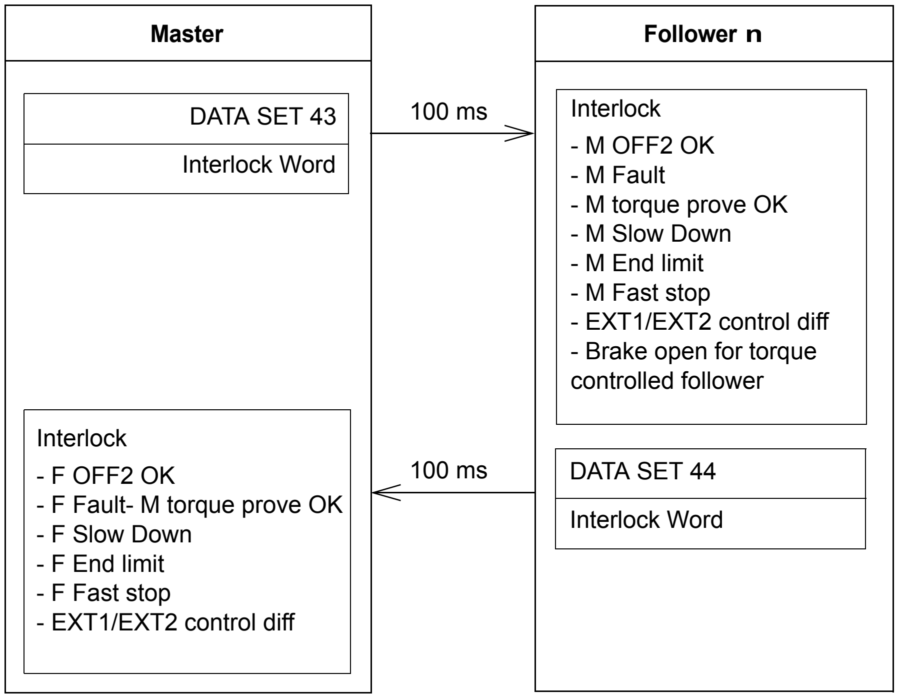
2) If Torque mode / Load sharing = Common load

Master/Follower interlock words

Data set 43 is used for transmission of Master Interlock Word from Master drive to Follower drive. Data set 43 is updated on 100 ms.

Data set word 44.1 is used for transmission of Follower Interlock Word from Follower drive to Master drive. Data set word 44.2 is used for transmission of sync pos error from Follower drive to Master drive. Data set 44 is updated on 100 ms.

The figure below illustrates the transmission of Master and Follower interlock words in both directions.



Speed reference scaling between the Master and the Follower

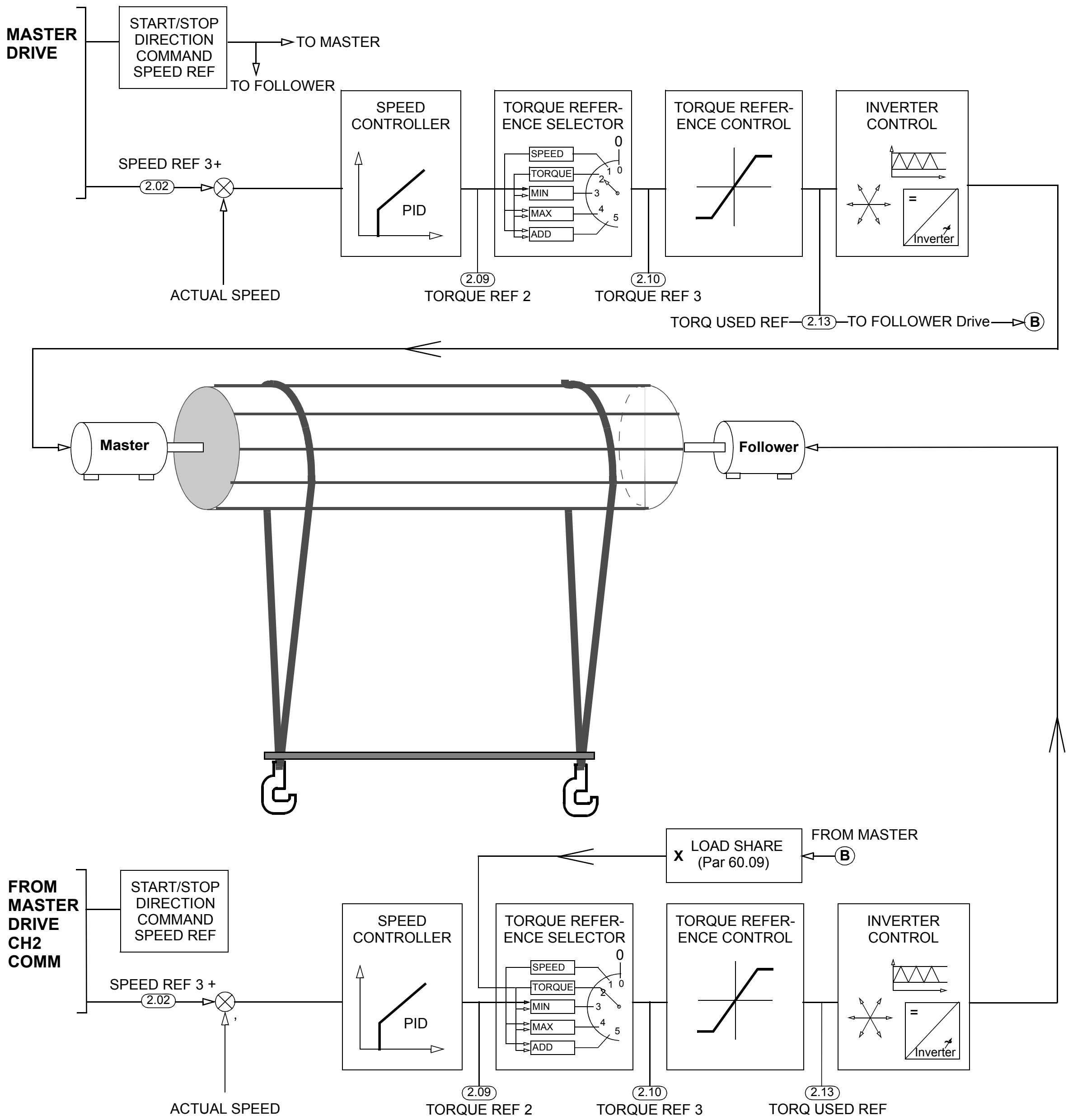
When a Master/Follower and Synchro control application is used, the Follower usually needs to have a speed buffer for correcting the position error between the Master and the Follower. The Follower speed buffer needs to have +5 or +10% higher speed limit settings than the Master.

Example: The Follower’s speed buffer is 200 rpm more than the Master’s.

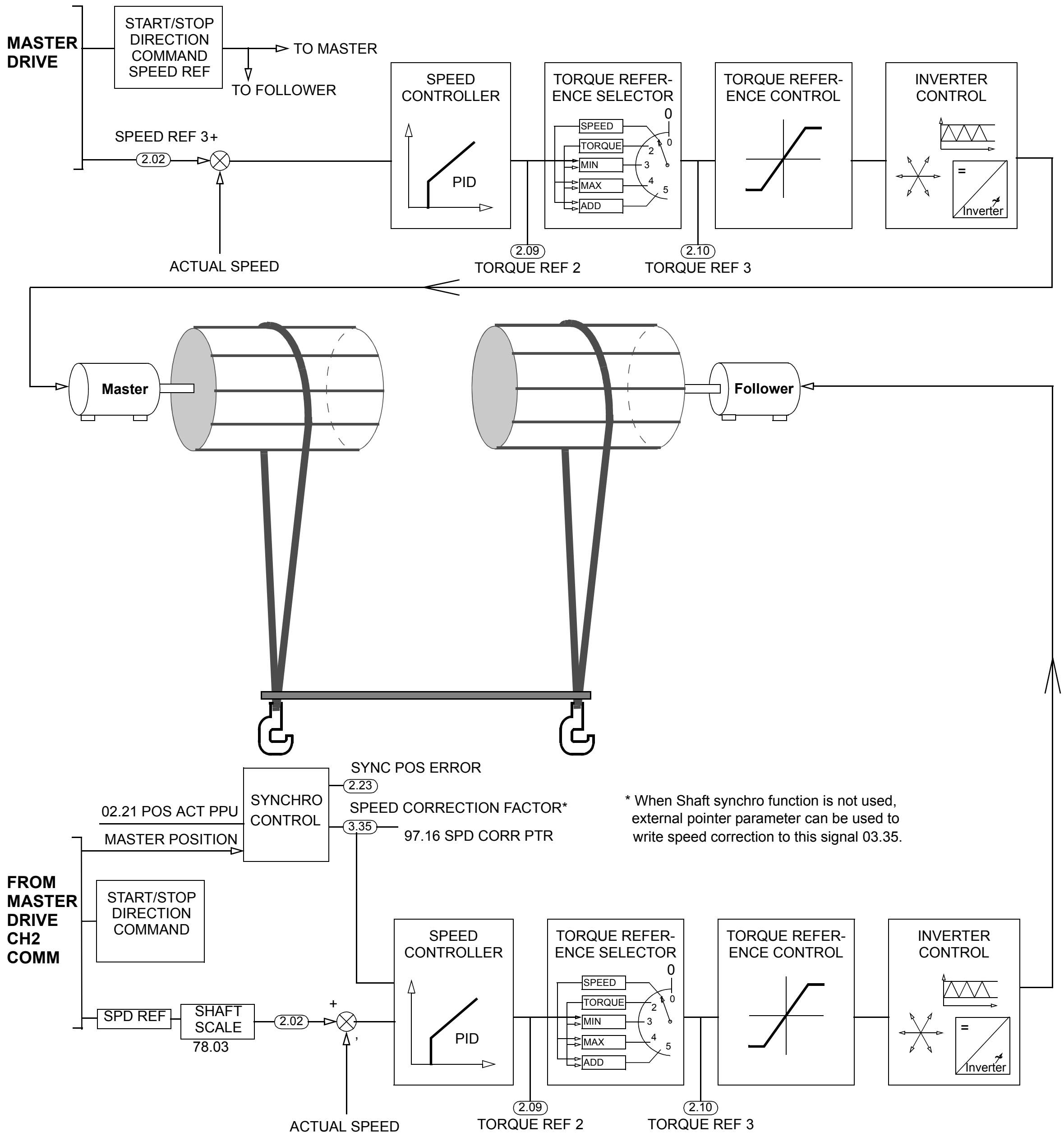
Master using AI1/Joystick in EXT2	Follower using COMM REF in EXT2
Master minimum and maximum limit speed = 1700 rpm	Follower minimum and maximum limit speed = 1700 rpm
Master sends out -20000 & +20000 on COMM REF	Follower receives -20000 & +20000 on COMM REF
Master parameter *13.03* SCALE AI1 = 88% (1500 rpm/1700 rpm = 88%)	
Master using 88% of limit speed 1700 rpm as maximum reference	Follower receives 1500 rpm and has a speed buffer of 200 rpm

The following figures illustrate two basic application types.

Master and Follower with a common drum and separate motors (Load Sharing)



Master and Follower with separate drums and separate motors (Shaft synchro)



Settings and Diagnostics

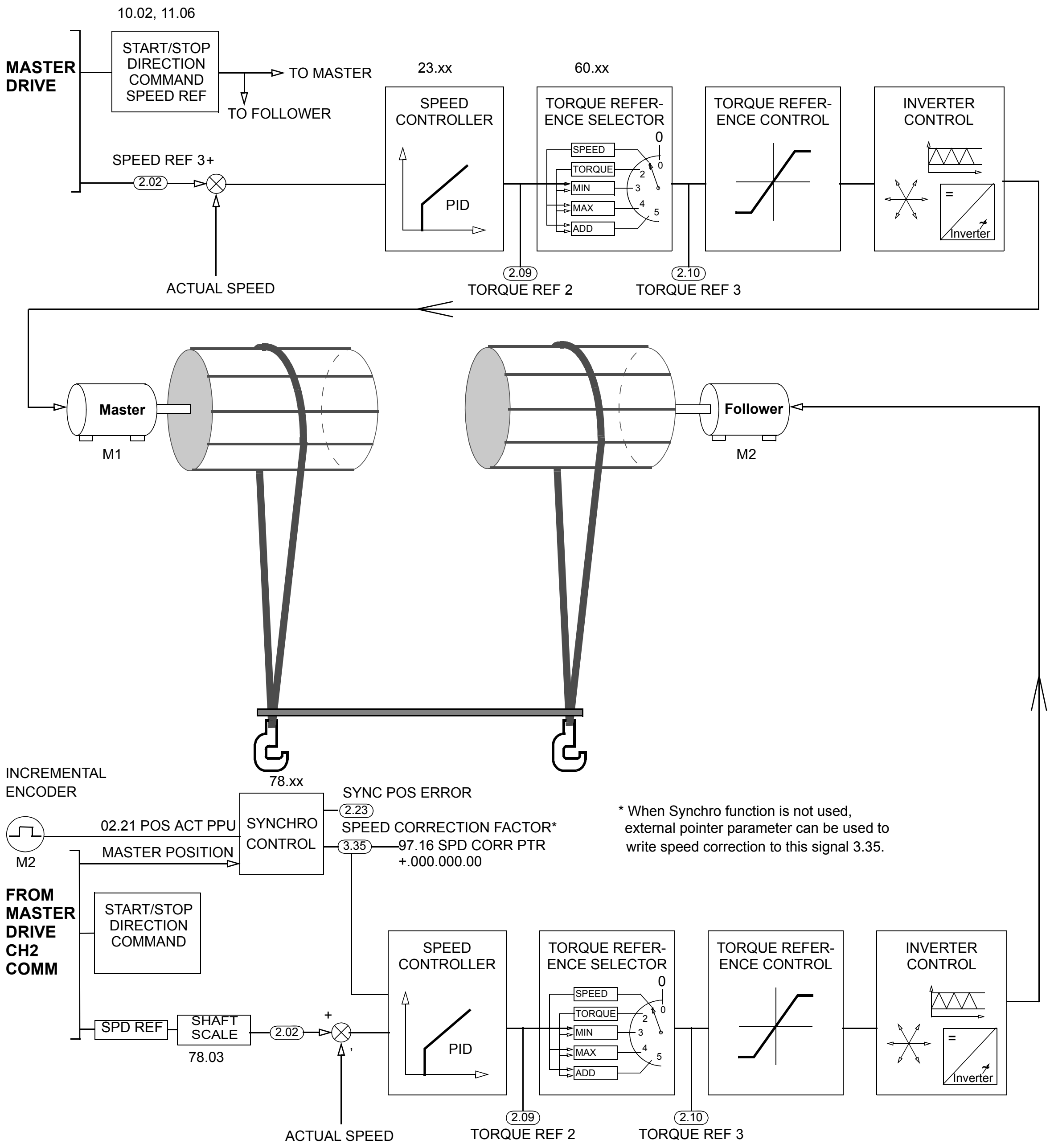
Parameter	Additional information
Group *60 MASTER/ FOLLOWER*	Master/Follower parameters

Shaft synchro (Only in EXT2 Control)

The Shaft synchro function synchronises the Master and Follower drives when the drives are in the Master/Follower mode (see section *Master/Follower use of several drives (Only in EXT2 Control)* on page *94*). However, the synchronisation is in use only when the drives are set to the speed mode. The function transfers the Master drive position to the Follower and uses the difference between the positions as the speed correction factor in the speed control loop of the Follower drive.

Note: The function can only be used if the drive is controlled from location EXT2.

The following figure gives an example of two motors in the Shaft synchro mode.



The Master position will be transferred at 6 ms intervals using data sets 41.1 and 41.2. Both data sets are required since the data set words are of integer type which limits the position value to -32767 mm to 32767 mm. Hence, for a wider position, range some of the unused bits in the Follower Control Word (signal *03.11*) are combined together and used as the multiplying factor for position value in terms of 32767. Six bits of the Follower Control Word are used for generating the multiplying factor. With these six bits (one bit for sign), we can have a maximum possible range of position value from -1048544 mm to 1048544 mm. The Follower Control Word (signal *03.11*) is modified to include the position multiplying bits, and a new Follower Control Word (signal *03.37*) is used for transmission from the Master to the Follower drives in the Shaft synchro mode. The position remainder (signal *03.38*) is transferred using data set 41.2.

The Master transmits the new Follower Control Word (signal *03.37*) which consists of the new Follower Control Word and the position multiplying bits using data set 41.1 when the Synchro control is enabled with Par. *78.01*. When Synchro control is OFF in the Master or Master is in EXT1, the Follower Control Word (signal *03.11*) is transmitted using data set 41.1. Similarly, when Synchro control is ON in the Master and the drive is in EXT2, the Master position remainder value is sent using data set 41.2; when Synchro control is OFF or the drive is in EXT1, the Speed reference (signal *02.02*) is sent to the Follower.

The parameter *78.01* SYNCRO CONTROL activates the execution of the Shaft synchro function in the Master and Follower drives. The position error is calculated in all the Follower drives only when the Synchro control is ON. Therefore, the speed correction according to the position error in the respective Follower drives does not happen when Synchro control is OFF. Parameters *10.14* SYNC SEL and the signal *02.23* SYNC POS ERROR are not updated in the Follower drives if the Synchro control is OFF. SYNC FAULT will not be generated if Synchro control is OFF. However, actual position value *02.21* will be available even when the Synchro control is OFF.

To configure the Shaft synchro function, do the following:

- enable the use of the function with parameter *10.14* SYNC SEL in both Master and Follower drives. Define the basic data for speed correction in the Follower drive.
- calculate the linear rope speed.
- define the basic data for speed reference calculation in the Follower drive.

Defining the basic data for speed correction

Example: If parameter *78.02* SYNCRO GAIN is set to 0.1, the speed correction in the Follower drive is (0.1 × *78.08* SYNC CORR SCALE) rpm if the position error between the Master and Follower drive is 1 unit.

Calculating the linear rope speed

The linear rope speed can be calculated as follows.

$$\text{Linear speed} = \frac{\text{Pi * Diameter of the rope drum (mm) * Motor speed (rpm)}}{\text{Gear ratio}}$$

Example:

If the diameter of rope drum = 1000 mm

Gear ratio = 2.5

Motor rotating at 500 rpm

Then the linear speed = (3.1416 * 1000 * 500) / 2.5 = 628320 mm/min

Defining the basic data for speed reference calculation

Parameter *78.03* SHAFT SCALE defines the position correction factor used in the speed reference calculation in the Follower drive.

Example: If the Master drive full speed corresponds to a rope speed of 40 000 mm/min, and the Follower drive full speed corresponds to 30 000 mm/min, parameter *78.03* SHAFT SCALE should be set to value 40 000/30 000 = 1.333. The Follower multiplies this factor with the speed reference of the Master drive. (Note that there may be a difference in the gear ratio, which also needs to be considered.)

Parameters *78.05* POS CORR MAX LIMIT and *78.06* POS CORR MIN LIMIT are used for limiting the speed correction in terms of mm. If the error exceeds or falls below these parameters (respectively), the speed correction in terms of mm will be limited to these parameter values.

When the absolute error is greater than the value defined in *78.09* SYNC ERR LIM for a period longer than *78.07* SYNC ERR FLT DLY, the drive will trip on SYNC FAULT.

Signal *02.23* SYNC POS ERROR displays the position error of the drive in mm if the drive is a Follower. Signals *02.24* SYNC POS ERROR 1, *02.25* SYNC POS ERROR 2, *02.26* SYNC POS ERROR 3 and *02.27* SYNC POS ERROR 4 are the respective Follower 1, Follower 2, Follower 3 and Follower 4 position errors in mm that are displayed in the Master drive.

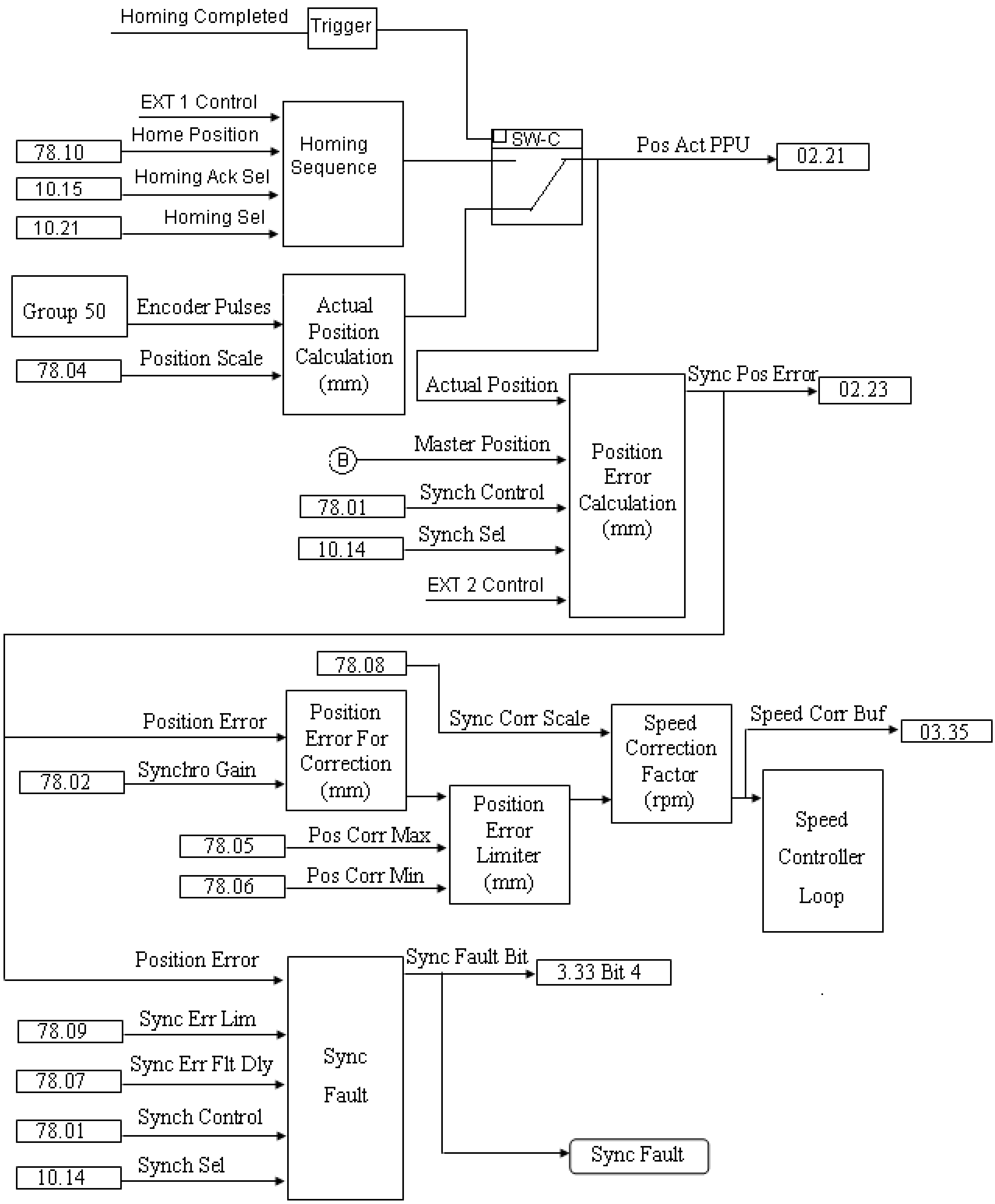
The position can be moved to a predefined value using the *Homing sequence*. An initial position value in mm can be entered in Par. *78.10* HOME POSITION to initialize the actual position to the predefined value. The actual position is initialized in the respective drives on completion of the homing sequence. Homing is possible from EXT1 control location only. Therefore, after the homing sequence is done, the control should be moved to EXT2 and a Synchro command given using Par. *10.14*. Before the Synchro command is given, parameter *78.12* SYNC CORR MODE has to be selected.

If an offset of position is required in the Follower, set parameter *78.12* to OFFSET and activate the Synchro command in the Follower when it is at the required position. The difference in the position between the Master and the Follower when the Synchro command is activated is taken as a constant offset in this case.

If an offset is not required in the Follower, set parameter *78.12* to DIRECT and activate the Synchro command in the Follower. The difference in the position between the Master and Follower when the Synchro command is activated is taken as the position error in this case. The position error will be calculated with the new position value with respect to the actual Master position.

Example: Actual position value *02.21* is initialized with 1000 mm after a homing sequence, and the drive is then moved to EXT2 control for synchronisation. Consider the Master actual position received by Follower drive as 5000 mm. After a Synchro command is given with parameter *78.12* SYNC CORR MODE as DIRECT, the *02.23* SYNC POS ERROR will be (5000 … 1000) 4000 mm. If a Synchro command is given with parameter *78.12* SYNC CORR MODE as OFFSET, the *02.23* SYNC POS ERR will be 0 mm, and the difference (5000 … 1000) 4000 mm will be considered a permanent offset.

Figure: Control diagram for Shaft synchronisation executed in 20 ms



Settings

Parameter	Additional information
Group 60	Settings for the Master/Follower application. To be adjusted in the Master and Follower drives.
78.01, *78.03*	Activation of the Shaft synchro function. To be adjusted in the Master and Follower drives.
78.01, *78.02*, *78.03*, *78.04*, *78.05*, *78.06*, *78.07*, *78.08*	Settings of the Shaft synchro function. To be adjusted in the Follower drive.
78.09 *78.10*	Settings of the Synchro error limit. To be adjusted in the Follower drives. Setting and selection of home position value in case of a homing sequence.
10.14 *10.15*	Enables the Shaft synchro function. To be adjusted in the Master and Follower drives. Settings for resetting of actual position

Diagnostics

Actual signals	Additional information
02.21, *02.22*	Actual Position value and Shaft Position value.
02.23, *02.24*, *02.25*, *02.26*, *02.27*	Actual Shaft Position error values.
03.32 bit 7 *03.33* bit 4	Synchronisation enabled Synchro Fault
Faults	
SYNC FAULT	Synchro fault generated in Follower because of position error greater than the Synchro error limit

Example:

The following example shows the parameter configuration for a Master/Follower Synchro control application.

Master in speed mode

EXT1 = stand-alone mode

EXT2 = MF + synchro

10.01: EXT1 STRT/STP/DIR	DI1 F, DI2 R
10.02: EXT2 STRT/STP/DIR	DI1 F, DI2 R
10.03: REF DIRECTION	REQUEST
10.14: SYNC SEL	PAR 10.17
10.17: SYNC PTR	+.001.017.03
11.02: EXT1/EXT2 SELECT	PARAM 11.09
11.03: EXT REF1 SELECT	AI1/JOYST
11.04: EXT REF1 MINIMUM [rpm]	0
11.05: EXT REF1 MAXIMUM [rpm]	1500
11.06: EXT REF2 SELECT	AI1/JOYST
11.07: EXT REF2 MINIMUM [%]	0
11.08: EXT REF2 MAXIMUM [%]	100
11.09: EXT 1/2 SEL PTR	+.001.017.03
50.01: PULSE NR	1024
50.02: SPEED MEAS MODE	A _-_B _-_
50.03: ENCODER FAULT	FAULT
50.04: ENCODER DELAY [ms]	1000
50.05: ENCODER DDCS CH	CH 1
50.06: SPEED FB SEL	ENCODER
50.07: ENC CABLE CHECK	DISABLED
60.01: MASTER LINK MODE	MASTER
60.02: TORQUE SELECTOR	SPEED
60.03: WINDOW SEL ON	NO
60.04: WINDOW WIDTH POS [rpm]	0.0
60.05: WINDOW WIDTH NEG [rpm]	0.0
60.06: DROOP RATE [%]	0.0
60.07: MASTER SIGNAL 2	338
60.08: MASTER SIGNAL 3	202
60.09: LOAD SHARE [%]	<Read-protected>
60.10: NO OF SLAVES	1
60.11: SLAVE MODE	SPEED
78.01: SYNCRO CONTROL	ON
78.02: SYNCRO GAIN	1.00
78.03: SHAFT SCALE	1.00
78.04: POS SCALE [P/mm]	100.0
78.05: POS CORR MAX LIM [mm]	10.00
78.06: POS CORR MIN LIM [mm]	-10.00
78.07: SYNC ERR FLT DLY [s]	2.0
78.08: SYNC CORR SCALE [rpm]	1.0
78.09: SYNC ERR LIM [mm]	10.0
78.10: HOME POSITION [mm]	0.0
78.12: SYNC CORR MODE	OFFSET
78.13: POS HYSTERISIS [mm]	5.0

01.13: CTRL LOCATION	EXT2
01.17: DIL DI6-1 STATUS	0000 0000 0000 0000 0100 1110 b
02.18: SPEED MEASURED [rpm]	-691.25
02.21: POS ACT PPU [mm]	7078.6
02.24: SYNC POS ERROR 1 [mm]	-1.0
03.36: M F STATUS WORD	0000 0000 0000 0000 0000 0100 b

Follower in speed/synchro mode

EXT1 = stand-alone mode

EXT2 = MF + synchro

10.01: EXT1 STRT/STP/DIR	DI1 F, DI2 R
10.02: EXT2 STRT/STP/DIR	COMM.CW
10.03: REF DIRECTION	REQUEST
10.14: SYNC SEL	PAR 10.17
10.17: SYNC PTR	+.001.017.03
11.02: EXT1/EXT2 SELECT	PARAM 11.09
11.03: EXT REF1 SELECT	AI1/JOYST
11.04: EXT REF1 MINIMUM [rpm]	0
11.05: EXT REF1 MAXIMUM [rpm]	1500
11.06: EXT REF2 SELECT	COMM. REF
11.07: EXT REF2 MINIMUM [%]	0
11.08: EXT REF2 MAXIMUM [%]	100
11.09: EXT 1/2 SEL PTR	+.001.017.03
50.01: PULSE NR	1024
50.02: SPEED MEAS MODE	A _-_B _-_
50.03: ENCODER FAULT	FAULT
50.04: ENCODER DELAY [ms]	1000
50.05: ENCODER DDCS CH	CH 1
50.06: SPEED FB SEL	ENCODER
50.07: ENC CABLE CHECK	DISABLED
60.01: MASTER LINK MODE	FOLLOWER 1
60.02: TORQUE SELECTOR	SPEED
60.03: WINDOW SEL ON	NO
60.04: WINDOW WIDTH POS [rpm]	0.0
60.05: WINDOW WIDTH NEG [rpm]	0.0
60.06: DROOP RATE [%]	0.0
60.07: MASTER SIGNAL 2	202
60.08: MASTER SIGNAL 3	213
60.09: LOAD SHARE [%]	100.00
60.10: NO OF SLAVES	<Read-protected>
60.11: SLAVE MODE	SPEED
78.01: SYNCRO CONTROL	ON
78.02: SYNCRO GAIN	1.00
78.03: SHAFT SCALE	1.00
78.04: POS SCALE [P/mm]	100.0
78.05: POS CORR MAX LIM [mm]	50.00
78.06: POS CORR MIN LIM [mm]	-50.00
78.07: SYNC ERR FLT DLY [s]	2.0
78.08: SYNC CORR SCALE [rpm]	1.0
78.09: SYNC ERR LIM [mm]	50.0
78.10: HOME POSITION [mm]	0.0
78.12: SYNC CORR MODE	OFFSET
78.13: POS HYSTERISIS [mm]	5.0

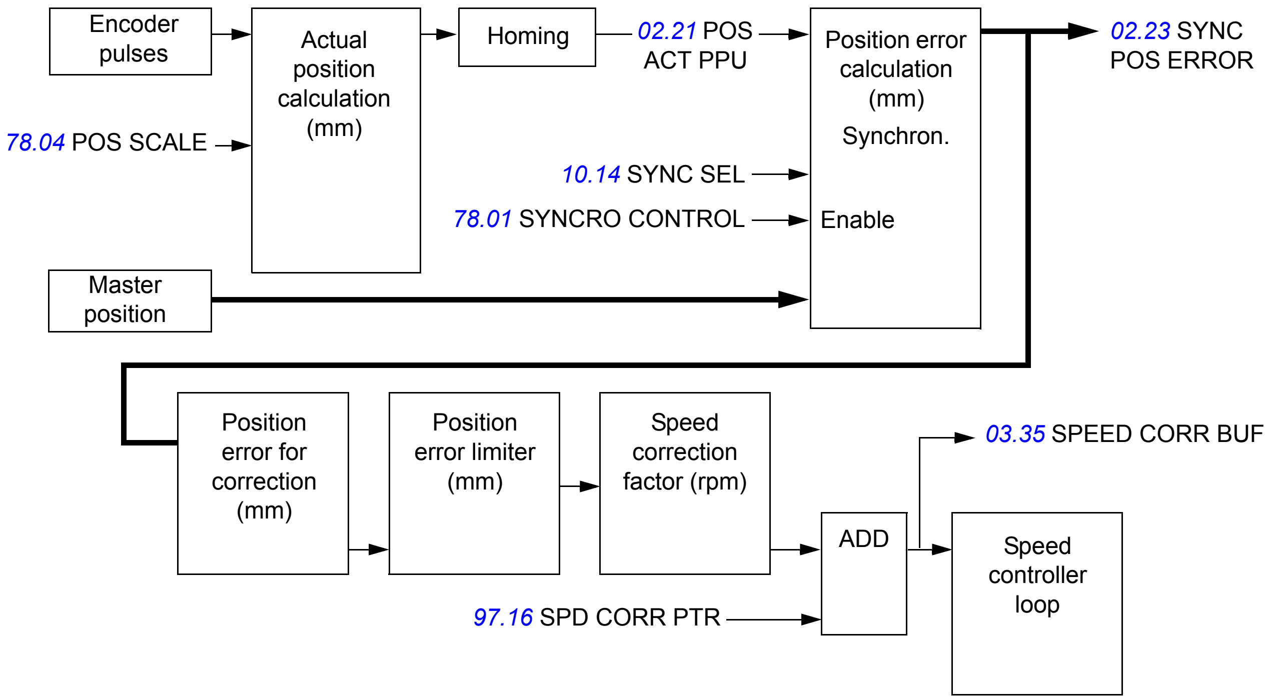
01.13: CTRL LOCATION	EXT2
01.17: DIL DI6-1 STATUS	0000 0000 0000 0000 0100 1100 b
02.18: SPEED MEASURED [rpm]	-691.80
02.21: POS ACT PPU [mm]	10509.3
02.23: SYNC POS ERROR [mm]	-0.5
03.35: SPEED CORR BUF [rpm]	-0.5
03.36: M F STATUS WORD	0000 0000 0000 0000 0001 1000 b

External speed correction

When the Synchro function is not used, you can use External speed correction. Parameter *97.16* SPD CORR PTR defines the correction by writing it to signal *03.35* SPEED CORR BUFF. This speed correction bypasses internal ramps. The speed correction value is added to the speed controller.

Example: To make an external device control the follower speed reference, for example, through analogue input AI3, connect it to be the source for the reference: *97.16* SPD CORR PTR = 09.03.00 (*09.03* AI3 SCALED).

The figure below illustrates the operation of the function.

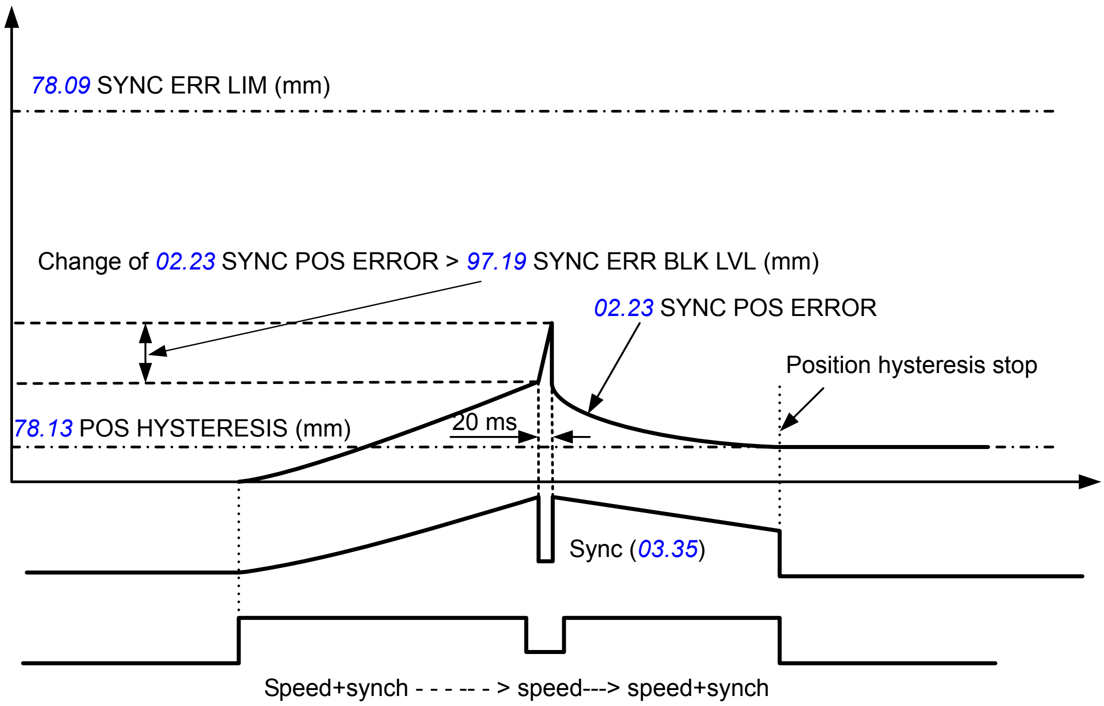


Settings

Parameter *97.16*

Synchro error blocking

For special cases (for example, external disturbances), it is possible to block speed correction signal *03.35* SPEED CORR BUFF with parameter *97.19* SYNC ERR BLK LVL. If the change in *02.23* SYNC POS ERROR is bigger than the value of *97.19* SYNC ERR BLK LVL, signal *03.35* SPEED CORR BUFF is blocked and no synchronisation correction is performed during that period (in the following example figure 20 ms).



Settings

Parameter *97.19*.

Service counter

The Service counter function supervises the 01.43 CRANE OPT TIME and the 02.28 BRAKE OPT COUNTS. The two signals can be monitored for the calculation of the overall crane operation time and the brake open counts. The brake open counts can be reset using the parameter 79.01 BRAKE CTR RESET and the crane operation time can be reset using the parameter 79.02 RESET OPT TIME.

Settings

Parameter	Additional information
79.01	Reset brake operation counts
79.02	Reset crane operation time

Diagnostics

Actual signals	Additional information
01.43	Crane operation time
02.28	Number of brake open counts

Adaptive Programming using the function blocks

Conventionally, you can control the operation of the drive with parameters. Each parameter has a fixed set of choices or a setting range. The parameters make the programming easy, but the choices are limited. You cannot customise the operation any further. The Adaptive Program (AP) makes free customising possible without the need of a special programming tool or language:

- The program is built of standard function blocks included in the drive application program.
- The control panel is the programming tool.
- You 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 the *Application Guide for Adaptive Program* (3AFE64527274 [English]).

For examples of Adaptive Programming (AP) and creating AP files for new features, see *Adaptive Programming examples for crane control* on page 297.

Note: If you use and/or change the AP blocks used in the Crane control program made by ABB, you are responsible for the software and the application.

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 with PC.

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

Examples of crane functionalities created with DriveAP

Main contactor control logic

Using Adaptive Programming (AP), you can create a main contactor control logic for the 3-phase power supply of the ACS800 drive. With the help of the main contactor control logic, the power supply of the drive is disabled when the crane is not used (the standby energy-efficiency mode).

For an example how to create the AP file, see *Main contactor control logic* on page *297*.

Brake match

Brake match detects mechanical brake slips and downward movement of the load when Mechanical brake control is in use, the operator has given the stop command and the target is to close the brake. The slip detection is based on the motor encoder position signal, and the function works only if an encoder is used. You can use the function for an automatic restart of the crane or just for a warning (alarm) indication.

For an example how to create the AP file, see section *Brake match* on page *301*.

Redundancy in Master/Follower crane control

In the Master/Follower crane control, redundancy is implemented using a spare drive unit that is ready to be used as a Master or a Follower. The spare unit usually replaces the faulty Master or one of the Followers.

Adaptive Programming provides the ability to switch between the Master, Follower or standby (spare unit) mode. This means that the Master and Follower are no longer fixed, but can be changed when needed.

Using the Adaptive Programming (AP), you can create a redundancy control logic. For an example how to create the AP file, see *Redundancy in Master/Follower crane control* on page *304*.

Scaling actual encoder position signal (mm) to analogue output as mA

The actual encoder position signal *02.21* POS ACT PPU (mm) can be scaled to 4 … 20 mA for analogue outputs and sent to other systems as an mA signal, for example, for supervision or protection purposes.

Using Adaptive Programming (AP), you can create an AP file for scaling the actual encoder position signal for an analogue output. For an example how to create the AP file, see *Scaling actual encoder position signal (mm) to analogue output as mA* on page *310*.

Slack rope torque detection

Using Adaptive Programming (AP), you can create a function for detecting slackness of the ropes on the drum. The detection is based on monitoring the motor torque. For more information, see *Slack rope torque detection* on page *311*.

Conical rotor motors

Using Adaptive Programming (AP), you can create a file for handling brake control of conical rotor motors that do not have an external brake. With the help of Adaptive Programming, the conical rotor motors can be used together with the Crane control program. For more information, see *Conical rotor motors* on page *313*.

Control of a mechanical brake

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

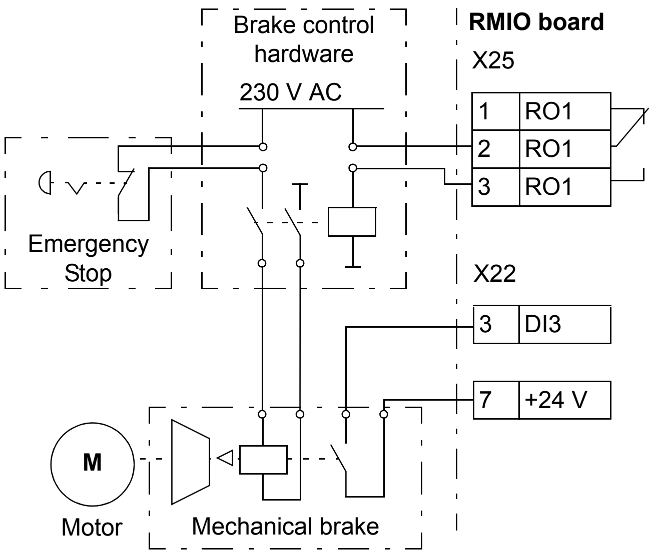
Example

The figure below shows a brake control application example.

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

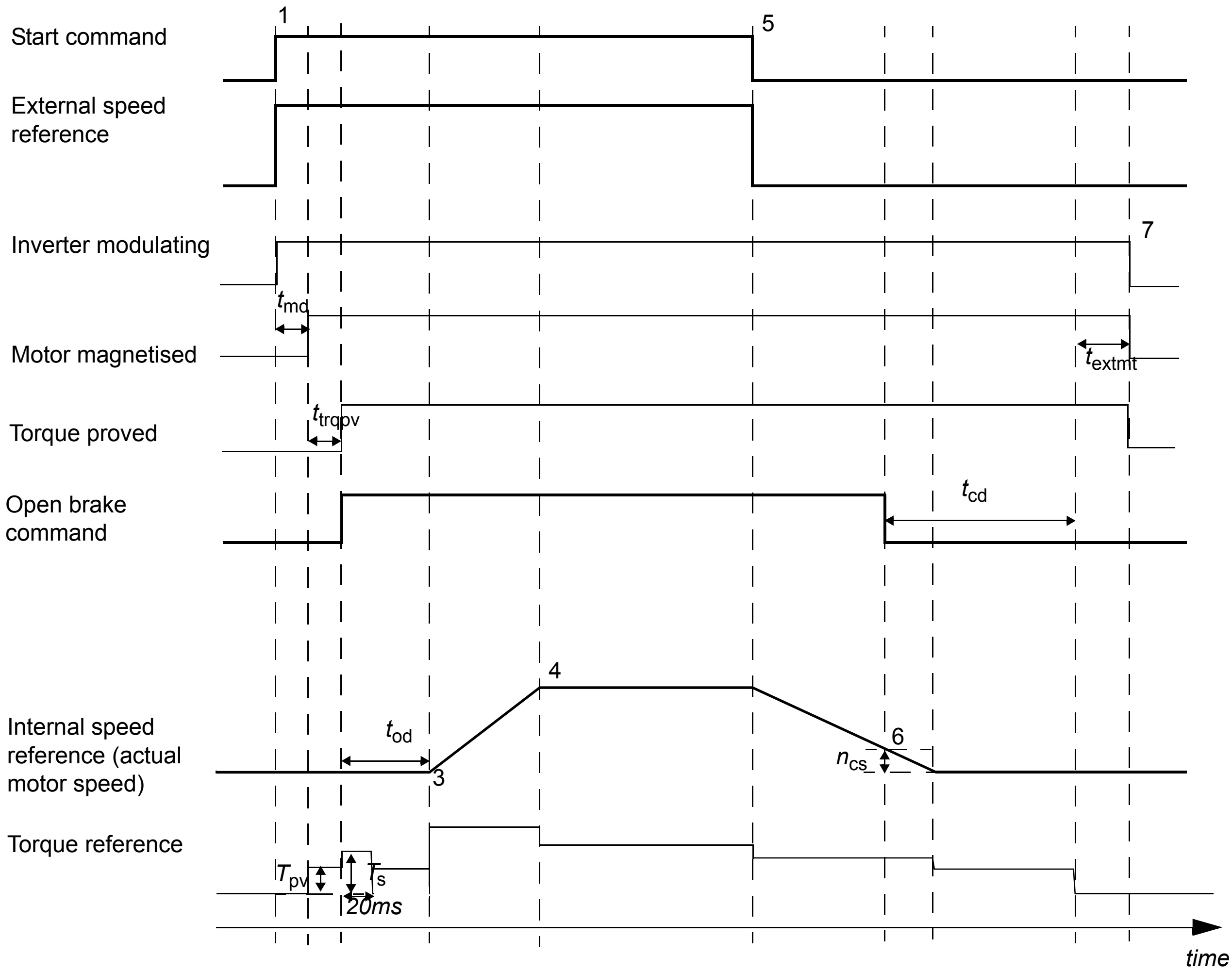
Brake control logic is integrated in the drive application program. The brake control hardware and wirings needs to be done by the user.

- Brake on/off control through relay output RO1.
- Brake supervision through digital input DI3 (optional).
- Emergency brake switch in the brake control circuit.



Operation time scheme

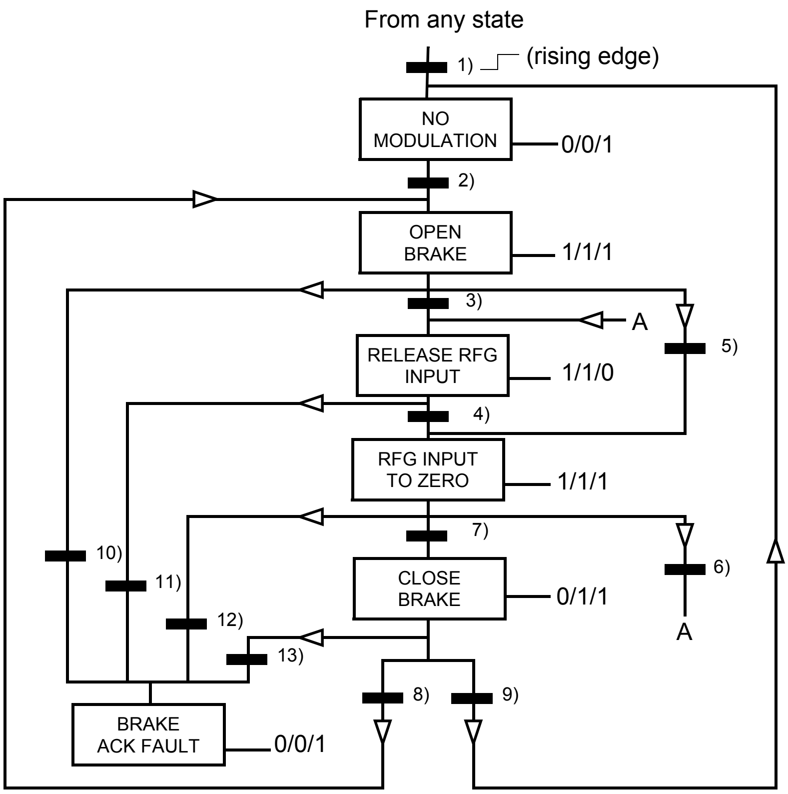
The time scheme below illustrates the operation of the brake control function. See also *State shifts* on page *114*.



T_s	Start torque at brake release (Parameters *42.07* and *42.08* from torque memory or AI or as per selection of Par. *42.07*)
t_{md}	Motor magnetising delay (Par. *21.02*, Constant DC Magn time)
t_{od}	Brake open delay (Parameter *42.03*, Speed reference delay and brake ackn DI supervision delay)
n_{cs}	Brake close speed (Parameter *42.05*, Absolute brake close speed level)
t_{cd}	Brake close delay (Parameter *42.04*, Torque ON time during closing of mechanical brake and brake ackn DI supervision time)
t_{trqpv}	Torque proving time period
T_{pv}	Torque proving reference. Fixed as 30% positive torque reference.
t_{extmt}	Extended run time (Parameter *42.09*, Magnetising ON after brake close)

1. Start command
2. Brake open command
3. Brake open delay
4. At speed setpoint
5. Stop command
6. At brake close speed
7. Drive stopped

State shifts



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

State (Symbol NN X/Y/Z)

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

X = 1 Open the brake. The relay output set to brake on/off control energises.

Y = 1 Forced start. The function keeps the internal Start on until the brake is closed in spite of the status of the external Start signal.

Z = 1 Ramp in zero. Forces the used speed reference (internal) to zero along a ramp.

State change conditions (Symbol ▬)

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

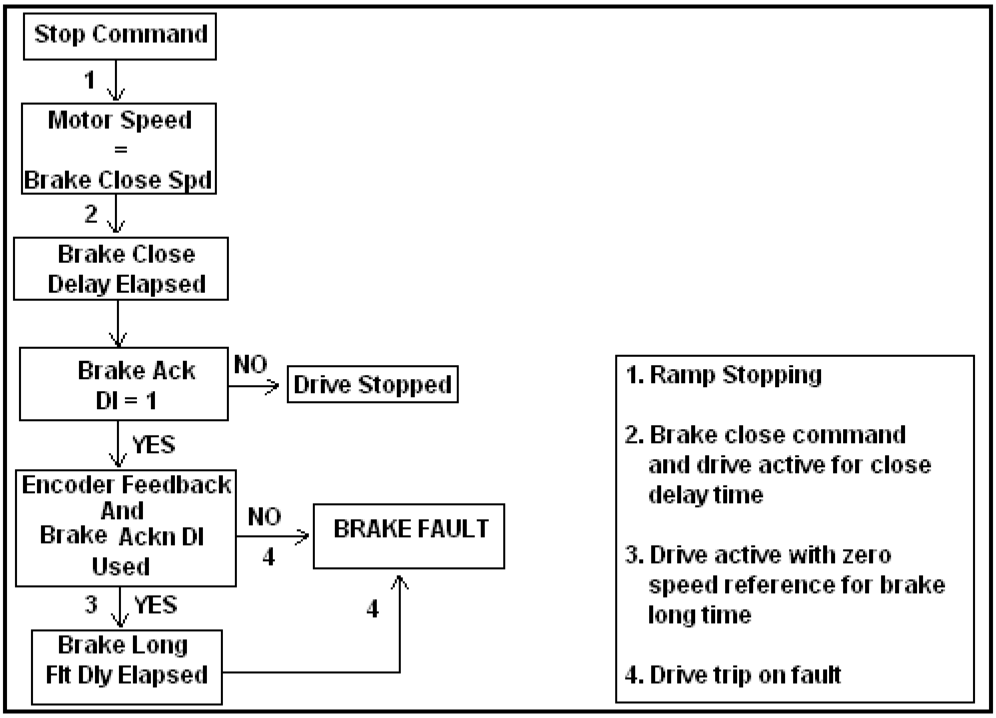
Only if parameter *42.02* ≠ OFF:

10) Brake Acknowledge = 0 AND Brake open delay passed =1
11) Brake Acknowledge = 0
12) Brake Acknowledge = 0
13) Brake Acknowledge = 1 AND Brake close delay passed. See *42.13* BRK LONG FLT DLY also.

As seen in the state diagram, the brake Open command is triggered when the drive comes to the run mode after the motor gets magnetised. The drive waits for the Torque proving ok signal and then releases the brake Open command, which switches on the brake open relay output. Any rotation of the motor above the allowed motor slip speed during the torque generation will result in a brake slip fault. The drive waits for the period of the brake open delay for the brake to get opened mechanically. The drive supervises for a brake fault if the brake does not open within the period of the brake open delay time. If the brake open delay has elapsed, the drive moves on to the next state for the releasing of the speed reference.

The (*42.09*) EXTEND RUN T can be used when the start request is released within a short span on receiving the Stop command. The drive keeps the motor magnetised for the extended time, and thereby reduces the next start sequence time. In the local control mode, the extended run time can be stopped by pressing the CDP stop button twice. The second stop request should be given when the drive is in the extended time period.

The (*42.13*) BRK LONG FLT DLY can be used for safety purposes if the brake is not closed properly in the stopping sequence. The delay is applicable only when encoder feedback is used and when the brake acknowledge is configured to a DI. The drive checks for the brake acknowledge signal during the stopping sequence. If the signal remains ON after the brake close delay (Par. *42.04*) has elapsed, the drive keeps the torque ON to the motor for the brake long fault delay period. This ensures that the drive does not trip immediately and drops the load. During the brake long fault delay period, a signal (*03.32* bit 9) is activated which can be used for safety interlocks. If the brake long fault delay has elapsed and the brake acknowledge is still ON, the drive trips on a brake fault. See the figure below.



The (*42.16*) BRK REOPEN DELAY can be used for a safety purpose in the event of a frequent Start -> Stop -> Start sequence. This parameter delays the opening of the brake when a Start command is issued immediately after a stop sequence.

Settings

Parameter	Additional information
14.01	Relay output for the brake control (set to BRAKE CTRL)
Group *42 BRAKE CONTROL*	Brake function settings

Diagnostics

Actual signal	Additional information
03.01	Ramp in zero bit
03.13 bit 6 *03.32* bit 9	The state of bit “brake Open/Close command” The brake long time active bit
Warnings	
BRAKE ACKN *BRK LONG TIME* *BRAKE SLIP FLT*	Unexpected state of Brake Acknowledge signal Brake closing sequence not completed and drive active with zero speed reference Brake slip detected during starting sequence when the brake is closed
Faults	
BRAKE ACKN	Unexpected state of Brake Acknowledge signal

Reduced run function

The Reduced run function is available for parallel-connected inverters. The function makes it possible to continue the operation with limited current if an inverter module(s) is out of order. If one of the modules is broken, it must be removed. Parameter change is needed to continue the run with reduced current (*95.03* INT CONFIG USER). For instructions on how to remove and reconnect an inverter module, see the appropriate drive hardware manual.

Settings

Parameter	Additional information
95.03	Number of existing parallel connected inverters

Diagnostics

Actual signal	Additional information
04.01	INT board fault
Faults	
INT CONFIG	Number of inverter modules is not equal to original number of inverters

Safety functions

External 24 V supply of RMIO board

In crane applications, external voltage is typically connected to the RMIO board to keep the software running even if the main power supply is disabled. If the external auxiliary voltage is used, parameter *16.09* CTRL BOARD SUPPLY must be set to EXTERNAL 24V. The default value of the parameter is INTERNAL 24V.

Settings

Parameter	Additional information
16.09	Source of the control board power supply

Slowdown

This function limits speed to a preset level (parameter SLOW DOWN REF *11.12*) if the *10.09* SLOW DOWN INPUT is active (DI = 0). The drive remembers the direction of movement and allows full speed in the opposite direction as long as the supply voltage (AMC board supply) is not switched off. If the voltage has been switched off and the input SLOWDOWN is active (DI = 0), then only slow speed is allowed in both directions.

By setting parameter *10.09* SLOW DOWN INPUT to DI3 F,DI4 R, separate inputs are available for wiring slowdown limit switches to the drive. Slowdown forward (UP) is wired to digital input 3, Slowdown reverse (down) to digital input 4. If input 3 is active (DI = 0), speed is limited to the slowdown reference level in the forward (up) speed direction, but not limited in the reverse direction (down). And vice versa if input 4 is active (DI = 0). If both inputs 3 and 4 are not active (DI = 1), there is no slowdown speed limitation in any direction, and full speed is allowed. See *Figure: Slowdown and End limit* on page *120*.

If the drives are in a Master/Follower configuration and in EXT2 control, then all the drives will run within the slowdown limit if Slowdown is activated in any of the drives.

The drive displays SLOW DOWN UP and SLOW DOWN DOWN warning messages according to the Slowdown condition active.

Settings

Parameter	Additional information
10.09	Selection for Slowdown
11.12	Speed limit during Slowdown

Diagnostics

Actual signal	Additional information
03.32 bit 0	Slowdown enabled bit
Warnings	
SLOW DOWN UP *SLOW DOWN DOWN*	Slowdown activated in up direction Slowdown activated in down direction

Fast stop

This function is used to ramp down to zero speed according to a predefined deceleration time (parameter *22.10* FST STP DCCL TIME). The drive decelerates to zero speed on receiving the *10.10* FAST STOP PTR command. The FAST STOP PTR should be active (according to the selection of pointer value) for enabling the Fast stop command. After the command, the input must be inactive for the next start sequence to happen.

When receiving a Fast stop command, the drive gives a FAST STOP warning message on the panel.

If the drives are in a Master/Follower configuration and in EXT2 control, all the drives will stop on a Fast stop command from any of the drives.

Settings

Parameter	Additional information
10.10	Selection for fast stop
22.10	Deceleration time on Fast stop command

Diagnostics

Actual signal	Additional information
03.32 bit 1	Fast stop enabled bit
Warnings	
FAST STOP	Fast stop is active

High-end and Low-end limits

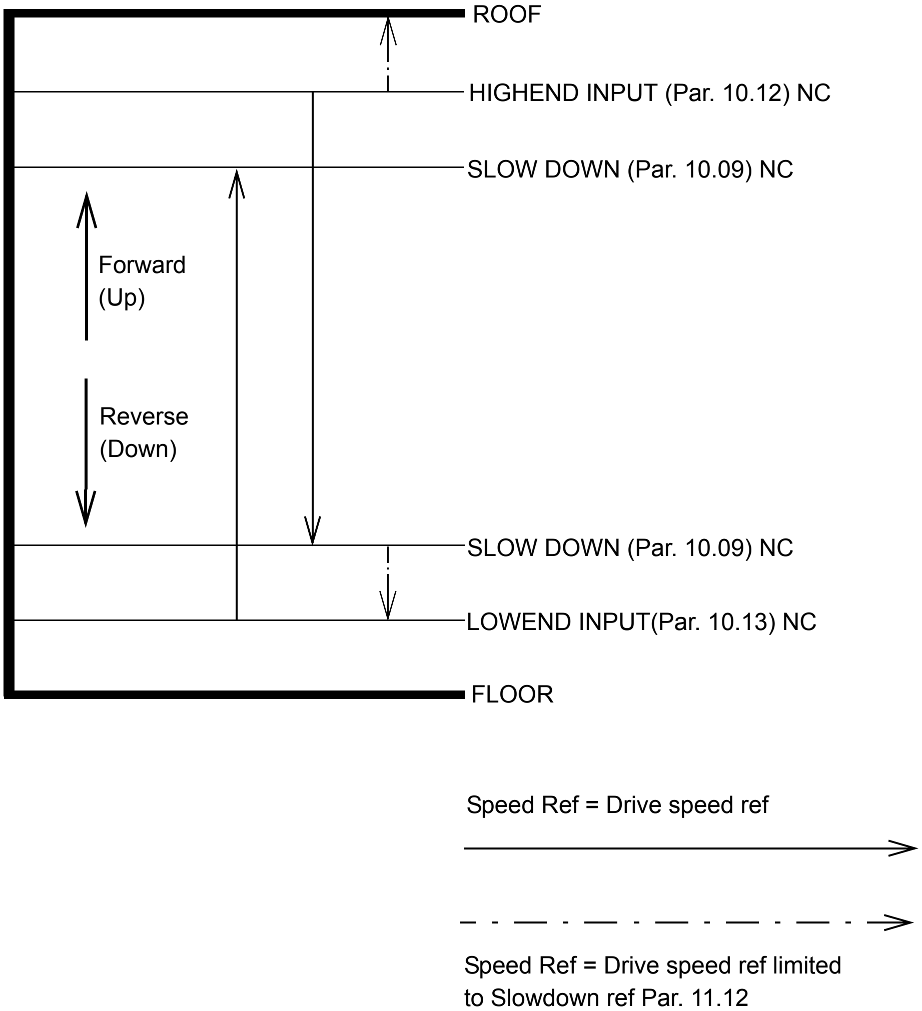
This function releases an Emergency command to the drive if any of the end limits are active. Two separate end limits, *10.12* HIGHEND PTR and *10.13* LOWEND PTR can be configured to be used in the forward (up) and reverse (down) direction, respectively. The two limits are independent of each other, and thus, they get activated only if configured properly. The HIGHEND input (active when DI = 0 if the pointer value is used after inverting the bit value) should be wired to the forward (up) limit switch, while the LOWEND input (active when DI = 0 if the pointer value is used after inverting the bit value) should be used for the reverse (down) limit switches.

The function releases an Emergency command (OFF3) if the HIGHEND input gets activated while the drive is running in the forward (up) direction. The drive then decelerates according to the EM STOP RAMP TIME *22.07*. The HIGHEND input should be inactive for the drive to release a new start sequence in the forward direction. However, the drive can be run in the reverse (down) direction when the HIGHEND input is active. The drive generates a HIGHEND LIMIT warning on the activation of the HIGHEND command.

Similarly, an Emergency command (OFF3) is released if the LOWEND input gets activated while the drive is running in the reverse (down) direction. The drive then decelerates according to the EM STOP RAMP TIME *22.07*. The LOWEND input should be inactive for the drive to release a new start sequence in the reverse direction. However, the drive can be run in the forward (up) direction when the LOWEND input is active. The drive generates a LOWEND LIMIT warning on the activation of the LOWEND command. If the warnings do not need to be shown in the control panel or fault logger, they can be blocked. See *Application message blocking* on page *127*.

If the drives are in a Master/Follower configuration and in EXT2 control, all the drives will stop when a HIGHEND or LOWEND command comes from any of the drives.

Figure: Slowdown and End limit



Settings

Parameter	Additional information
10.12 *10.13*	Selection of High-end limit Selection of Low-end limit
22.07	Setting of Emergency stop ramp time

Diagnostics

Actual signal	Additional information
03.32 bit 2 *03.32* bit 3	High-end limit enabled Low-end limit enabled
Warnings	
HIGHEND LIMIT *LOWEND LIMIT*	High-end limit is activated in up direction Low-end limit is activated in down direction

Start high logic

Warning *START HIGH (FFB3)* may be caused by the following conditions:

- Prevention of start during power-on sequence. The Crane control program includes prevention of the crane start when the mains power is switched on. If the crane start signal is TRUE during mains power switch-on, the drive indicates warning *START HIGH (FFB3)*. Change the crane start signal to zero and give a new crane start command.
- Use of fieldbus control bits in the wrong order. For more information, see section *Start/Stop sequence using communication bits* on page *254*.

Diagnostics

Actual signal	Additional information
03.32 bit 14	START HIGH (FFB3): Crane start signal high when switching power ON or starting against end limit logic sensor high

Watchdog function

This function supervises the below-mentioned fault and alarm conditions and generates a WATCH DOG BIT-N bit, which can be used for safety or emergency interlocks. The drive is healthy when the bit is active (value = 1). When any of the fault or alarm conditions get activated, the bit becomes inactive (value = 0). The fault and alarm conditions used to generate the WATCH DOG BIT-N are listed below.

1. CPU HEALTHY
2. EXTERNAL FAULT (3.06 bit 8)
3. M_F COMM ERROR (3.3 bit 13)
4. BR OVER TEMP (3.17 bit 3)
5. BC OVER TEMP (3.17 bit 4)
6. BC SHORT CIRC (3.17 bit 2)
7. FB COMM ERROR (3.6 bit 12)

Diagnostics

Actual signal	Additional information
03.32 bit 11	WATCH DOG-N active (bit = 0)

Inverter limit

This function is a safety protection from the drive operation point. The function checks for the following limits when the drive is running in the generating mode with generating power greater than 10% of the motor nominal power and the speed greater than 5% of the maximum speed. The limits checked are TORQUE INVERTER CURRENT LIMIT and IPP OVERLOAD ALARM. If one of these limits is hit, and a period of 200 ms elapses, the drive trips on the INV LIMIT fault, and the brake is closed.

03.04 LIMIT WORD 1 bit 4 indicates the current limit of the torque inverter.

Diagnostics

Actual signal	Additional information
03.33 bit 5	INV LIMIT fault active bit
Warnings	
INV LIMIT (FFBF)	Inverter limit hit when the drive is in the generating mode

Load speed control

This function is used for running the motor above the base speed if the motor is able to provide a sufficient torque with respect to the load condition. The function allows you to run the motor at a higher speed above the base speed according to the motor current at the base speed with the load. It is assumed that the load at which the motor crosses the base speed remains constant until the motor stops, and then a new Start command is given.

The user defines a set of current (A) and speed (rpm) parameters, which specify the curve to be used to calculate the motor speed limit according to the current at the base speed Par. *77.20*. The motor current at the base speed Par. *77.20* is checked for a predefined time period of Par. *77.03* HOLD RAMP, so that the motor current would have settled down to a less oscillating value.

Parameter *77.01* LOAD SPD CTRL SEL defines the activation command for the Load speed control function. Parameter *77.03* HOLD RAMP defines the time period after which the motor has crossed the base speed to check for the motor current. This motor current after this time period delay is regarded by the function as the base speed current for the particular load used. Parameters *77.04*…*77.19* plot the base speed versus current graph in both the forward and reverse direction and are further used to limit the speed according to the base speed current.

If parameters *77.04*…*77.19* are not configured properly in the correct sequence, the speed is always limited to Par. *77.20* BASE SPEED, and the error bit (signal *03.32* bit 10) is set to 1. Parameters *77.04*…*77.19* are to be configured as follows:

- The current values for the forward direction to be entered in parameters *77.04*, *77.06*, *77.08* and *77.10* have to be entered in the increasing order.
- The speed limit values for the forward direction to be entered in parameters *77.05*, *77.07*, *77.09* and *77.11* have to be entered in the decreasing order.
- The current values for the reverse direction to be entered in parameters *77.12*, *77.14*, *77.16* and *77.18* have to be entered in the increasing order.
- The speed limit values for the reverse direction to be entered in parameters *77.13*, *77.15*, *77.17* and *77.19* have to be entered in the decreasing order.

Example: Consider that the motor nominal current is 10 A corresponding to the base speed of 1500 rpm. Then the parameters are to be configured in the following sequence.

Note: The values defined below are only used to define the sequence, and the actual parameter values have to be entered according to the actual motor details and the load.

Par. *77.04* ------- 7 A

Par. *77.05* ------- 2000 rpm

Par. *77.06* ------- 8 A

Par. *77.07* ------- 1800 rpm

Par. *77.08* ------- 9 A

Par. *77.09* ------- 1600 rpm

Par. *77.10* ------- 10 A

Par. *77.11* ------- 1500 rpm

Parameters *77.12…77.19* for the reverse direction should also be entered in the same sequence as shown above. If the sequence of the parameters is not correct, then the speed is automatically limited to Par. *77.20* BASE SPEED, and the error bit (signal *03.32* bit 10) is set to 1.

Example: This example describes the parameter configuration that can be used for having a two-speed control. This configuration enables you to run the motor at two speeds, one being a high speed in the empty hook condition and the other a limited speed in the load condition.

Note: The values defined below are considered only to describe the function, and the actual parameter values have to be entered according to the actual motor details and the load.

Par. *77.04* CURR X1 FWD ------- 10 A

Par. *77.05* REF Y1 FWD ------- 2000 rpm

Par. *77.06* CURR X2 FWD ------- 12 A

Par. *77.07* REF Y2 FWD ------- 2000 rpm

Par. *77.08* CURR X3 FWD ------- 20 A

Par. *77.09* REF Y3 FWD ------- 1300 rpm

Par. *77.10* CURR X4 FWD ------- 25 A

Par. *77.11* REF Y4 FWD ------- 1300 rpm

Par. *77.12* CURR X1 REV ------- 10 A

Par. *77.13* REF Y1 REV ------- 2000 rpm

Par. *77.14* CURR X2 REV ------- 12 A

Par. *77.15* REF Y2 REV ------- 2000 rpm

Par. *77.16* CURR X3 REV ------- 20 A

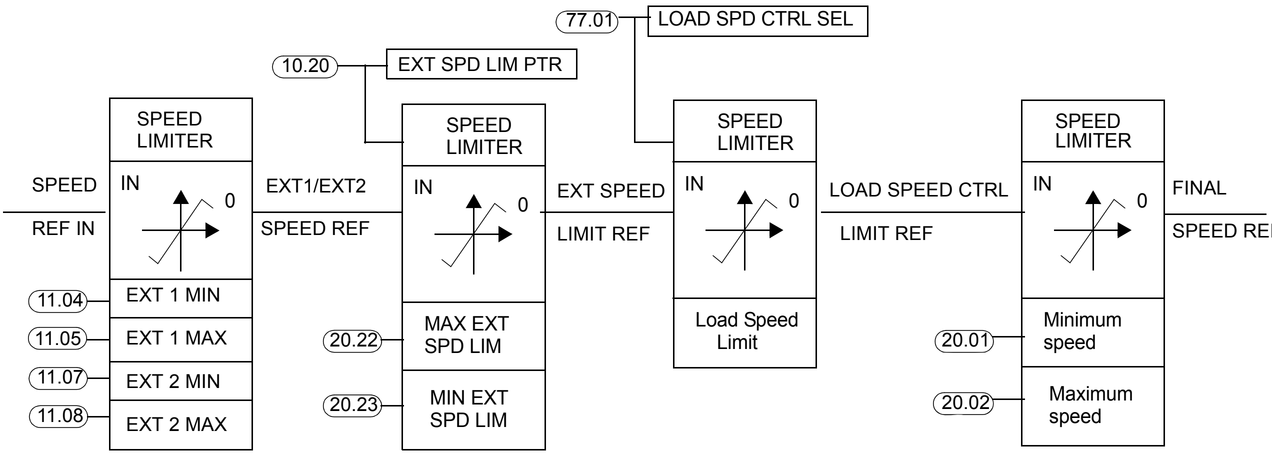
Par. 77.17 REF Y3 REV ------- 1300 rpm

Par. 77.18 CURR X4 REV ------- 25 A

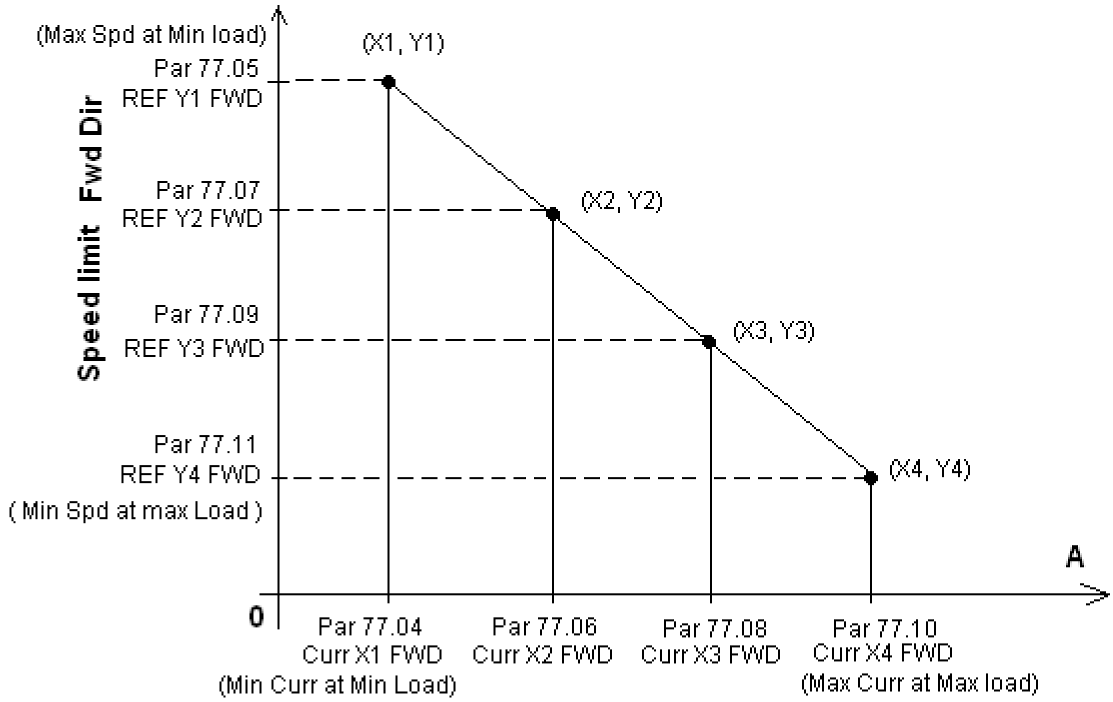
Par. 77.19 REF Y4 REV ------- 1300 rpm

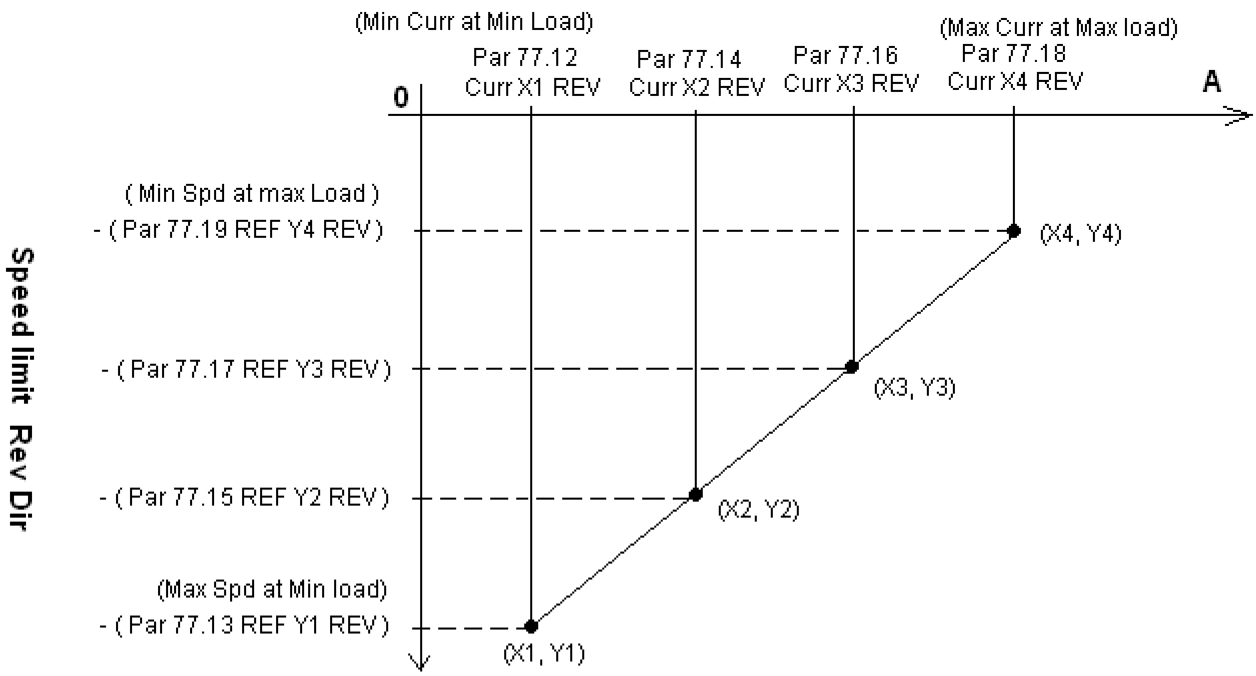
In this example, the empty hook current is considered in the range 10 … 12 A, both in the forward and reverse direction. The current in the load condition is considered in the range 20 … 25 A, both in the forward and reverse direction. In the empty hook condition, the Load speed control function would allow the speed of 2000 rpm, provided that the speed reference given is more than or equal to 2000 rpm, and the speed is not limited by Par. 20.01 Minimum speed or 20.02 Maximum speed or any other speed limits. In the load condition, if the actual motor current at the base speed is within the range of 20 … 25 A, the Load speed control function will limit the speed to 1300 rpm. Therefore, the functionality of two-speed control is achieved with these settings.

The figure below shows the speed reference chain in Load speed control.



The figures below show speed limits according to different load conditions.





Settings

Parameter	Additional information
77.01	Selection of Load speed control
77.03	Setting of time period for holding the speed reference at base speed
77.04…77.19	Setting of speed limits according to motor current at the base speed

Diagnostics

Actual signal	Additional information
03.32 bit 10	Load speed control error bit
03.32 bit 5 *03.32* bit 6	Speed is limited in the forward direction by the Load speed control function Speed is limited in the reverse direction by the Load speed control function
Warnings	
LOAD SP UP LIM *LOAD SP DW LIM*	Speed limited in the forward direction by the Load speed control function Speed limited in the reverse direction by the Load speed control function

Application message blocking

You can use parameter *97.17* APL LIM WRN MASK to block the application messages if you do not need the messages. When a message is blocked, the relevant function remains in use, but the message itself is not shown on the control panel display and in the PC tool history.

You can activate or deactivate the messages by setting or resetting the individual message masking bits. Bit value “1” activates the message: the combined value of the bits has to be entered in integer format.

The messages and the corresponding masking bits are as follows:

Bit	Messages	Default
0	SLOW DOWN UP (FFF4) SLOW DOWN DOWN (FFF5)	0
1	HIGHEND LIMIT (FFF6) LOWEND LIMIT (FFF7)	0
2	LOAD SP UP LIM (FFB8) LOAD SP DW LIM (FFB9)	0
3	JOYSTICK CHECK (FFFA)	1
4	ZERO POS WARN (FFFB)	1
5	START HIGH (FFB3)	1
6	HOMING ACTIVE (FFB1) HOMING DONE (FFB0)	1
7	FLWR1 LIM/FLT (FFFD) FLWR2 LIM/FLT (FFFE) FLWR3 LIM/FLT (FFB5) FLWR4 LIM/FLT (FFB4)	1
8	MASTERLIM/FLT (FFB2)	1
9	START INTERLOCK	1

Application macros, control location EXT1/EXT2

Chapter overview

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

Overview of macros

Application macros are preprogrammed parameter sets. While starting up the drive, you typically select one of the macros - the one that is best suited to your needs - with parameter *99.02*, make the essential changes and save the result as a user macro.

There is a crane macro and two user macros. The table below contains a summary of the macros and describes the suitable applications.

Macro	**Suitable Applications**
Crane	Crane control
User	You can save the customised standard macro, that is the parameter settings including group 99, and the results of the motor identification into the permanent memory, and recall the data at a later time. Two user macros are essential when switching between two different motors is required.

Control locations EXT1/EXT2

Two control locations are used in the crane macro for fast switch-over between different modes. Control location EXT1 is used for the stand-alone mode, and control location EXT2 is used for the Master/Follower and Synchro control mode.

EXT1 STANDALONE *10.01* START/STOP *11.03* REF	*11.02* EXT1/EXT2 SELECT
EXT2 MASTER-FOLLOWER *10.02* START/STOP *11.06* REF	

Control locations and control modes

Stand-alone mode

Control location EXT1 is used for the stand-alone mode when the crane motion is working alone. For more information, see *Stand-alone mode (EXT1)* on page *56*.

The homing control mode is used in the stand-alone state. For more information, see section *Homing sequence* on page *92*.

A speed-controlled crane is also controlled in control location EXT1.

Master/Follower and Synchro control mode

Control location EXT2 is used for the Master/Follower and Synchro control mode when the crane motions (for example, hooks) are working together. For the Master-Follower data transfer, see the figure in section *Master/Follower use of several drives (Only in EXT2 Control)*.

The control location EXT2 Master can be in the speed or torque control mode and the Followers can be in the speed, torque or Synchro control mode.

Crane macro

This section describes the default control interfaces and signals of the macro and shows the connection diagrams. You can give all drive commands and reference settings from the control panel (local control) or an external device (external control). The ***LOC/REM*** key of the panel selects between local and external control.

The drive is speed-controlled as default.

EXT1 is the default external control location of the application program. The reference signal is connected to analogue input AI1. The Start Fwd and Start Rev signals are connected to digital inputs DI1 and DI2. By default, the direction is fixed to REQUEST (with parameter *10.03*).

The Slowdown signal, the Fast Stop signal DI5, High-end limit and Low-end limit signals do not have any default values as they are pointer parameters. You have to configure these signals.

Two analogue signals (speed and current) and three relay output signals (Brake Lift, running and inverted fault) are available.

The default signals on the display of the control panel are SPEED, CURRENT and TORQUE.

Default control connections

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

[1)] Parameter *10.03* should be REQUEST.

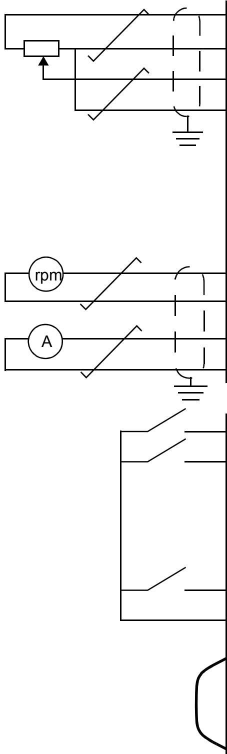
[2)] The US default settings differ as follows:

DI1	DI2	Operation
0	0	Stop
1	0	Start Forward
0	1	Start Reverse
1	1	Stop

[3)] See the wiring diagram on page *338* if used as power ackn signal.

[4)] +24 V DC external auxiliary voltage to the RMIO board.

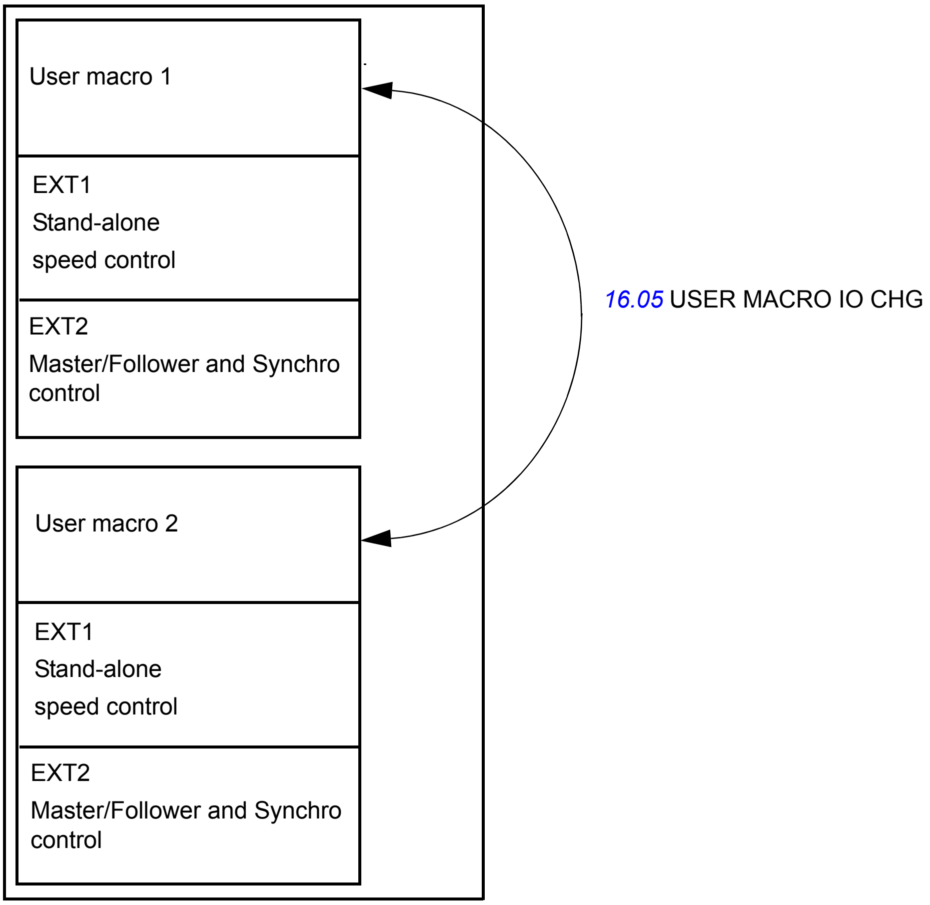
For more information, see *External 24 V supply of RMIO board* on page *117*.



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

User macros

In addition to the standard application macros, it is possible to create two user macros.



The user macro allows you to save the parameter settings including Group 99, and the results of the motor identification into the permanent memory, and to recall the data at a later time. The panel reference is also saved, if the macro is saved and loaded in the Local control mode. The Remote control location setting is saved into the user macro, but the Local control location setting is not.

To create User Macro 1:

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

Note: If the user macro save function is executed several times, the drive memory fills up and file compression starts. The file compression can last up to 10 minutes. Macro saving will be completed after the file compression. (The operation is indicated on the last row of the control panel display by blinking dots).

To recall the user macro:

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

The user macro can also be switched via digital inputs (see parameter *16.05* USER MACRO IO CHG).

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

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

Control schemes

This section describes the different control schemes which can be used to control the drive and the parameters to be set accordingly.

Control using digital inputs and Potentiometer Reference

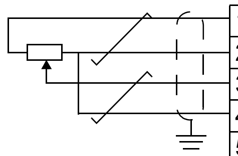
Name	Description	Set parameters	Parameter value
Start/Stop Control for EXT1	Selecting the source for start and stop signals of the two external control locations, EXT1 and EXT2		
	Selecting between EXT1 and EXT2	11.02	EXT 1
	Defining Start/Stop selection	10.01	DI1 F, DI2 R
	Defining the direction control	10.03	REQUEST
	Selecting the DI for Slowdown	10.09	DI4
	Selecting signal Fast Stop	10.10	
	Selecting the signal High-end limit	10.12	
	Selecting the signal Low-end limit	10.13	
Referencing EXT1			
	Selecting the source for the speed reference	11.03	AI1
	(If AI1 is used: Setting analogue input AI1 limits, scale, inversion)	(13.01, 13.02, 13.03, 13.04, 13.05, 30.01)	
	Setting the reference limits	11.04,11.05	
	Setting the speed (frequency) limits	20.02, 20.01, (20.08, 20.07)	
	Setting the Slowdown reference	11.12	
	Setting acceleration/deceleration	22.01	ACC/DEC DIR
	Setting acceleration and deceleration times	22.02, 22.03, 22.10	
Referencing EXT2			
	Selecting the source for the speed/torque reference	11.06	AI1
	(If AI1 is used: Setting analogue input AI1 limits, scale, inversion)	(13.01, 13.02, 13.03, 13.04, 13.05, 30.01)	
	Setting the reference limits	11.07,11.08	
	Setting the speed (frequency) limits	20.02, 20.01, (20.08, 20.07)	
	Setting acceleration/deceleration	22.01	ACC/DEC DIR
	Setting acceleration and deceleration times	22.02, 22.03, 22.10	

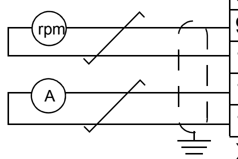
See figures below for control connection for control using digital inputs and Potentiometer Reference.

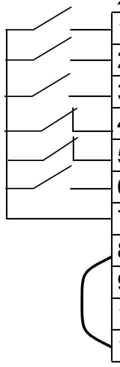
1) See the wiring diagram on page 338 if used as power ON ackn signal.

* To be configured using respective pointer parameters

2) Considering the function pointer is configured with an inverted signal







X20

1	VREF	Reference voltage -10 V DC
2	GND	1 kohm ≤ R_L ≤ 10 kohm

X21

1	VREF	Reference voltage 10 V DC
2	GND	1 kohm ≤ R_L ≤ 10 kohm
3	AI1+	Speed reference 0(2) … 10 V, R_{in} > 200 kohm
4	AI1-	
5	AI2+	By default, not in use. 0(4) … 20 mA, R_{in} =
6	AI2-	100 ohm
7	AI3+	By default, not in use. 0(4) … 20 mA, R_{in} =
8	AI3-	100 ohm
9	AO1+	Motor speed 0(4) … 20 mA ≙ 0 … motor nom.
10	AO1-	speed, R_L ≤ 700 ohm
11	AO2+	Output current 0(4) … 20 mA ≙ 0 … motor
12	AO2-	nom. current, R_L ≤ 700 ohm

X22

1	DI1	Forward Start
2	DI2	Reverse Start
3	DI3	Brake Acknowledge (1= brake open) *
4	DI4	Slowdown (0= Slowdown active)*
5	DI5	Fast Stop (0= Fast Stop active) 2) *
6	DI6	
7	+24 V	+24 V DC, max. 100 mA
8	+24 V	
9	DGND1	Digital ground
10	DGND2	Digital ground
11	DI IL	Start interlock (0 = stop) 1)

X23

1	+24 V	Auxiliary voltage output, non-isolated, 24 V
2	GND	DC, 250 mA

X25

1	RO11	Relay output 1
2	RO12	**Open Brake**
3	RO13	

X26

1	RO21	Relay output 2
2	RO22	**Running**
3	RO23	

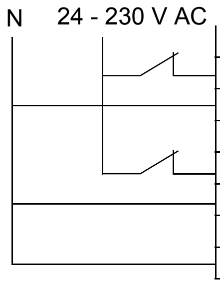
X27

1	R031	Relay output 3
2	R032	**Inverted fault**
3	R033	

RDIO-01 digital I/O extension

1) Considering the function pointer is configured with an inverted signal

* To be configured using respective pointer parameters



X11		
1	DI1A	High-end limit (0 = Emergency stop) 1) *
2	DI1B	High-end limit
X12		
1	DI2A	Low-end limit (0 = Emergency stop) 1) *
2	DI2B	Low-end limit
3	DI3A	
4	DI3B	

Control using Joystick

Name	Description	Set parameters	Parameter value
Start/Stop Control for EXT1	Selecting the source for start and stop signals of the two external control locations, EXT1 and EXT2		
	Selecting between EXT1 and EXT2	11.02	EXT 1
	Defining Start/Stop selection	10.01	DI1
	Defining the direction control	10.03	REQUEST
	Selecting the DI for Slowdown	10.09	DI4
	Selecting the signal for Fast Stop	10.10	
	Selecting the signal for High-end limit	10.12	
	Selecting the signal for Low-end limit	10.13	
	Selecting the signal for Zero Position	10.16	
Referencing EXT1			
	Selecting the source for the speed reference (If unipolar)	11.03	AI1/JOYSTICK
	Selecting the source for the speed reference (If Bipolar)	11.03	AI1 BIPOLAR
	(If AI1 is used: Setting analogue input AI1 limits, scale, inversion)	(13.01, 13.02, 13.03, 13.04, 13.05, 30.01)	
	Setting the reference limits	11.04	
		11.05	
	Setting the speed (frequency) limits	20.02, 20.01, (20.08, 20.07)	
	Setting the Slowdown reference	11.12	
	Setting acceleration and deceleration times	22.02, 22.03, 22.10	
	Setting Joystick Warning delay	11.13	2 seconds

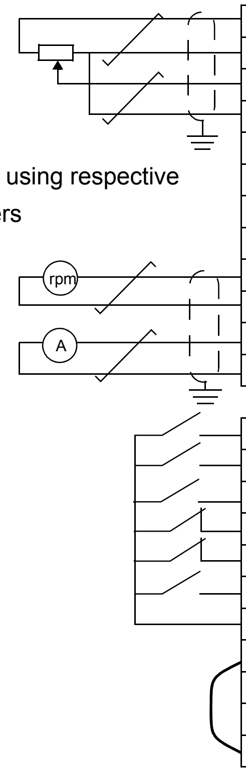
Name	Description	Set parameters	Parameter value
Referencing EXT2			
	Selecting the source for the speed/ torque reference (If unipolar)	11.06	AI1/JOYSTICK
	Selecting the source for the speed / torque reference (If Bipolar)	11.06	AI1 BIPOLAR
	(If AI1 is used: Setting analogue input AI1 limits, scale, inversion)	(13.01, 13.02, 13.03, 13.04, 13.05, 30.01)	
	Setting the reference limits	11.07	
		11.08	
	Setting the speed (frequency) limits	20.02, 20.01, (20.08, 20.07)	
	Setting the Slowdown reference	11.12	
	Setting acceleration and deceleration times	22.02, 22.03, 22.10	
	Setting Joystick Warning delay	11.13	2 seconds

See figures below for control connection using Joystick in Unipolar configuration

[1)] See the wiring diagram on page 338 if used as power ON ackn signal.

[2)] Considering the function pointer is configured with an inverted signal

[*] To be configured using respective pointer parameters



X20

1	VREF	Reference voltage -10 V DC
2	GND	1 kohm ≤ R_L ≤ 10 kohm

X21

1	VREF	Reference voltage 10 V DC
2	GND	1 kohm ≤ R_L ≤ 10 kohm
3	AI1+	Speed reference 0(2) … 10 V, R_{in} > 200 kohm
4	AI1-	
5	AI2+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
6	AI2-	
7	AI3+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
8	AI3-	
9	AO1+	Motor speed 0(4) … 20 mA ≙ 0 … motor nom. speed, R_L ≤ 700 ohm
10	AO1-	
11	AO2+	Output current 0(4) … 20 mA ≙ 0 … motor nom. current, R_L ≤ 700 ohm
12	AO2-	

X22

1	DI1	Start / Stop(0=stop, 1=start)
2	DI2	
3	DI3	Brake Acknowledge (1= brake open) *
4	DI4	Slowdown (0= Slowdown active)*
5	DI5	Fast Stop (0= Fast Stop active)[2 *)]
6	DI6	Zero position (1=Zero position active) [2) *]
7	+24 V	+24 V DC, max. 100 mA
8	+24 V	
9	DGND1	Digital ground
10	DGND2	Digital ground
11	DI IL	Start interlock (0 = stop) [1)]

X23

1	+24 V	Auxiliary voltage output, non-isolated, 24 V DC, 250 mA
2	GND	

X25

1	RO11	Relay output 1
2	RO12	**Open Brake**
3	RO13	

X26

1	RO21	Relay output 2
2	RO22	**Running**
3	RO23	

X27

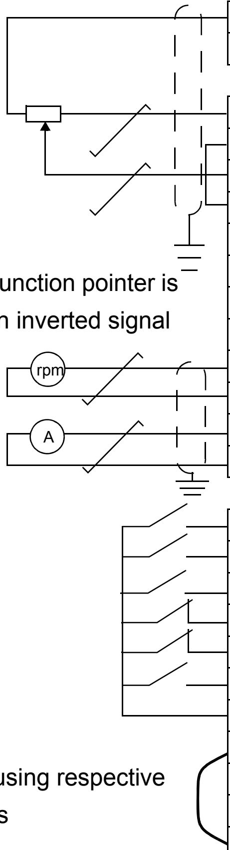
1	R031	Relay output 3
2	R032	**Inverted fault**
3	R033	

See figures below for control connection using Joystick in Bipolar configuration

1) See the wiring diagram on page 338 if used as power ON ackn signal.

2) Considering the function pointer is configured with an inverted signal

* To be configured using respective pointer parameters



X20

1	VREF	Reference voltage -10 V DC
2	GND	1 kohm ≤ R_L ≤ 10 kohm

X21

1	VREF	Reference voltage 10 V DC
2	GND	1 kohm ≤ R_L ≤ 10 kohm
3	AI1+	Speed reference 0(2) … 10 V, R_{in} > 200 kohm
4	AI1-	
5	AI2+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
6	AI2-	
7	AI3+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
8	AI3-	
9	AO1+	Motor speed 0(4) … 20 mA ≙ 0 … motor nom. speed, R_L ≤ 700 ohm
10	AO1-	
11	AO2+	Output current 0(4) … 20 mA ≙ 0 … motor nom. current, R_L ≤ 700 ohm
12	AO2-	

X22

1	DI1	Start /Stop (0=stop, 1=start)
2	DI2	
3	DI3	Brake Acknowledge (1= brake open) *
4	DI4	Slowdown (0= Slowdown active) *
5	DI5	Fast Stop (0= Fast Stop active) 2) *
6	DI6	Zero position (1=Zero position active) 2) *
7	+24 V	+24 V DC, max. 100 mA
8	+24 V	
9	DGND1	Digital ground
10	DGND2	Digital ground
11	DI IL	Start interlock (0 = stop) 1)

X23

1	+24 V	Auxiliary voltage output, non-isolated, 24 V DC, 250 mA
2	GND	

X25

1	RO11	Relay output 1
2	RO12	**Open Brake**
3	RO13	

X26

1	RO21	Relay output 2
2	RO22	**Running**
3	RO23	

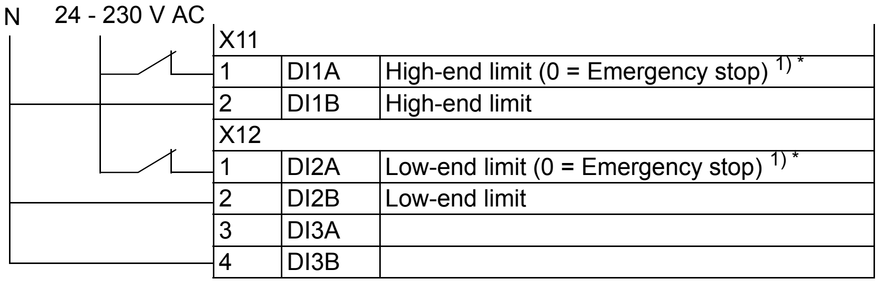
X27

1	R031	Relay output 3
2	R032	**Inverted fault**
3	R033	

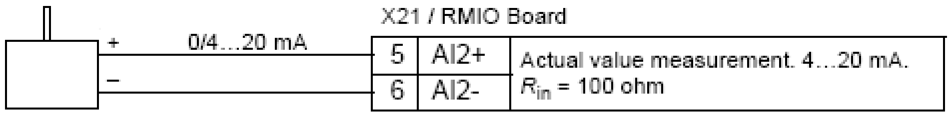
RDIO-01 digital I/O extension

[1)] Considering the function pointer is configured with an inverted signal

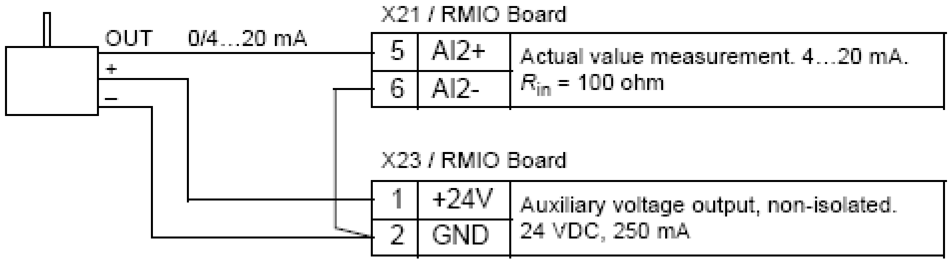
[*] To be configured using respective pointer parameters

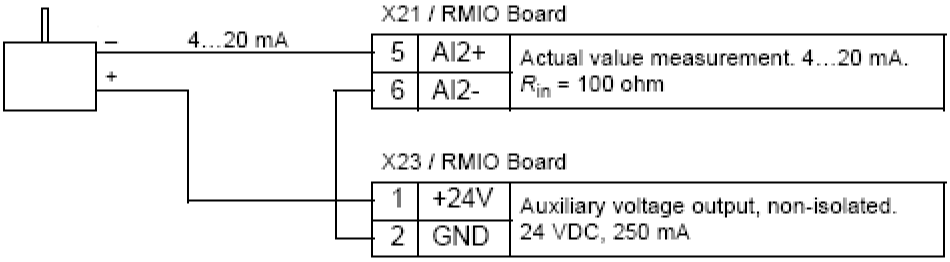


Wiring diagrams for Joystick using external and internal power supplies



Note: The joystick must be powered externally





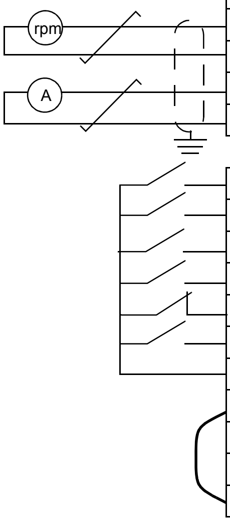
Control using motorized potentiometer

Name	Description	Set parameters	Parameter value
Start/Stop Control for EXT1	Selecting the source for start and stop signals of the two external control locations, EXT1 and EXT2		
	Selecting between EXT1 and EXT2	11.02	EXT 1
	Defining Start/Stop selection	10.01	DI1 F, DI2 R
	Defining the direction control	10.03	REQUEST
	Selecting the DI for Slowdown	10.09	DI5
	Selecting the signal for Fast Stop	10.10	
	Selecting the signal for the High-end limit	10.12	
	Selecting the signal for Low-end limit	10.13	
Referencing EXT1			
	Selecting the source for the speed reference	11.03	DI3U,4D
	Setting the reference limits	11.04	
		11.05	
	Setting the speed (frequency) limits	20.02, 20.01, (20.08, 20.07)	
	Setting the Slowdown reference	11.12	
	Setting acceleration and deceleration times	22.02, 22.03, 22.10	
Referencing EXT2			
	Selecting the source for the speed/ torque reference	11.06	DI3U,4D
	Setting the reference limits	11.07	
		11.08	
	Setting the speed (frequency) limits	20.02, 20.01, (20.08, 20.07)	
	Setting the Slowdown reference	11.12	
	Setting acceleration and deceleration times	22.02, 22.03, 22.10	
	Setting Joystick Warning delay	11.13	2 seconds

See figures below for control connection using motorized potentiometer

1) See the wiring diagram on page 338 if used as power ON ackn signal.

* To be configured using respective pointer parameters

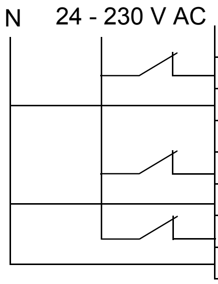


X20	1	VREF	Reference voltage -10 V DC
	2	GND	1 kohm ≤ R_L ≤ 10 kohm
X21	1	VREF	Reference voltage 10 V DC
	2	GND	1 kohm ≤ R_L ≤ 10 kohm
	3	AI1+	not in use 0(2) … 10 V, R_{in} > 200 kohm
	4	AI1-	
	5	AI2+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
	6	AI2-	
	7	AI3+	By default, not in use. 0(4)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

RDIO-01 digital I/O extension

1) Considering the function pointer is configured with an inverted signal

* To be configured using respective pointer parameters



X11		
1	DI1A	High-end limit (0 = Emergency stop) 1) *
2	DI1B	High-end limit
X12		
1	DI2A	Low-end limit (0 = Emergency stop) 1) *
2	DI2B	Low-end limit
3	DI3A	Fast Stop (0= Fast Stop active)1)
4	DI3B	Fast Stop

Control using step reference

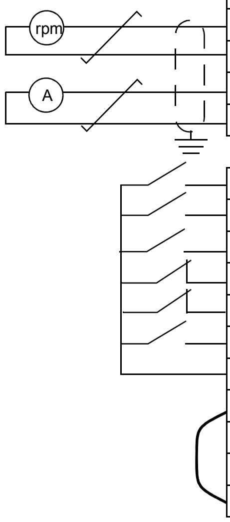
Name	Description	Set parameters	Parameter value
Start/Stop Control for EXT1	Selecting the source for start and stop signals of the two external control locations, EXT1 and EXT2		
	Selecting between EXT1 and EXT2	11.02	EXT 1
	Defining Start/Stop selection	10.01	DI1 F, DI2 R
	Defining the direction control	10.03	REQUEST
	Selecting the DI for Slowdown	10.09	DI4
	Selecting the signal for Fast Stop	10.10	
	Selecting the signal for the High-end limit	10.12	
	Selecting the signal for Low-end limit	10.13	
	Selecting the Step reference	12.01	DI9,DI10,DI11
Referencing			
	Setting Step references	12.02	
		12.03	
		12.04	
		12.05	
	Setting the speed (frequency) limits	20.02, 20.01, (20.08, 20.07)	
	Setting the Slowdown reference	11.12	
	Setting acceleration and deceleration times	22.02, 22.03, 22.10	

See figures below for control connection using step reference

1) See the wiring diagram on page 338 if used as power ON ackn signal.

2) Considering the function pointer is configured with an inverted signal

* To be configured using respective pointer parameters



X20

1	VREF	Reference voltage -10 V DC
2	GND	1 kohm ≤ R_L ≤ 10 kohm

X21

1	VREF	Reference voltage 10 V DC
2	GND	1 kohm ≤ R_L ≤ 10 kohm
3	AI1+	not in use 0(2) … 10 V, R_{in} > 200 kohm
4	AI1-	
5	AI2+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
6	AI2-	
7	AI3+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
8	AI3-	
9	AO1+	Motor speed 0(4) … 20 mA ≙ 0 … motor nom. speed, R_L ≤ 700 ohm
10	AO1-	
11	AO2+	Output current 0(4) … 20 mA ≙ 0 … motor nom. current, R_L ≤ 700 ohm
12	AO2-	

X22

1	DI1	Forward Start
2	DI2	Reverse Start
3	DI3	Brake Acknowledge (1= brake open) *
4	DI4	Slowdown (0= Slowdown active) *
5	DI5	Fast Stop (0= Fast Stop active) 2) *
6	DI6	
7	+24 V	+24 V DC, max. 100 mA
8	+24 V	
9	DGND1	Digital ground
10	DGND2	Digital ground
11	DI IL	Start interlock (0 = stop) 1)

X23

1	+24 V	Auxiliary voltage output, non-isolated, 24 V DC, 250 mA
2	GND	

X25

1	RO11	Relay output 1 **Open Brake**
2	RO12	
3	RO13	

X26

1	RO21	Relay output 2 **Running**
2	RO22	
3	RO23	

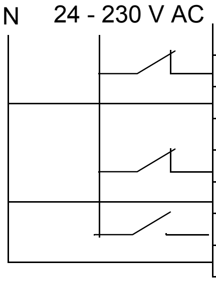
X27

1	R031	Relay output 3 **Inverted fault**
2	R032	
3	R033	

RDIO-01 digital I/O extension module -1

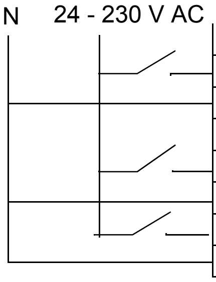
1) Considering the function pointer is configured with an inverted signal

* To be configured using respective pointer parameters



X11		
1	DI1A	High-end limit (0 = Emergency stop) 1) *
2	DI1B	High-end limit
X12		
1	DI2A	Low-end limit (0 = Emergency stop) 1) *
2	DI2B	Low-end limit
3	DI3A	Step reference DI
4	DI3B	

RDIO-01 digital I/O extension module -2



X11		
1	DI1A	Step reference DI
2	DI1B	
X12		
1	DI2A	Step reference DI
2	DI2B	
3	DI3A	
4	DI3B	

Control using fieldbus

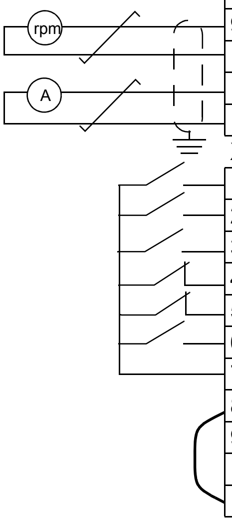
Name	Description	Set parameters	Parameter value
Start/Stop Control for EXT1	Selecting the source for start and stop signals of the two external control locations, EXT1 and EXT2		
	Selecting between EXT1 and EXT2	11.02	COMM.CW
	Defining Start/Stop selection	10.01	COMM.CW
	Defining the direction control	10.03	REQUEST
	Selecting the DI for Slowdown	10.09	DI4
	Selecting the signal for Fast Stop	10.10	
	Selecting the signal for the High-end limit	10.12	
	Selecting the signal for Low-end limit	10.13	
Referencing EXT1	Selecting the source for the speed reference	11.03	COMM.REF
	Setting the reference limits	11.04 11.05	
	Setting the speed (frequency) limits	20.02, 20.01, (20.08, 20.07)	
	Setting the Slowdown reference	11.12	
	Setting acceleration and deceleration times	22.02, 22.03, 22.10	
Referencing EXT2	Selecting the source for the speed/ torque reference	11.06	COMM.REF
	Setting the reference limits	11.07 11.08	
	Setting the speed (frequency) limits	20.02, 20.01, (20.08, 20.07)	
	Setting the Slowdown reference	11.12	
	Setting acceleration and deceleration times	22.02, 22.03, 22.10	
	Setting Joystick Warning delay	11.13	2 seconds
Communication Setup	Setting the communication Interface	98.02	
	Setting the communication profile	98.07	
	Setting up the communication Adapter (If Adapter used)	group51	
	Setting up the communication (If Standard Modbus used)	group52	

See figures below for control connection in fieldbus mode

[1] See the wiring diagram on page 338 if used as power ON ackn signal.

[2] Considering the function pointer is configured with an inverted signal

* To be configured using respective pointer parameters



X20

1	VREF	Reference voltage -10 V DC
2	GND	1 kohm ≤ R_L ≤ 10 kohm

X21

1	VREF	Reference voltage 10 V DC
2	GND	1 kohm ≤ R_L ≤ 10 kohm
3	AI1+	not in use 0(2) … 10 V, R_{in} > 200 kohm
4	AI1-	
5	AI2+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
6	AI2-	
7	AI3+	By default, not in use. 0(4) … 20 mA, R_{in} = 100 ohm
8	AI3-	
9	AO1+	Motor speed 0(4) … 20 mA ≙ 0 … motor nom. speed, R_L ≤ 700 ohm
10	AO1-	
11	AO2+	Output current 0(4) … 20 mA ≙ 0 … motor nom. current, R_L ≤ 700 ohm
12	AO2-	

X22

1	DI1	
2	DI2	
3	DI3	Brake Acknowledge (1= brake open) *
4	DI4	Slowdown (0= Slowdown active) *
5	DI5	Fast Stop (0= Fast Stop active) [2] *
6	DI6	
7	+24 V	+24 V DC, max. 100 mA
8	+24 V	
9	DGND1	Digital ground
10	DGND2	Digital ground
11	DI IL	Start interlock (0 = stop [1]

X23

1	+24 V	Auxiliary voltage output, non-isolated, 24 V DC, 250 mA
2	GND	

X25

1	RO11	Relay output 1 **Open Brake**
2	RO12	
3	RO13	

X26

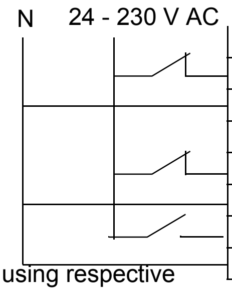
1	RO21	Relay output 2 **Running**
2	RO22	
3	RO23	

X27

1	R031	Relay output 3 **Inverted fault**
2	R032	
3	R033	

RDIO-01 digital I/O extension

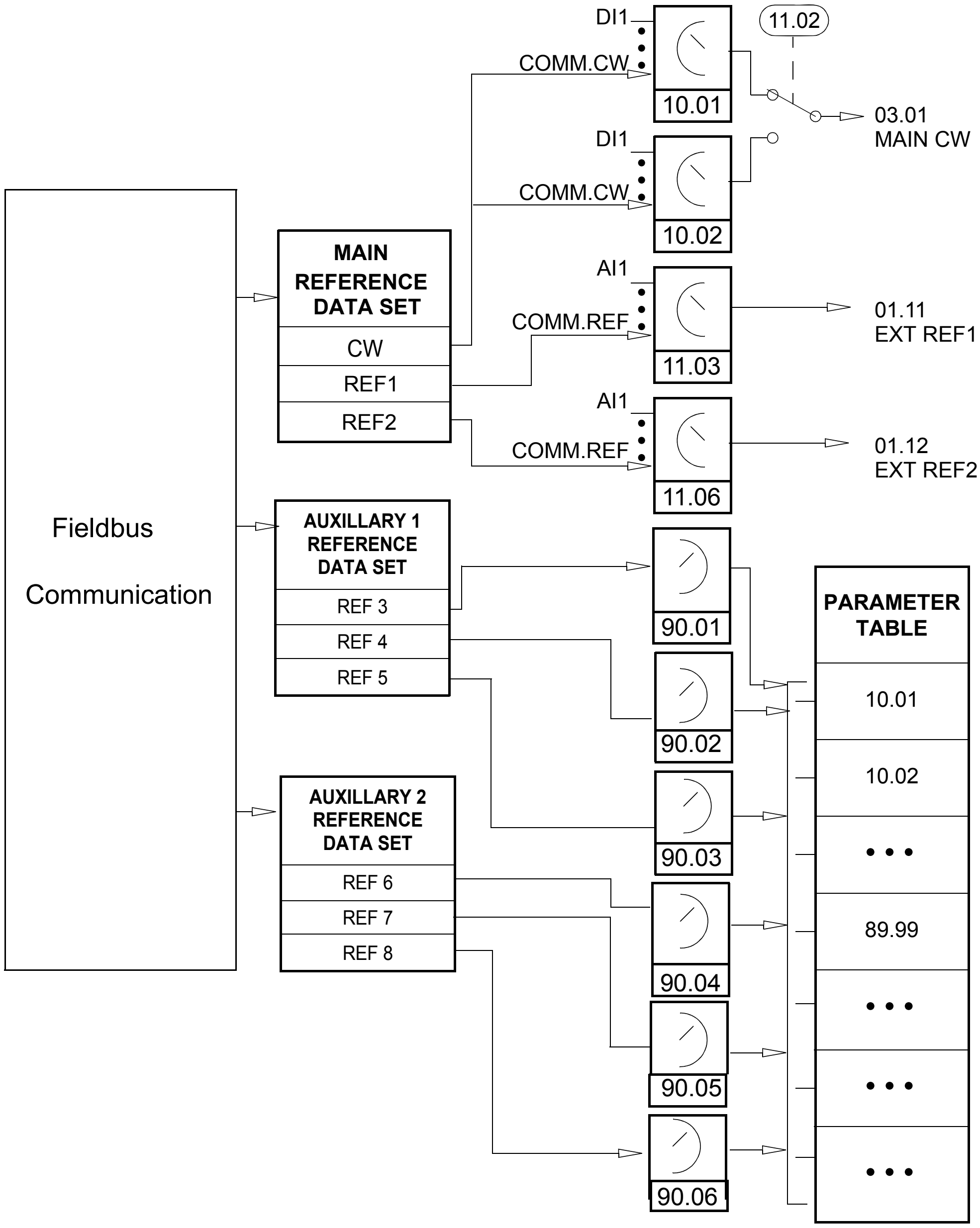
[2] Considering the function pointer is configured with an inverted signal



X11		
1	DI1A	High-end limit (0 = Emergency stop) [2] *
2	DI1B	High-end limit
X12		
1	DI2A	Low-end limit (0 = Emergency stop) [2] *
2	DI2B	Low-end limit
3	DI3A	
4	DI3B	

* To be configured using respective pointer parameters

Communication Interface



Actual signals and parameters

Chapter overview

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

Terms and abbreviations

Term	Definition
Absolute Maximum Frequency	Value of *20.08*, or *20.07* if the absolute value of the minimum limit is greater than the maximum limit.
Absolute Maximum Speed	Value of parameter *20.02*, or *20.01* if the absolute value of the minimum limit is higher than the maximum limit.
Actual signal	Signal measured or calculated by the drive. You can monitor the signal but no user settings are 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.

Actual signals

No.	Name/Value	Description	FbEq
01 ACTUAL SIGNALS		Basic signals for monitoring of the drive.	
01.02	SPEED	Calculated motor speed in rpm. Filter time setting with parameter *34.04* MOTOR SP FILT TIM.	-20000 = -100% 20000 = 100% of motor abs. max. speed
01.03	FREQUENCY	Calculated drive output frequency.	-100 = -1 Hz 100 = 1 Hz
01.04	CURRENT	Measured motor current.	10 = 1 A
01.05	TORQUE	Calculated motor torque. 100 is the motor nominal torque. Filter time setting with parameter *34.05* TORQ ACT FILT TIM.	-10000 = -100% 10000 = 100% of motor nom. torque
01.06	POWER	Motor power. 100 is the nominal power.	-1000 = -100% 1000 = 100% of motor nom. power
01.07	DC BUS VOLTAGE V	Measured intermediate circuit voltage.	1 = 1 V
01.08	MAINS VOLTAGE	Calculated supply voltage.	1 = 1 V
01.09	OUTPUT VOLTAGE	Calculated motor voltage.	1 = 1 V
01.10	ACS800 TEMP	Calculated IGBT temperature.	1 = 1 °C
01.11	EXTERNAL REF 1	External reference REF1 in rpm. (Hz if value of parameter *99.04* MOTOR CTRL MODE is SCALAR.)	1 = 1 rpm
01.12	EXTERNAL REF 2	External reference REF2. Depending on the use, 100% is the motor maximum speed, motor nominal torque, or maximum process reference.	0 = 0% 10000 = 100% 1)
01.13	CTRL LOCATION	Active control location. (1,2) LOCAL; (3) EXT1; (4) EXT2. See section *Local control vs. external control*.	See descr.
01.14	OP HOUR COUNTER	Elapsed time counter. Runs when the control board is powered.	1 = 1 h
01.15	KILOWATT HOURS	kWh counter. Counts inverter output kWh during operation (motor side - generator side).	1 = 100 kWh
01.17	DIL DI6-1 STATUS	Status of digital inputs. **Example:** 0000001 = DI1 is on, DI2 to DI6 and DIL are off.	
01.18	AI1 [V]	Value of analogue input AI1.	1 = 0.001 V
01.19	AI2 [mA]	Value of analogue input AI2.	1 = 0.001 mA
01.20	AI3 [mA]	Value of analogue input AI3.	1 = 0.001 mA
01.21	RO3-1 STATUS	Status of relay outputs. **Example:** 001 = RO1 is energised, RO2 and RO3 are de-energised.	
01.22	AO1 [mA]	Value of analogue output AO1.	1 =0.001 mA
01.23	AO2 [mA]	Value of analogue output AO2.	1 = 0.001 mA
01.27	APPLICATION MACRO	Active application macro (value of parameter *99.02*).	See *99.02*
01.28	EXT AO1 [mA]	Value of output 1 of the analogue I/O extension module (optional).	1 = 0.001 mA
01.29	EXT AO2 [mA]	Value of output 2 of the analogue I/O extension module (optional).	1 = 0.001 mA
01.30	PP 1 TEMP	Measured heatsink temperature in inverter no. 1.	1 = 1°C
01.31	PP 2 TEMP	Measured heatsink temperature in inverter no. 2 (used only in high power units with parallel inverters).	1 = 1 °C

No.	Name/Value	Description	FbEq
01.32	PP 3 TEMP	Measured heatsink temperature in inverter no. 3 (used only in high power units with parallel inverters).	1 = 1 °C
01.33	PP 4 TEMP	Measured heatsink temperature in inverter no. 4 (used only in high power units with parallel inverters).	1 = 1 °C
01.35	MOTOR 1 TEMP	Measured temperature of motor 1. See parameter *35.01* MOT 1 TEMP AI1 SEL.	1 = 1 °C
01.36	MOTOR 2 TEMP	Measured temperature of motor 2. See parameter *35.04* MOT 2 TEMP AI2 SEL.	1 = 1 °C
01.37	MOTOR TEMP EST	Estimated motor temperature. Signal value is saved at power switch off.	1 = 1 °C
01.38	AI5 [mA]	Value of analogue input AI5 read from AI1 of the analogue I/O extension module (optional). A voltage signal is also displayed in mA (instead of V).	1 = 0.001 mA
01.39	AI6 [mA]	Value of analogue input AI6 read from AI2 of the analogue I/O extension module (optional). A voltage signal is also displayed in mA (instead of V).	1 = 0.001 mA
01.40	DI15-7 STATUS	Status of digital inputs DI15 to DI7 read from the digital I/O extension modules (optional). For example, value 000000001: DI7 is on, DI8 to DI15 are off.	1 = 1
01.41	EXT RO STATUS	Status of the relay outputs on the digital I/O extension modules (optional). For example, value 0000001: RO1 of module 1 is energised. Other relay outputs are de-energised.	1 = 1
01.42	PROCESS SPEED REL	Motor actual speed in percent of the Absolute Maximum Speed. If parameter *99.04* MOTOR CTRL MODE is SCALAR, the value is the relative actual output frequency.	1 = 1
01.43	CRANE OPT TIME	Crane operation time counter. The counter runs when the inverter modulates. Can be reset with parameter *79.02* RESET OPT TIME.	1 = 10 h
01.44	FAN ON-TIME	Running time of the drive cooling fan. **Note:** Resetting of the counter is recommended when the fan is replaced. For more information, contact your local ABB representative.	1 = 10 h
01.45	CTRL BOARD TEMP	Control board temperature.	1 = 1°C
01.46	OEM SIGNAL	Text defined in parameter *99.12* OEM SIGNAL. Can be used for displaying in the control panel.	
02 ACTUAL SIGNALS		Speed and torque reference monitoring signals.	
02.01	SPEED REF 2	Limited speed reference. 100% corresponds to the Absolute Maximum Speed of the motor.	0 = 0% 20000 = 100% of motor absolute max. speed
02.02	SPEED REF 3	Ramped and shaped speed reference. 100% corresponds to the Absolute Maximum Speed of the motor.	20000 = 100%
02.09	TORQUE REF 2	Speed controller output. 100% corresponds to the motor nominal torque.	0 = 0% 10000 = 100% of motor nominal torque
02.10	TORQUE REF 3	Torque reference. 100% corresponds to the motor nominal torque.	10000 = 100%
02.13	TORQ USED REF	Torque reference after frequency, voltage and torque limiters. 100% corresponds to the motor nominal torque.	10000 = 100%
02.14	FLUX REF	Flux reference in percent.	10000 = 100%
02.17	SPEED ESTIMATED	Estimated motor speed. 100% corresponds to the Absolute Maximum Speed of the motor.	20000 = 100%

No.	Name/Value	Description	FbEq
02.18	SPEED MEASURED	Measured motor actual speed (zero when no encoder is used). 100% corresponds to the Absolute Maximum Speed of the motor.	20000 = 100%
02.19	MOTOR ACCELERATIO	Calculated motor acceleration from signal *01.02* SPEED.	1=1 rpm/s.
02.21	POS ACT PPU	Actual position measurement value, which is scaled with Par. *78.04* POS SCALE.	1=1mm
02.22	SHAFT POS	Actual shaft position in pulses.	1=1
02.23	SYNC POS ERROR	Actual Shaft position error in mm. Applicable only if the drive is a Follower.	1=1 mm
02.24	SYNC POS ERROR 1	Actual Shaft position error of Follower 1 in mm. Applicable only if the drive is the Master.	1=1 mm
02.25	SYNC POS ERROR 2	Actual Shaft position error of Follower 2 in mm. Applicable only if the drive is the Master.	1=1 mm
02.26	SYNC POS ERROR 3	Actual Shaft position error of Follower 3 in mm. Applicable only if the drive is the Master.	1=1 mm
02.27	SYNC POS ERROR 4	Actual Shaft position error of Follower 4 in mm. Applicable only if the drive is the Master.	1=1 mm
02.28	BRAKE OPT COUNTS	Brake open counter. The counter displays the number of brake open counts. Can be reset with parameter *79.01* BRAKE CTR RESET.	
03 ACTUAL SIGNALS		Data words for monitoring of fieldbus communication (each signal is a 16-bit data word).	2)
03.01	MAIN CTRL WORD	A 16-bit data word. See section *03.01 MAIN CONTROL WORD* in chapter *Fieldbus control*.	
03.02	MAIN STATUS WORD	A 16-bit data word. See section *03.02 MAIN STATUS WORD* in chapter *Fieldbus control*.	
03.03	AUX STATUS WORD	A 16-bit data word. See section *03.03 AUXILIARY STATUS WORD* in chapter *Fieldbus control*.	
03.04	LIMIT WORD 1	A 16-bit data word. See section *03.04 LIMIT WORD 1* in chapter *Fieldbus control*.	
03.05	FAULT WORD 1	A 16-bit data word. See section *03.05 FAULT WORD 1* in chapter *Fieldbus control*.	
03.06	FAULT WORD 2	A 16-bit data word. See section *03.06 FAULT WORD 2* in chapter *Fieldbus control*.	
03.07	SYSTEM FAULT	A 16-bit data word. See section *03.07 SYSTEM FAULT WORD* in chapter *Fieldbus control*.	
03.08	ALARM WORD 1	A 16-bit data word. See section *03.08 ALARM WORD 1* in chapter *Fieldbus control*.	
03.09	ALARM WORD 2	A 16-bit data word. See section *03.09 ALARM WORD 2* in chapter *Fieldbus control*.	
03.11	FOLLOWER MCW	A 16-bit data word. See section *03.11 FOLLOWER MAIN COMMAND WORD* in chapter *Fieldbus control*. For the contents, see also *Master/ Follower Application Guide* [3AFE64590430 (English)].	
03.13	AUX STATUS WORD 3	A 16-bit data word. See section *03.13 AUXILIARY STATUS WORD 3* in chapter *Fieldbus control*.	
03.14	AUX STATUS WORD 4	A 16-bit data word. See section *03.14 AUXILIARY STATUS WORD 4* in chapter *Fieldbus control*.	
03.15	FAULT WORD 4	A 16-bit data word. See section *03.15 FAULT WORD 4* in chapter *Fieldbus control*.	

No.	Name/Value	Description	FbEq
03.16	ALARM WORD 4	A 16-bit data word. See section *03.16 ALARM WORD 4* in chapter *Fieldbus control*.	
03.17	FAULT WORD 5	A 16-bit data word. See section *03.17 FAULT WORD 5* in chapter *Fieldbus control*.	
03.18	ALARM WORD 5	A 16-bit data word. See section *03.18 ALARM WORD 5* in chapter *Fieldbus control*.	
03.19	INT INIT FAULT	A 16-bit data word. See section *03.19 INT INIT FAULT* in chapter *Fieldbus control*.	
03.20	LATEST FAULT	Fieldbus code of the latest fault. See section *03.20...03.24 Fault codes* in chapter *Fieldbus control*.	
03.21	2.LATEST FAULT	Fieldbus code of the 2nd latest fault. See section *03.20...03.24 Fault codes* in chapter *Fieldbus control*.	
03.22	3.LATEST FAULT	Fieldbus code of the 3rd latest fault. See section *03.20...03.24 Fault codes* in chapter *Fieldbus control*.	
03.23	4.LATEST FAULT	Fieldbus code of the 4th latest fault. See section *03.20...03.24 Fault codes* in chapter *Fieldbus control*.	
03.24	5.LATEST FAULT	Fieldbus code of the 5th latest fault. See section *03.20...03.24 Fault codes* in chapter *Fieldbus control*.	
03.25	LATEST WARNING	Fieldbus code of the latest warning. See section *03.25...03.29 Warning codes* in chapter *Fieldbus control*.	
03.26	2.LATEST WARNING	Fieldbus code of the 2nd latest warning. See section *03.25...03.29 Warning codes* in chapter *Fieldbus control*.	
03.27	3.LATEST WARNING	Fieldbus code of the 3rd latest warning. See section *03.25...03.29 Warning codes* in chapter *Fieldbus control*.	
03.28	4.LATEST WARNING	Fieldbus code of the 4th latest warning. See section *03.25...03.29 Warning codes* in chapter *Fieldbus control*.	
03.29	5.LATEST WARNING	Fieldbus code of the 5th latest warning. See section *03.25...03.29 Warning codes* in chapter *Fieldbus control*.	
03.30	LIMIT WORD INV	A 16-bit data word. See section *03.30 LIMIT WORD INV* in chapter *Fieldbus control*.	
03.31	ALARM WORD 6	A 16-bit data word. See section *03.31 ALARM WORD 6* in chapter *Fieldbus control*.	
03.32	CRANE STATUS WORD	A 16-bit data word. See section *03.32 CRANE STATUS WORD* in chapter *Fieldbus control*.	
03.33	CRANE FAULT WORD	A 16-bit data word. See section *03.33 CRANE FAULT WORD* in chapter *Fieldbus control*.	
03.34	APPL CONTROL WORD	A 16-bit data word. See section *03.34 APPL CONTROL WORD* in chapter *Fieldbus control*.	
03.35	SPEED CORR BUF	A real value which shows the speed correction value in rpm that is used in speed control loop.	
03.36	M F STATUS WORD	A 16-bit data word. See section *03.36 M F STATUS WORD* in chapter *Fieldbus control*.	
03.37	FLW CMD WITH POS	A 16-bit data word. See section *03.37 FCW WITH POS* in chapter *Fieldbus control*.	
03.38	POSITION REM	An integer word which is used for transmission of Master position remainder, when the drive is in Shaft synchro mode. See section *Control location EXT1/EXT2 supervision mismatch* for more explanation.	

No.	Name/Value	Description	FbEq
04 ACTUAL SIGNALS		Signals for the Adaptive Program	2)
04.01	FAULTED INT INFO	A 16-bit data word. See section *03.37 FCW WITH POS* in chapter *Fieldbus control*.	
04.02	INT SC INFO	A 16-bit data word. See section *04.02 INT SC INFO* in chapter *Fieldbus control*.	
09 ACTUAL SIGNALS		Signals for the Adaptive Program	
09.01	AI1 SCALED	Value of analogue input AI1 scaled to an integer value.	20000 = 10 V
09.02	AI2 SCALED	Value of analogue input AI2 scaled to an integer value.	20000 = 20 mA
09.03	AI3 SCALED	Value of analogue input AI3 scaled to an integer value.	20000 = 20 mA
09.04	AI5 SCALED	Value of analogue input AI5 scaled to an integer value.	20000 = 20 mA
09.05	AI6 SCALED	Value of analogue input AI6 scaled to an integer value.	20000 = 20 mA
09.06	DS MCW	Control Word (CW) of the Main Reference data set received from the Master station through the fieldbus interface	0 ... 65535 (Decimal)
09.07	MASTER REF1	Reference 1 (REF1) of the Main Reference data set received from the Master station through the fieldbus interface	-32768 … 32767
09.08	MASTER REF2	Reference 2 (REF2) of the Main Reference data set received from the Master station through the fieldbus interface	-32768 … 32767
09.09	AUX DS VAL1	Auxiliary data set value 1 received from the Master station through the fieldbus interface	-32768 … 32767
09.10	AUX DS VAL2	Auxiliary data set value 2 received from the Master station through the fieldbus interface	-32768 … 32767
09.11	AUX DS VAL3	Auxiliary data set value 3 received from the Master station through the fieldbus interface	-32768 … 32767
09.12	AUX DS VAL4	Auxiliary data set value 4 received from the Master station through the fieldbus interface	-32768 … 32767
09.13	AUX DS VAL5	Auxiliary data set value 5 received from the Master station through the fieldbus interface	-32768 … 32767
09.14	AUX DS VAL6	Auxiliary data set value 6 received from the Master station through the fieldbus interface	-32768 … 32767
09.15	LCU ACT SIGNAL1	Line-side converter signal selected with parameter *95.08* LCU PAR1 SEL. A 16-bit data word.	
09.16	LCU ACT SIGNAL2	Line-side converter signal selected with parameter *95.09* LCU PAR2 SEL. A 16-bit data word.	

1) Percent of motor maximum speed / nominal torque / maximum process reference (depending on the ACS800 macro selected).

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

Parameters

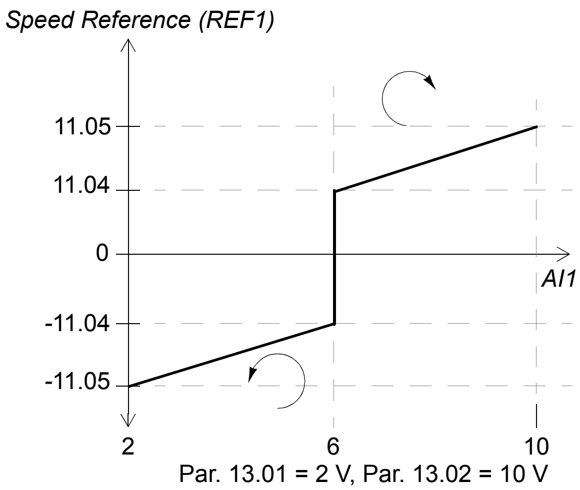
Index	Name/Selection	Description	FbEq
10 START/STOP/DIR		The sources for external start, stop and direction control	
10.01	EXT1 STRT/STP/DIR	Defines the connections and the source of the Start, Stop and Direction commands for external control location 1 (EXT1). **Note**: In M/F configuration, EXT2 should be used for M/F mode and EXT1 for stand-alone mode.	
	NOT SEL	No Start, Stop and Direction command source.	1
	DI1 F, DI2 R	Start, Stop and Direction commands through digital inputs DI1 and DI2. **DI1 / DI2 / Operation** 0 / 0 / Stop 1 / 0 / Start forward 0 / 1 / Start reverse 1 / 1 / Stop **Note:** Parameter *10.03* REF DIRECTION must be REQUEST.	2
	DI3 F, DI4R	Start, Stop and Direction commands through digital inputs DI3 and DI4. See selection DI1 F, DI2 R.	3
	DI5 F, DI6 R	Start, Stop and Direction commands through digital inputs DI5 and DI6. See selection DI1 F, DI2 R.	4
	KEYPAD	Control panel. To control the direction, parameter *10.03* REF DIRECTION must be REQUEST.	5
	COMM.CW	Fieldbus Control Word. See *03.01 MAIN CONTROL WORD* bit 3 on page *250*.	6
	PARAM 10.04	Source selected with parameter *10.04* EXT1 STRT PTR. This selection can be used for joystick controls when the joystick reference is used for deciding the direction.	7
10.02	EXT2 STRT/STP/DIR	Defines the connections and the source of the Start, Stop and Direction commands for external control location 2 (EXT2). **Note**: In M/F configuration, EXT2 should be used for M/F mode and EXT1 for stand-alone mode.	
	NOT SEL	See parameter *10.01* EXT1 STRT/STP/DIR.	1
	DI1 F, DI2 R	See parameter *10.01* EXT1 STRT/STP/DIR.	2
	DI3 F, DI4R	See parameter *10.01* EXT1 STRT/STP/DIR.	3
	DI5 F, DI6 R	See parameter *10.01* EXT1 STRT/STP/DIR.	4
	KEYPAD	See parameter *10.01* EXT1 STRT/STP/DIR.	5
	COMM.CW	See parameter *10.01* EXT1 STRT/STP/DIR.	6
	PARAM 10.05	Source selected with*10.05* EXT2 STRT PTR.This selection can be used for joystick controls when the joystick reference is used for deciding the direction.	7
10.03	REF DIRECTION	Enables the control of rotation direction of the motor, or fixes the direction.	
	FORWARD	Fixed to forward	1
	REVERSE	Fixed to reverse	2
	REQUEST	Direction of rotation control allowed	3

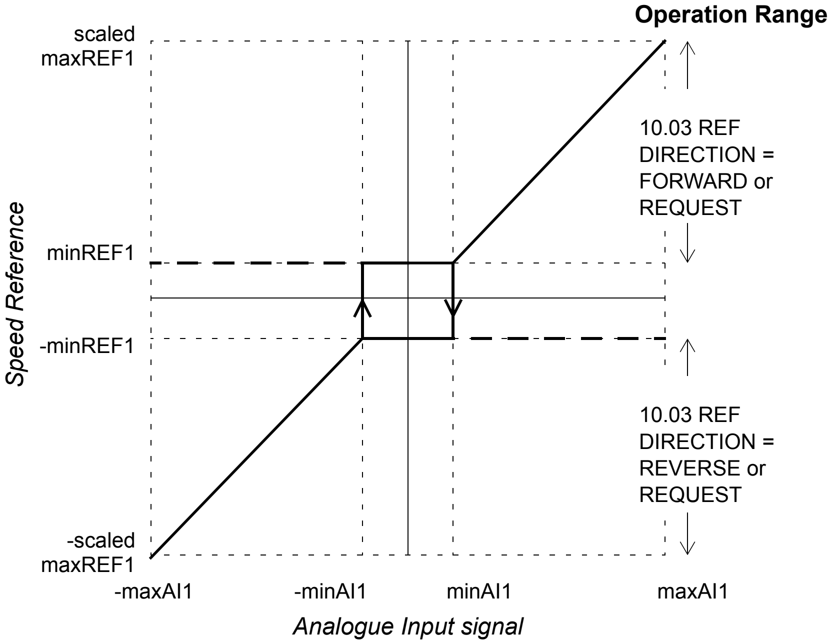
Index	Name/Selection	Description	FbEq
10.04	EXT1 STRT PTR	Defines the source or constant for value Par. *10.04* EXT1 STRT PTR of parameter *10.01* EXT1 STRT/STP/DIR.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value: - Parameter pointer: Inversion, group, index and 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.	-
10.05	EXT2 STRT PTR	Defines the source or constant for value Par. 10.05 of parameter *10.02* EXT2 STRT/STP/DIR.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	-
10.07	NET CONTROL	When active, fieldbus overrides the selection of parameter *10.01* EXT1 STRT/STP/DIR. Fieldbus Control Word (except bit 11) is enabled when EXT1 is selected as the active control location. **Note:** Only visible with the Generic Drive communication profile selected (*98.07*). **Note:** The setting is not saved in the permanent memory (will reset to zero when power is switched off).	
	0	Inactive	0
	1	Active	1
10.08	NET REFERENCE	When active, fieldbus overrides the selection of parameter *11.03* EXT REF1 SELECT. Fieldbus reference REF1 is enabled when EXT1 is selected as the active control location. **Note:** Only visible with the Generic Drive communication profile selected (*98.07*). **Note:** The setting is not saved in the permanent memory (will reset to zero when power is switched off).	
	0	Inactive	0
	1	Active	1
10.09	SLOW DOWN INPUT	Defines the input for the Slowdown command for external control location 1 (EXT1) and 2 (EXT2). When the command is active, the drive limits the speed to the slowdown reference defined with parameter *11.12* SLOW DOWN REF.	
	NOT SEL	No Slowdown selection.	1
	DI3 F,DI4 R	Slowdown command through digital input 3 and digital input 4. Slowdown active in forward direction (UP) when DI3 = 0, inactive when DI3 = 1. Slowdown active in reverse (down) direction when DI4 = 0, inactive when DI4 = 1.	2
	DI4 F,DI5 R	Slowdown command through digital input 4 and digital input 5. See DI3 F,DI4 R selection.	3
	DI7 F,DI8 R	Slowdown command through digital input 7 and digital input 8. See DI3 F,DI4 R selection.	4
	DI9 F,DI10 R	Slowdown command through digital input 9 and digital input 10. See DI3 F,DI4 R selection.	5
	PAR 10.19	Slowdown command through parameter *10.19*. This selection can be used if only one DI is used for up and down directions in parallel. Slowdown active when pointer value = 0, inactive when pointer value = 1.	6

Index	Name/Selection	Description	FbEq
10.10	FAST STOP PTR	Defines the source or constant for the Fast Stop command. The command can be a normally open (if the bit selection is not inverted) or normally closed (if the bit selection is inverted) logic according to the selection in the pointer value. When the command is active, the drive decelerates according to the parameter *22.10* value. **Note:** For safety, it is better to use the bit selection as normally closed by inverting the bit in the pointer value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	-
10.12	HIGHEND PTR	Defines the source or constant for the High-end limit command. The command can be a normally open (if the bit selection is not inverted) or normally closed (if the bit selection is inverted) logic according to the selection in the pointer value. When the command is active, emergency stop in forward direction, stop within time defined with Par. *22.07* EM STOP RAMP TIME. **Note:** For safety, it is better to use the bit selection as normally closed by inverting the bit in the pointer value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
10.13	LOWEND PTR	Defines the source or constant for the Low-end limit command. The command can be a normally open (if the bit selection is not inverted) or normally closed (if the bit selection is inverted) logic according to the selection in the pointer value. When the command is active, emergency stop in reverse direction, stop within time defined with Par. *22.07*. **Note:** For safety, it is better to use the bit selection as normally closed by inverting the bit in the pointer value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
10.14	SYNC SEL	Defines the Input for the Synchro command. When the command is active, and the drive is in Master/Follower mode, the Shaft synchronisation is enabled. The synchronisation should be enabled through the parameter *78.01* SYNCRO CONTROL Synchro selection for this parameter to be used.	
	NOT SEL	No Synchro selection.	1
	ENABLE	Synchro command always active.	2
	COMM.MODULE	Synchro command through APPL CONTROL WORD (3.34) bit 0.	3
	PARAM 10.17	Source selected with Par. *10.17* SYNC PTR.	4
10.15	HOMING ACK SEL	Defines the Input for homing acknowledgment signal used in the homing sequence. The signal initialises Actual Position PPU Par. *02.21* POS ACT PPU. The value is initialised to value defined in Par. *78.10* HOME POSITION when the drive is in homing sequence. The drive stops automatically on receiving this command in homing sequence. For more details, see section *Homing sequence* on page *92*. **Note:** Homing is activated only when the drive is controlled from EXT1.	
	NOT SEL	No selection.	1
	RESET	Homing acknowledgment using the control panel. Automatically reverts back to NOT SEL, once the acknowledgment is done.	2
	COMM.MODULE	Homing Ackn command through (03.34) APPL CONTROL WORD bit 1.	3
	PARAM 10.22	Source selected with Par. *10.22* HOMING ACK PTR.	4

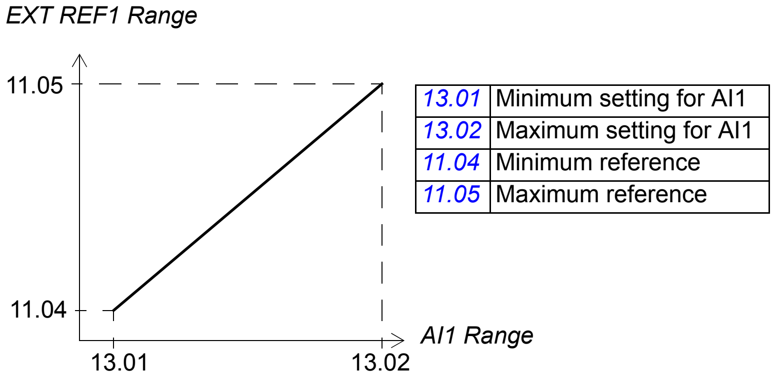
Index	Name/Selection	Description	FbEq
10.16	ZERO POS PTR	Defines the source or constant for Zero position input. Checks for this signal before the drive can be started in case the drive has stopped in a fast stop or fault condition.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	-
10.17	SYNC PTR	Defines the source or constant for value Par. *10.17* SYNC PTR of parameter *10.14* SYNC SEL.	
	-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.	-
10.19	SLOW DOWN PTR	Defines the source or constant for value Par. *10.19* SLOW DOWN PTR of parameter *10.09* SLOW DOWN INPUT.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
10.20	EXT SPD LIM PTR	Defines the source or constant for the External Speed Limit command. The command can be a normally open (if the bit selection is not inverted) or normally closed (if the bit selection is inverted) logic according to the selection in the pointer value. When the command is active, the drive speed reference is limited to the value defined in Par. *20.22* MAX EXT LIM SPD or Par. *20.23* MIN EXT LIM SPD depending on the motor direction. **Note:** For safety, it is better to use the bit selection as normally closed by inverting the bit in the pointer value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	-
10.21	HOMING SEL PTR	Defines the source or constant for Homing activation command. When the command is activated, homing sequence is activated and homing reference (Par. *11.14*) is used as the speed reference. **Note:** Homing is activated only when the drive is controlled from EXT1.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	-
10.22	HOMING ACK PTR	Defines the source or constant for Homing acknowledge command. When the command is activated and the drive is in homing sequence, the drive actual position (*02.21*) is initialized with the value set in parameter *78.10* HOME POSITION. The drive stops automatically on receiving this command during the homing sequence. **Note:** Homing is activated only when the drive is controlled from EXT1.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	-

Index	Name/Selection	Description	FbEq
11 REFERENCE SELECT		Panel reference type, external control location selection and external reference sources and limits	
11.01	KEYPAD REF SEL	Selects the type of the reference given from panel.	
	REF1 (rpm)	Speed reference in rpm. (Frequency reference (Hz) if parameter *99.04* is SCALAR.)	1
	REF2 (%)	%-reference. The use of REF2 vary depending on the application. For example, if the Torque Control using M/F is selected, REF2 is the torque reference.	2
11.02	EXT1/EXT2 SELECT	Defines the source from which the drive reads the signal that selects between the two external control locations, EXT1 or EXT2. **Note**: In M/F configuration, EXT2 should be used for control in M/F mode and EXT1 for stand-alone mode.	
	EXT1	EXT1 active. The control signal sources are defined with parameter *10.01* and *11.03*.	1
	EXT2	EXT2 active. The control signal sources are defined with parameter *10.02* and *11.06*.	2
	COMM.CW	Fieldbus Control Word. See *03.01 MAIN CONTROL WORD* bit 11 on page *250*.	3
	DI7	Digital input DI7 is the signal source.	4
	DI8	Digital input DI8 is the signal source.	5
	DI9	Digital input DI9 is the signal source.	6
	DI10	Digital input DI10 is the signal source.	7
	PARAM 11.09	Source selected with parameter *11.09*.	8
11.03	EXT REF1 SELECT	Selects the signal source for external reference REF1 **Note**: In M/F configuration, EXT2 should be used for M/F mode and EXT1 for stand-alone mode.	
	KEYPAD	Control panel. The first line on the display shows the reference value.	1
	AI1	Analogue input AI1. **Note:** If the signal is bipolar (±10 V DC), use the selection AI1 BIPOLAR. (The selection AI1 ignores the negative signal range.)	2
	AI2	Analogue input AI2.	3
	AI3	Analogue input AI3.	4

Index	Name/Selection	Description	FbEq
	AI1/JOYST	Unipolar analogue input AI1 as joystick. The minimum input signal runs the motor at the maximum reference in the reverse direction, the maximum input at the maximum reference in the forward direction. **Note:** Parameter *10.03* REF DIRECTION must have the value REQUEST. Start DI direction, if used (*10.01* or *10.02*) overwrites the joystick direction. **WARNING!** Minimum reference for joystick must be higher than 0.5 V. Set parameter *13.01* MINIMUM AI1 to 2 V or to a value higher than 0.5 V and analogue signal loss detection parameter *30.01* AI<MIN FUNCTION to FAULT. The drive will stop in case the control signal is lost.  **Note:** If the signal is bipolar (±10 V DC), use the selection AI1 BIPOLAR. The selection AI1/JOYST ignores the negative signal range.	5
	AI2/JOYST	See selection AI1/JOYST.	6
	DI3U,4D(R)	Digital input 3: Reference increase. Digital input DI4: Reference decrease. Stop command or power switch off resets the reference to zero. Parameter *22.04* ACCEL TIME 2 defines the rate of the reference change.	7
	DI3U,4D	Digital input 3: Reference increase. Digital input DI4: Reference decrease. The program stores the active speed reference (not reset with a Stop command or power switch-off). Parameter *22.04* ACCEL TIME 2 defines the rate of the reference change.	8
	DI5U,6D	See selection DI3U, 4D.	9
	COMM. REF	Fieldbus reference REF1	10
	FAST COMM	As with the selection COMM. REF, except the following differences: - shorter communication cycle time when transferring the reference to the core motor control program (6 ms -> 2 ms) - the direction cannot be controlled through interfaces defined with parameters *10.01* or *10.02*, nor with the control panel **Note:** If any of the following selections is true, the selection is not effective. Instead, the operation is according to COMM. REF. - parameter *99.04* MOTOR CTRL MODE is SCALAR	11
	AI5	Analogue input AI5	12
	AI5/JOYST	See selection AI1/JOYST.	13
	AI6/JOYST	See selection AI1/JOYST.	14
	DI11U,12D(R)	See selection DI3U,4D(R).	15

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td>DI11U,12D</td><td>See selection DI3U,4D.</td><td>16</td></tr>
<tr><td></td><td>PARAM 11.10</td><td>Source selected with Par. 11.10 EXT1 REF PTR.</td><td>17</td></tr>
<tr><td></td><td>AI1 BIPOLAR</td><td>Bipolar analogue input AI1 (-10 … 10 V). The figure below illustrates the use of the input as the speed reference.


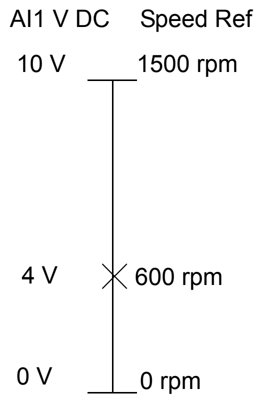
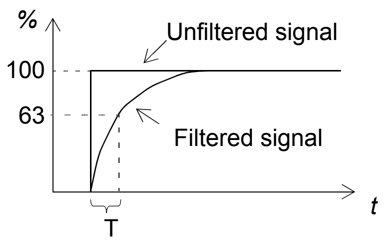
minAI1 = 13.01 MINIMUM AI1
maxAI1 = 13.02 MAXIMUM AI1
scaled maxREF1 = 13.03 SCALE AI1 x 11.05 EXT REF1 MAXIMUM
minREF1 = 11.04 EXT REF1 MINIMUM
Note: Start DI direction, if used (10.01 or 10.02) overwrites the joystick direction.</td><td>18</td></tr>
</table>

Index	Name/Selection	Description	FbEq
11.04	EXT REF1 MINIMUM	Defines the minimum value for external reference REF1 (absolute value). Corresponds to the minimum setting of the source signal used.	
	0 … 18000 rpm	Setting range in rpm (Hz if parameter *99.04* is SCALAR). **Example:** Analogue input AI1 is selected as the reference source (value of parameter *11.03* is AI1). The reference minimum and maximum correspond the AI minimum and maximum settings as follows:  **Note:** If the reference is given through fieldbus, the scaling differs from that of an analogue signal. See chapter *Fieldbus control* for more information.	1 … 18000
11.05	EXT REF1 MAXIMUM	Defines the maximum value for external reference REF1 (absolute value). Corresponds to the maximum setting of the used source signal.	
	0 … 18000 rpm	Setting range (Hz if value of parameter *99.04* is SCALAR). See parameter *11.04* EXT REF1 MINIMUM.	1 … 18000
11.06	EXT REF2 SELECT	Selects the signal source for external reference REF2. REF2 is a - speed reference in percent of the Absolute Maximum Speed if parameter *99.02* = CRANE. - frequency reference in percent of the Absolute Maximum Frequency if parameter *99.04* = SCALAR. **Note**: In M/F configuration, EXT2 should be used for M/F mode and EXT1 for stand-alone mode.	
	KEYPAD	See parameter *11.03* EXT REF1 SELECT.	1
	AI1	See parameter *11.03*. **Note:** If the signal is bipolar (±10 V DC), use the selection AI1 BIPOLAR. The selection AI1 ignores the negative signal range.	2
	AI2	See parameter *11.03*.	3
	AI3	See parameter *11.03*.	4
	AI1/JOYST	See parameter *11.03*.	5
	AI2/JOYST	See parameter *11.03*.	6
	DI3U,4D(R)	See parameter *11.03*.	7
	DI3U,4D	See parameter *11.03*.	8
	DI5U,6D	See parameter *11.03*.	9
	COMM. REF	See parameter *11.03*.	10
	FAST COMM	See parameter *11.03*. **Note:** In addition to the conditions stated for parameter 11.03, the drive must be in Torque control, and this reference used as a torque reference by the Follower drive. Otherwise this selection works like COMM.REF.	11

Index	Name/Selection	Description	FbEq
	AI5	See parameter *11.03*.	12
	AI5/JOYST	See parameter *11.03*.	13
	AI6/JOYST	See parameter *11.03*.	14
	DI11U,12D(R)	See parameter *11.03*.	15
	DI11U,12D	See parameter *11.03*.	16
	PARAM 11.11	Source selected with Par. *11.11* EXT2 REF PTR.	17
	AI1 BIPOLAR	See parameter *11.03* EXT REF1 SELECT.	18
11.07	EXT REF2 MINIMUM	Defines the minimum value for external reference REF2 (absolute value). Corresponds to the minimum setting of the source signal used.	
	0 … 100%	Setting range in percent. Correspondence to the source signal limits: - Source is an analogue input: See the example in parameter *11.04*. - Source is a serial link: See chapter *Fieldbus control*.	0 … 10000
11.08	EXT REF2 MAXIMUM	Defines the maximum value for external reference REF2 (absolute value). Corresponds to the maximum setting of the source signal used.	
	0 … 600%	Setting range. Correspondence to the source signal limits: - Source is an analogue input: See parameter *11.04*. - Source is a serial link: See chapter *Fieldbus control*.	0 … 6000
11.09	EXT 1/2 SEL PTR	Defines the source or constant for value Par. *11.09* of parameter *11.02*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
11.10	EXT 1 REF PTR	Defines the source or constant for value Par. *11.10* of parameter *11.03*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
11.11	EXT 2 REF PTR	Defines the source or constant for value Par. *11.11* of parameter *11.06*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
11.12	SLOW DOWN REF	Defines the absolute speed reference limit in Slowdown mode. Value in percentage of the motor maximum or minimum speed defined in Par. *20.02* or Par. *20.01*. If in Scalar Mode then maximum or minimum frequency defined in Par. *20.08* or Par. *20.07*. See Par. *10.09* also	
	0 … 100%	Setting range	0 … 100
11.13	JOYSTICK WARN TD	Defines the time delay for Joystick check warning in case of a joystick hardware error. Joystick error is detected, if zero speed selection is true and the speed reference or torque reference is greater than +/- 10% of minimum or maximum scaled value of the used joystick reference. If Start commands in both the direction is true simultaneously, then also it is detected as a joystick hardware error.	
	0 … 10 s	Setting range	0 … 100

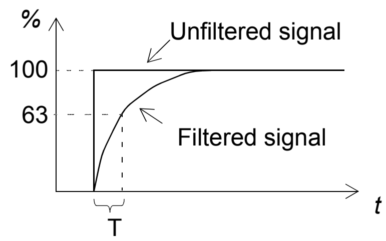
<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td>11.14</td><td>HOMING REF</td><td>Defines the speed reference in homing sequence. Value in rpm. The speed reference sign is not considered if the Start command used defines the direction also (For example, Par. 10.01 EXT1 STRT/STP/DIR configured as DI1F, DI2R). The speed reference sign will be considered when Start command does not define the direction (For example, Par. 10.01 EXT1 STRT/STP/DIR configured as Par.10.04).</td><td></td></tr>
<tr><td></td><td>-18000 … 18000 rpm</td><td>Setting range</td><td>-180000 … 180000</td></tr>
<tr><td colspan="2">12 STEP REFERENCING</td><td>Step referencing selection and values. An active step reference overrides the drive speed reference.</td><td></td></tr>
<tr><td>12.01</td><td>STEP REF SEL</td><td>Activates the step reference or selects the activation signal.</td><td></td></tr>
<tr><td></td><td>NOT SEL</td><td>No step reference in use</td><td>1</td></tr>
<tr><td></td><td>DI3,4,5</td><td>Speed defined by digital input DI3, DI4 and DI5.
<table><tr><th>DI3</th><th>DI4</th><th>DI5</th><th>Operation</th></tr><tr><td>0</td><td>0</td><td>0</td><td>STEP REF 1</td></tr><tr><td>1</td><td>0</td><td>0</td><td>STEP REF 2</td></tr><tr><td>1</td><td>1</td><td>0</td><td>STEP REF 3</td></tr><tr><td>1</td><td>1</td><td>1</td><td>STEP REF 4</td></tr></table>Any other combination of DI will activate STEP REF 1.</td><td>2</td></tr>
<tr><td></td><td>DI4,5,6</td><td>Speed defined by digital input DI4, DI5 and DI6. See DI3, 4, 5 selection.</td><td>3</td></tr>
<tr><td></td><td>DI7,8,9</td><td>Speed defined by digital input DI7, DI8 and DI9. See DI3, 4, 5 selection.</td><td>4</td></tr>
<tr><td></td><td>DI8,9,10</td><td>Speed defined by digital input DI8, DI9 and DI10. See DI3, 4, 5 selection.</td><td>5</td></tr>
<tr><td></td><td>DI9,10,11</td><td>Speed defined by digital input DI9, DI10 and DI11. See DI3, 4, 5 selection.</td><td>6</td></tr>
<tr><td></td><td>STEP POINTER</td><td>Speed defined by pointer selections Par. 12.06, Par. 12.07 and Par. 12.08. See DI3, 4, 5 selection.</td><td>7</td></tr>
<tr><td>12.02</td><td>STEP REF 1</td><td>Defines speed 1. An absolute value. Does not include the direction information.</td><td></td></tr>
<tr><td></td><td>0 … 18000 rpm</td><td>Setting range</td><td>0 … 18000</td></tr>
<tr><td>12.03</td><td>STEP REF 2</td><td>Defines speed 2. An absolute value. Does not include the direction information.</td><td></td></tr>
<tr><td></td><td>-18000 … 18000 rpm</td><td>Setting range</td><td>-18000 … 18000</td></tr>
<tr><td>12.04</td><td>STEP REF 3</td><td>Defines speed 3. An absolute value. Does not include the direction information.
Note: If inching is in use, the parameter defines the inching 1 speed. The sign is taken into account. See chapter Fieldbus control.</td><td></td></tr>
<tr><td></td><td>-18000 … 18000 rpm</td><td>Setting range</td><td>-18000 … 18000</td></tr>
<tr><td>12.05</td><td>STEP REF 4</td><td>Defines speed 4. An absolute value. Does not include the direction information.
Note: If inching is in use, the parameter defines the inching 2 speed. The sign is taken into account. See chapter Fieldbus control.</td><td></td></tr>
<tr><td></td><td>-18000 … 18000 rpm</td><td>Setting range</td><td>-18000 … 18000</td></tr>
<tr><td>12.06</td><td>STEP DI1 PTR</td><td>Defines the source or constant for value Par. 12.06 of parameter 12.01.</td><td></td></tr>
<tr><td></td><td>-255.255.31 … +255.255.31 / C.-32768 … C.32767</td><td>Parameter index or a constant value. See parameter 10.04 EXT1 STRT PTR for information on the difference.</td><td>-</td></tr>
</table>

Index	Name/Selection	Description	FbEq
12.07	STEP DI2 PTR	Defines the source or constant for value Par. *12.07* of parameter *12.01*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	-
12.08	STEP DI3 PTR	Defines the source or constant for value Par. *12.08* of parameter *12.01*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	-
13 ANALOGUE INPUTS		The analogue input signal processing. See section *Programmable analogue inputs* on page *60*.	
13.01	MINIMUM AI1	Defines the minimum value for analogue input AI1. When used as a reference, the value corresponds to the reference minimum setting. **Example:** If AI1 is selected as the source for external reference REF1, this value corresponds to the value of parameter *11.04*.	
	0 V	Zero volts. **Note:** The program cannot detect a loss of analogue input signal.	1
	2 V	Two volts	2
	TUNED VALUE	The value measured by the tuning function. See the selection *TUNE*.	3
	TUNE	The value measurement triggering. Procedure: - Connect the minimum signal to input. - Set the parameter to TUNE. **Note:** The readable range in tuning is 0 … 10 V.	4
13.02	MAXIMUM AI1	Defines the maximum value for analogue input AI1. When used as a reference, the value corresponds to the reference maximum setting. **Example:** If AI1 is selected as the source for external reference REF1, this value corresponds to the value of parameter *11.05*.	
	10 V	Ten volts (DC).	1
	TUNED VALUE	The value measured by the tuning function. See the selection *TUNE*.	2
	TUNE	Triggering of the tuning function. Procedure: - Connect the maximum signal to input. - Set the parameter to TUNE. **Note:** The readable range in tuning is 0 … 10 V.	3

Index	Name/Selection	Description	FbEq
13.03	SCALE AI1	Scales analogue input AI1. **Example:** The effect on speed reference REF1 when: - REF1 source selection (parameter *11.03*) = AI1 - REF1 maximum value setting (parameter *11.04*) = 0 rpm - REF1 maximum value setting (parameter *11.05*) = 1500 rpm - Minimum AI1 setting (parameter *13.01*) = 0 V - Maximum AI1 setting (parameter *13.02*) = 10 V - Actual AI1 value = 4 V (40% of the full scale value) - AI1 scaling = 100%  If the actual value of AI1 is 4 V, then the speed reference will correspond to (4 / (10-0)*100) = 40% of 1500 rpm which will be 600 rpm.	
	0 … 1000%	Scaling range	0 … 32767
13.04	FILTER AI1	Defines the filter time constant for analogue input AI1.  $O = I \cdot (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware (10 ms time constant). This cannot be changed with any parameter.	
	0.00 … 10.00 s	Filter time constant	0 … 1000
13.05	INVERT AI1	Activates/deactivates the inversion of analogue input AI1.	
	NO	No inversion	0
	YES	Inversion active. The maximum value of the analogue input signal corresponds to the minimum reference and vice versa.	65535
13.06	MINIMUM AI2	See parameter *13.01*.	
	0 mA	See parameter *13.01*.	1
	4 mA	See parameter *13.01*.	2
	TUNED VALUE	See parameter *13.01*.	3
	TUNE	See parameter *13.01*.	4

Index	Name/Selection	Description	FbEq
13.07	MAXIMUM AI2	See parameter 13.02.	
	20 mA	See parameter 13.02.	1
	TUNED VALUE	See parameter 13.02.	2
	TUNE	See parameter 13.02.	3
13.08	SCALE AI2	See parameter 13.03.	
	0 … 1000%	See parameter 13.03.	0 … 32767
13.09	FILTER AI2	See parameter 13.04.	
	0.00 … 10.00 s	See parameter 13.04.	0 … 1000
13.10	INVERT AI2	See parameter 13.05.	
	NO	See parameter 13.05.	0
	YES	See parameter 13.05.	65535
13.11	MINIMUM AI3	See parameter 13.01.	
	0 mA	See parameter 13.01.	1
	4 mA	See parameter 13.01.	2
	TUNED VALUE	See parameter 13.01.	3
	TUNE	See parameter 13.01.	4
13.12	MAXIMUM AI3	See parameter 13.02.	
	20 mA	See parameter 13.02.	1
	TUNED VALUE	See parameter 13.02.	2
	TUNE	See parameter 13.02.	3
13.13	SCALE AI3	See parameter 13.03.	
	0 … 1000%	See parameter 13.03.	0 … 32767
13.14	FILTER AI3	See parameter 13.04.	
	0.00 … 10.00 s	See parameter 13.04.	0 … 1000
13.15	INVERT AI3	See parameter 13.05.	
	NO	See parameter 13.05.	0
	YES	See parameter 13.05.	65535
13.16	MINIMUM AI5	See parameter 13.01. **Note:** If RAIO-01 is used with voltage input signal, 20 mA corresponds to 10 V.	
	0 mA	See parameter 13.01.	1
	4 mA	See parameter 13.01.	2
	TUNED VALUE	See parameter 13.01.	3
	TUNE	See parameter 13.01.	4
13.17	MAXIMUM AI5	See parameter 13.02. **Note:** If RAIO-01 is used with voltage input signal, 20 mA corresponds to 10 V.	
	20 mA	See parameter 13.02.	1
	TUNED VALUE	See parameter 13.02.	2
	TUNE	See parameter 13.02.	3
13.18	SCALE AI5	See parameter 13.03.	
	0 … 1000%	See parameter 13.03.	0 … 32767
13.19	FILTER AI5	See parameter 13.04.	
	0.00 … 10.00 s	See parameter 13.04.	0 … 1000

Index	Name/Selection	Description	FbEq
13.20	INVERT AI5	See parameter *13.05*.	
	NO	See parameter *13.05*.	0
	YES	See parameter *13.05*.	65535
13.21	MINIMUM AI6	See parameter *13.01*. **Note:** If RAIO-01 is used with voltage input signal, 20 mA corresponds to 10 V.	
	0 mA	See parameter *13.01*.	1
	4 mA	See parameter *13.01*.	2
	TUNED VALUE	See parameter *13.01*.	3
	TUNE	See parameter *13.01*.	4
13.22	MAXIMUM AI6	See parameter *13.02*. **Note:** If RAIO-01 is used with voltage input signal, 20 mA corresponds to 10 V.	
	20 mA	See parameter *13.02*.	1
	TUNED VALUE	See parameter *13.02*.	2
	TUNE	See parameter *13.02*.	3
13.23	SCALE AI6	See parameter *13.03*.	
	0 … 1000%	See parameter *13.03*.	0 … 32767
13.24	FILTER AI6	See parameter *13.04*.	
	0.00 … 10.00 s	See parameter *13.04*.	0 … 1000
13.25	INVERT AI6	See parameter *13.05*.	
	NO	See parameter *13.05*.	0
	YES	See parameter *13.05*.	65535
14 RELAY OUTPUTS		Status information indicated through the relay outputs, and the relay operating delays. See section *Programmable relay outputs* on page *64*.	
14.01	RO PTR1	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference. For example, default value +003.013.06 (Par. *03.13* bit 6) is used for Open brake command.	-
14.02	RO PTR2	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference. For example, default value +003.002.02 (Par. *03.02* bit 2) is used for drive running.	-
14.03	RO PTR3	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference. For example, default value -003.002.03 (Par. *03.02* bit 3) is used for inverted drive fault.	-
14.10	RO PTR4	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-

Index	Name/Selection	Description	FbEq
14.11	RO PTR5	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
14.12	RO PTR6	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
14.13	RO PTR7	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
14.14	RO PTR8	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
14.15	RO PTR9	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
15 ANALOGUE OUTPUTS		Selection of the actual signals to be indicated through the analogue outputs. Output signal processing. See section *Programmable analogue outputs* on page *61*.	
15.01	AO1 PTR	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference. For example, default value 001.002 (signal *01.02*) is used for actual speed.	1000 = 1 mA
15.02	INVERT AO1	Inverts the analogue output AO1 signal. The analogue signal is at the minimum level when the indicated drive signal is at its maximum level and vice versa.	
	NO	Inversion off	0
	YES	Inversion on	65535
15.03	MINIMUM AO1	Defines the minimum value of the analogue output signal AO1.	
	0 mA	Zero mA	1
	4 mA	Four mA	2
15.04	FILTER AO1	Defines the filtering time constant for analogue output AO1.	
	0.00 … 10.00 s	Filter time constant  $O = I \cdot (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant **Note:** Even if you select 0 s as the minimum value, the signal is still filtered with a time constant of 10 ms due to the signal interface hardware. This cannot be changed with any parameters.	0 … 1000

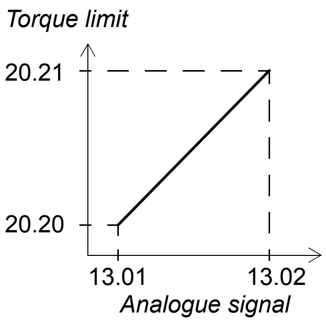
Index	Name/Selection	Description	FbEq
15.05	SCALE AO1	Scales the analogue output AO1 signal.	
	10 … 1000%	Scaling factor. If the value is 100%, the reference value of the drive signal corresponds to 20 mA. **Example:** The nominal motor current is 7.5 A and the measured maximum current at maximum load 5 A. The motor current 0 to 5 A needs to be read as 0 to 20 mA analogue signal through AO1. The required settings are: 1. AO1 is set to CURRENT with parameter *15.01*. 2. AO1 minimum is set to 0 mA with parameter *15.03*. 3. The measured maximum motor current is scaled to correspond to 20 mA analogue output signal by setting the scaling factor (k) to 150%. The value is defined as follows: The reference value of the output signal CURRENT is the motor nominal current, that is 7.5 A (see parameter *15.01* AO1 PTR). To make the measured maximum motor current correspond to 20 mA, it should be scaled equal to the reference value before it is converted to an analogue output signal. Equation: $k \times 5\ A = 7.5\ A \quad \Rightarrow \quad k = 1.5 = 150\%$	100 … 10000
15.06	AO2 PTR	Defines the source or constant for value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference. For example, default value 001.005 (signal *01.05*) is used for actual torque.	1000 = 1 mA
15.07	INVERT AO2	See parameter *15.02*.	
	NO	See parameter *15.02*.	0
	YES	See parameter *15.02*.	65535
15.08	MINIMUM AO2	See parameter *15.03*.	
	0 mA	See parameter *15.03*.	1
	4 mA	See parameter *15.03*.	2
15.09	FILTER AO2	See parameter *15.04*.	
	0.00 … 10.00 s	See parameter *15.04*.	0 … 1000
15.10	SCALE AO2	See parameter *15.05*.	
	10 … 1000%	See parameter *15.05*.	100 … 10000
16 SYST CTRL INPUTS		Run Enable, parameter lock etc.	
16.01	RUN ENABLE	Sets the Run Enable signal on, or selects a source for the external Run Enable signal. If Run Enable signal is switched off, the drive does not start or stops if it is running. The stop mode is set with parameter *21.07* RUN ENABLE FUNC. After the drive stops on Run disable condition, the drive does not restart automatically if the run enable signal is switched on with the Start command is ON. A new Start command has to be given for a new start.	
	YES	Run Enable signal is on.	1
	COMM.CW	External signal required through the Fieldbus Control Word (bit 3).	2
	DI7	Digital input DI7 is the signal source.	3
	DI9	Digital input DI9 is the signal source.	4
	DI11	Digital input DI11 is the signal source.	5
	PARAM 16.08	Source selected with parameter *16.08*.	6

Index	Name/Selection	Description	FbEq
16.02	PARAMETER LOCK	Selects the state of the parameter lock. The lock prevents parameter changing.	
	OPEN	The lock is open. Parameter values can be changed.	0
	LOCKED	Locked. Parameter values cannot be changed from the control panel. The lock can be opened by entering the valid code to parameter *16.03*.	1
16.03	PASS CODE	Selects the pass code for the parameter lock (see parameter *16.02*).	
	0 … 30000	Setting 358 opens the lock. Setting 584 opens the group 99 read only lock. The value reverts back to 0 automatically.	0 … 30000
16.04	FAULT RESET SEL	Selects the source for the fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists.	
	NOT SEL	Fault reset only from the control panel keypad (RESET key).	1
	COMM.CW	Reset through the fieldbus Control Word (bit 7), or with the RESET key of the control panel. **Note:** Reset through fieldbus Control Word (bit 7) is enabled automatically and it is independent of parameter *16.04* setting if parameter *10.01* or *10.02* is set to COMM.CW.	2
	ON STOP	Reset along with the stop signal received through a digital input, or with the RESET key of the control panel.	3
	DI8	Digital input DI8 is the signal source.	4
	DI10	Digital input DI10 is the signal source.	5
	DI12	Digital input DI12 is the signal source.	6
	PARAM 16.11	Source selected with parameter *16.11*.	7
16.05	USER MACRO IO CHG	Enables the change of the user macro through a digital input. See parameter *99.02*. The change is only allowed when the drive is stopped. During the change, the drive does not start. **Note:** Always save the user macro with parameter *99.02* after changing any parameter settings, or reperforming the motor identification. The last settings you have saved are loaded into use whenever the power is switched off and on again or the macro is changed. Any unsaved changes will be lost. **Note:** The value of this parameter is not included in the user macro. A setting once made remains despite the user macro change. **Note:** Selection of User Macro 2 can be supervised via relay output RO3. See parameter *14.03* RO PTR3 for more information.	
	NOT SEL	User macro change is not possible.	1
	DI8	Digital input DI8 is the signal source.	2
	DI9	Digital input DI9 is the signal source.	3
	DI10	Digital input DI10 is the signal source.	4
	COMM.CW	Macro change through the fieldbus Control Word (bit 12).	5
	PARAM 16.13	Source selected with parameter *16.13*.	6
16.06	LOCAL LOCK	Disables entering local control mode (***LOC/REM*** key of the panel). **WARNING!** Before activating, ensure that the control panel is not needed for stopping the drive!	
	OFF	Local control allowed.	0
	ON	Local control disabled.	65535

Index	Name/Selection	Description	FbEq
16.07	PARAMETER SAVE	Saves the valid parameter values to the permanent memory. **Note:** A new parameter value of a standard macro is saved automatically when changed from the panel but not when altered through a fieldbus connection.	
	DONE	Saving completed	0
	SAVE..	Saving in progress	1
16.08	RUN ENA PTR	Defines the source or constant for value Par. *16.08* of parameter *16.01*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
16.09	CTRL BOARD SUPPLY	Defines the source of the control board power supply. **Note:** If an external supply is used but this parameter has value INTERNAL, the drive trips on a fault at power switch off.	
	INTERNAL 24V	Internal (default).	1
	EXTERNAL 24V	External. The control board is powered from an external supply.	2
16.11	FAULT RESET PTR	Defines the source or constant for selection PARAM 16.11 of parameter *16.04*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
16.12	POWER ON RESET TD	Defines the time delay for drive reset after the power on ackn (DIL) signal is activated. Can be used for faults generated during drive initialization. See page *338* for a wiring diagram of the power ackn signal.	
	0 ... 60 s	Setting range in seconds.	0 ... 600
16.13	USER MACRO PTR	Defines the source or constant for parameter *16.05*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	-
16.14	FAN KWH CNT RESET	Resets the cooling fan running time counter or kWh counter.	
	NOT SEL	No selection.	0
	FAN CNT RST	Resets the running time counter of the drive cooling fan indicated by actual signal *01.44* FAN ON-TIME.	1
	KWH CNT RST	Resets the kWh counter indicated by actual signal *01.15* KILOWATT HOURS.	2
20 LIMITS		Drive operation limits.	
20.01	MINIMUM SPEED	Defines the allowed minimum speed. This value is the limit the drive will use in reverse direction. The limit cannot be set if parameter *99.04* = SCALAR. **Note:** The limit is linked to the motor nominal speed setting, that is parameter *99.08*. If *99.08* is changed, the default speed limit will also change.	
	-18000 / (no. of pole pairs) … Par. *20.02* rpm	Minimum speed limit. **Note:** If the value is positive, the motor cannot be run in the reverse direction.	1 = 1 rpm
20.02	MAXIMUM SPEED	Defines the allowed maximum speed. This value is the limit the drive will use in forward direction. The value cannot be set if parameter *99.04* = SCALAR. **Note:** The limit is linked to the motor nominal speed setting, that is parameter *99.08*. If *99.08* is changed, the default speed limit will also change.	
	Par. *20.01* … 18000 / (no. of pole pairs) rpm	Maximum speed limit	1 = 1 rpm

Index	Name/Selection	Description	FbEq
20.03	MAXIMUM CURRENT	Defines the allowed maximum motor current.	
	0.0 … x.x A	Current limit	0 …10·x.x
20.04	TORQ MAX LIM1	Defines the maximum torque limit 1 for the drive.	
	0.0 … 600.0%	Value of limit in percent of motor nominal torque.	0 … 60000
20.05	OVERVOLTAGE CTRL	Activates or deactivates the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque. **Note:** If a brake 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
20.06	UNDERVOLTAGE CTRL	Activates or deactivates the undervoltage control of the intermediate DC link. If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor speed in order to keep the voltage above the lower limit. By decreasing the motor speed, the inertia of the load will cause regeneration back into the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to stop. This will act as a power-loss ride-through functionality in systems with a high inertia, such as a centrifuge or a fan.	
	OFF	Undervoltage control deactivated.	0
	ON	Undervoltage control activated.	65535
20.07	MINIMUM FREQ	Defines the minimum limit for the drive output frequency. The limit can be set only if parameter *99.04* = SCALAR.	
	-300.00 … 50 Hz	Minimum frequency limit. **Note:** If the value is positive, the motor cannot be run in the reverse direction.	-30000 … 5000
20.08	MAXIMUM FREQ	Defines the maximum limit for the drive output frequency. The limit can be set only if parameter *99.04* = SCALAR.	
	-50 … 300.00 Hz	Maximum frequency limit	-5000 … 30000
20.11	P MOTORING LIM	Defines the allowed maximum power fed by the inverter to the motor.	
	0 … 600%	Power limit in percent of the motor nominal power.	0 … 60000
20.12	P GENERATING LIM	Defines the allowed maximum power fed by the motor to the inverter.	
	-600 … 0%	Power limit in percent of the motor nominal power.	-60000 … 0
20.13	MIN TORQ SEL	Selects the minimum torque limit for the drive. The update interval is 100 ms.	
	MIN LIM1	Value of parameter *20.15*.	1
	AI1	Analogue input AI1. See parameter *20.20* on how the signal is converted to a torque limit.	2
	AI2	See selection AI1.	3
	AI5	See selection AI1.	4
	PARAM 20.18	Limit given with 20.18	5
	NEG MAX TORQ	Inverted maximum torque limit defined with parameter *20.14*.	6
20.14	MAX TORQ SEL	Defines the maximum torque limit for the drive. The update interval is 100 ms.	
	MAX LIM1	Value of parameter *20.04*.	1
	AI1	Analogue input AI1. See parameter *20.20* on how the signal is converted to a torque limit.	2

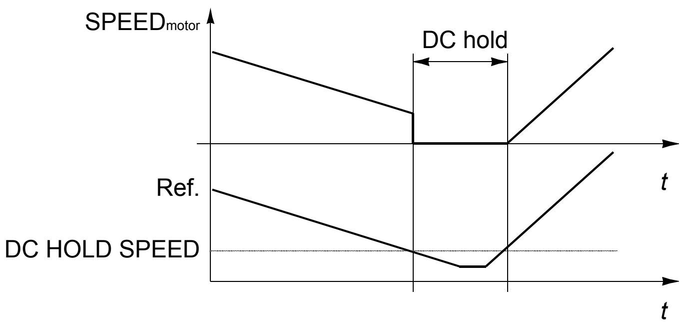
Index	Name/Selection	Description	FbEq
	AI2	See selection AI1.	3
	AI5	See selection AI1.	4
	PARAM 20.19	Limit given with 20.19	5
20.15	TORQ MIN LIM1	Defines the minimum torque limit 1 for the drive.	
	-600.0 … 0.0%	Value of limit in percent of motor nominal torque.	-60000 … 0
20.16	TORQ MIN LIM2	Defines the minimum torque limit 2 for the drive.	
	-600.0 … 0.0%	Value of limit in percent of motor nominal torque	-60000 … 0
20.17	TORQ MAX LIM2	Defines the maximum torque limit 2 for the drive.	
	0.0 … 600.0%	Value of limit in percent of motor nominal torque.	0 … 60000
20.18	TORQ MIN PTR	Defines the source or constant for value Par. *20.18* of parameter 20.13	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value.	100 = 1%
20.19	TORQ MAX PTR	Defines the source or constant for value Par. *20.19* of parameter 20.14	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference. FbEq for the torque value is 100 = 1%.	100 = 1%
20.20	MIN AI SCALE	Defines how an analogue signal (mA or V) is converted to a torque minimum or maximum limit (%). The figure below illustrates converting when analogue input AI1 has been set the source for a torque limit with parameter *20.13* or *20.14*.	

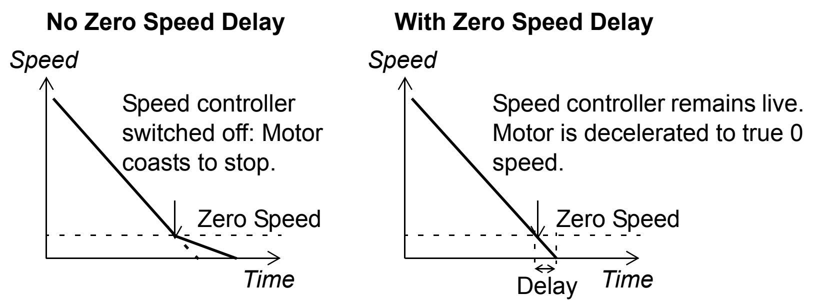


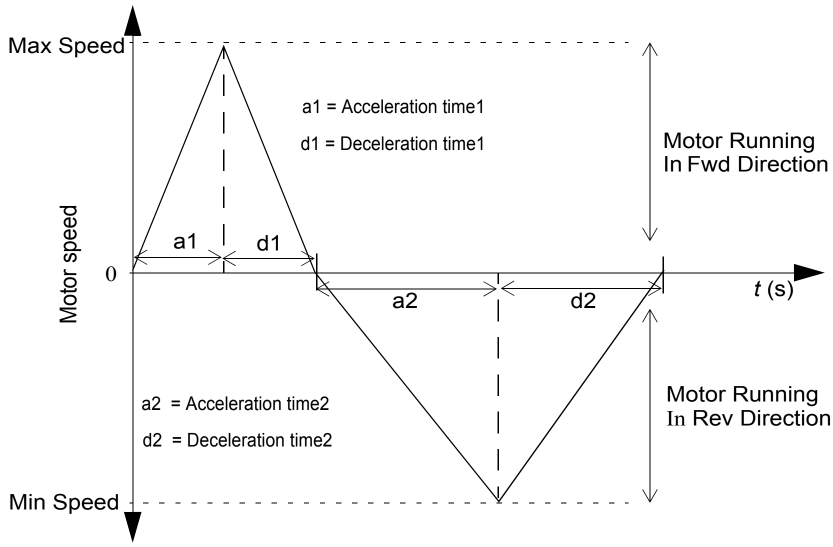
13.01	Minimum setting for AI1
13.02	Maximum setting for AI1
20.20	Minimum torque
20.21	Maximum torque

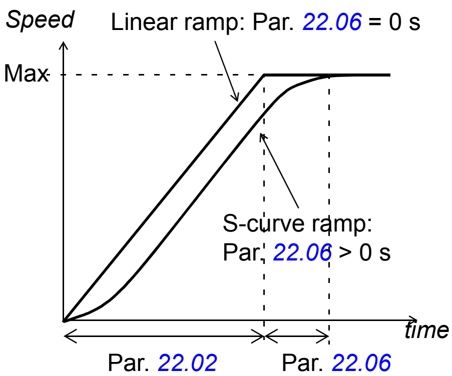
	0.0 … 600.0%	%-value that corresponds to the minimum setting of the analogue input.	100 = 1%
20.21	MAX AI SCALE	See parameter *20.20*.	
	0.0 … 600.0%	%-value that corresponds to the maximum setting of the analogue input.	100 = 1%
20.22	MAX EXT SPD LIM	Maximum external speed limit used for limiting the drive speed reference using an external source. The drive speed reference is limited to this value when the signal defined in Par. *10.20* is active in the forward direction. Signal *03.14 AUXILIARY STATUS WORD 4* bit 10 can be used to monitor if the drive speed reference is limited because of this function.	
	0… 18000 rpm	Setting range	0 ... 180000
20.23	MIN EXT SPD LIM	Minimum external speed limit used for limiting the drive speed reference using an external source. The drive speed reference is limited to this value when the signal defined in Par. *10.20* is active in the reverse direction. Signal *03.14 AUXILIARY STATUS WORD 4* bit 11 can be used to monitor if the drive speed reference is limited because of this function.	
	-18000… 0 rpm	Setting range	-180000 ...0

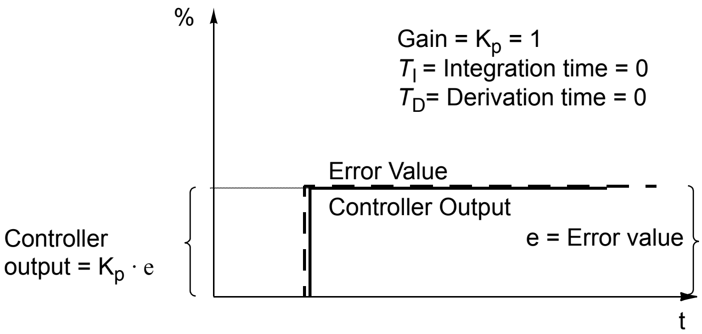
<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td colspan="2">21 START/STOP</td><td>Start and stop modes of the motor.</td><td></td></tr>
<tr><td>21.01</td><td>START FUNCTION</td><td>Selects the motor starting method.
In special crane applications like slew-motion cranes, its possible to enable the auto start function mode. For more information, contact your local ABB representative.</td><td></td></tr>
<tr><td></td><td>CNST DC MAGN</td><td>In the crane applications, this parameter is fixed to CNST DC MAGN. Constant DC magnetising is needed when constant pre-magnetising time is required (For example, if the motor start must be simultaneous with a mechanical brake release). CNST DC MAGN also guarantees the highest possible break-away torque when the pre-magnetising time is set long enough. The pre-magnetising time is defined with parameter 21.02.
Note: Starting to a rotating machine is not possible when DC magnetising is selected.
Note: DC magnetising cannot be selected if parameter 99.04 = SCALAR.
WARNING! The drive will start after the set magnetising time has passed although the motor magnetisation is not completed. Ensure always in applications where a full break-away torque is essential, that the constant magnetising time is long enough to allow generation of full magnetisation and torque.</td><td>3</td></tr>
<tr><td>21.02</td><td>CONST MAGN TIME</td><td>Defines the magnetising time in the constant magnetising mode. See parameter 21.01. After the Start command, the drive automatically pre-magnetises the motor the set time.</td><td></td></tr>
<tr><td></td><td>30.0 … 10000.0 ms</td><td>Magnetising time. To ensure full magnetising, set this value to the same value as or higher than the rotor time constant. If not known, use the rule-of-thumb value given in the table below:
<table>
<tr><th>Motor Rated Power</th><th>Constant Magnetising Time</th></tr>
<tr><td>< 10 kW</td><td>≥ 100 to 200 ms</td></tr>
<tr><td>10 to 200 kW</td><td>≥ 200 to 1000 ms</td></tr>
<tr><td>200 to 1000 kW</td><td>≥ 1000 to 2000 ms</td></tr>
</table></td><td>30 … 10000</td></tr>
<tr><td>21.03</td><td>STOP FUNCTION</td><td>Selects the motor stop function.</td><td></td></tr>
<tr><td></td><td>COAST</td><td>Stop by cutting of the motor power supply. The motor coasts to a stop.
WARNING! If the mechanical brake control function is on, the application program uses ramp stop in spite of the selection COAST (see parameter group 42 BRAKE CONTROL).</td><td>1</td></tr>
<tr><td></td><td>RAMP</td><td>Stop along a ramp. See parameter group 22 ACCEL/DECEL.</td><td>2</td></tr>
</table>

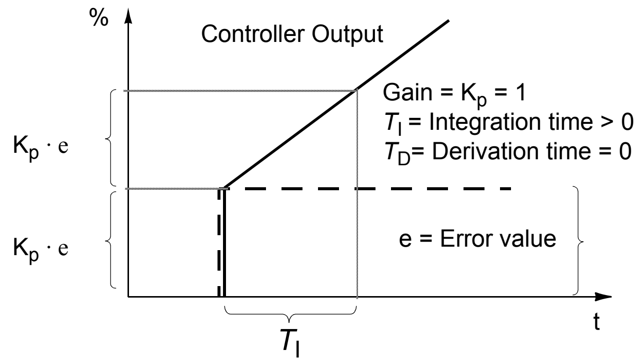
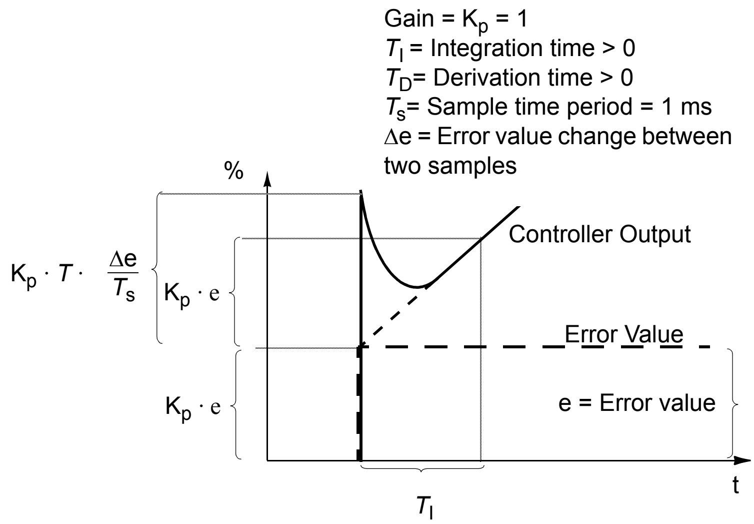
Index	Name/Selection	Description	FbEq
21.04	DC HOLD	Activates/deactivates the DC hold function. DC hold is not possible if parameter *99.04* = SCALAR. When both the reference and the speed drop below the value of parameter *21.05*, the drive will stop generating sinusoidal current and start to inject DC into the motor. The current is set with parameter *21.06*. When the reference speed exceeds parameter *21.05*, 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.	
	NO	Inactive	0
	YES	Active	65535
21.05	DC HOLD SPEED	Defines the DC hold speed. See parameter *21.04*.	
	0 … 3000 rpm	Speed in rpm	0 … 3000
21.06	DC HOLD CURR	Defines the DC hold current. See parameter *21.04*.	
	0 … 100%	Current in percent of the motor nominal current	0 … 100
21.07	RUN ENABLE FUNC	Selects the stop mode applied when Run Enable signal is switched off. Run Enable signal is put into use with parameter *16.01*. **Note:** In the Master/Follower mode, the settings must be the same in both the Master and the Follower drives. **Note:** The setting overrides the normal stop mode setting (parameter *21.03*) when Run Enable signal is switched off.	
	RAMP STOP	The application program stops the drive along the deceleration ramp defined in group *22 ACCEL/DECEL*.	1
	COAST STOP	The application program stops the drive by cutting off the motor power supply (the inverter IGBTs are blocked). The motor rotates freely to zero speed. **WARNING!** If the brake control function is on, the application program uses ramp stop in spite of the selection COAST STOP (see parameter group *42 BRAKE CONTROL*).	2
	OFF2 STOP	The application program stops the drive by cutting off the motor power supply (the inverter IGBTs are blocked). The motor rotates freely to zero speed. The drive will restart only when the Run Enable signal is on and the start signal is switched on (the program receives the rising edge of the start signal).	3
	OFF3 STOP	The application program stops the drive along the ramp defined with parameter *22.07*. The drive will restart only when the Run Enable is on and the start signal is switched on (the program receives the rising edge of the start signal).	4

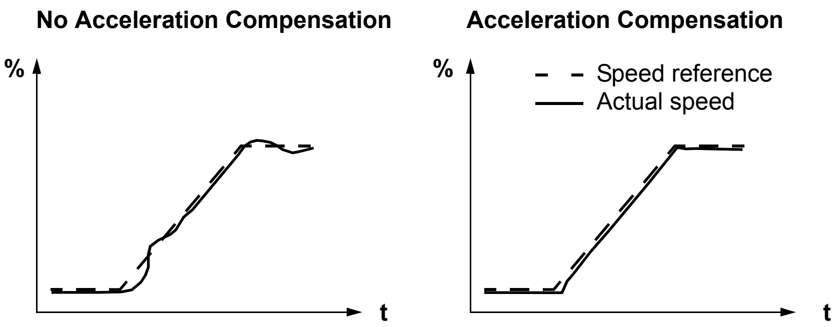
Index	Name/Selection	Description	FbEq
21.08	SCALAR FLY START	Activates the flying start feature in the Scalar control mode. See parameters *21.01* and *99.04*.	
	NO	Inactive	0
	YES	Active	65535
21.09	START INTRL FUNC	Defines how the Start Interlock input on the RMIO board affects the drive operation. **Note:** In the Master/Follower mode, the settings must be the same in both the Master and the Follower drives.	
	OFF2 STOP	Drive running: 1 = Normal operation. 0 = Stop by coasting. Drive stopped: 1 = Start allowed. 0 = No start allowed. Restart after OFF2 STOP: Input is back to 1 and the drive receives rising edge of the Start signal.	1
	OFF3 STOP	Drive running: 1 = Normal operation. 0 = Stop by ramp. The ramp time is defined with parameter 22.07 EM STOP RAMP. Drive stopped: 1 = Normal start. 0 = No start allowed. Restart after OFF3 STOP: Start Interlock input = 1 and the drive receives rising edge of the Start signal.	2
21.10	ZERO SPEED DELAY	Defines the delay for the zero speed delay function. The function is useful in applications where a smooth and quick restarting is essential. During the delay the drive knows accurately the rotor position.  **No Zero Speed Delay** The drive receives a Stop command and decelerates along a ramp. When the motor actual speed falls below an internal limit (called Zero Speed), the speed controller is switched off. The inverter modulation is stopped and the motor coasts to standstill. **With Zero Speed Delay** The drive receives a Stop command and decelerates along a ramp. When the actual motor speed falls below an internal limit (called Zero Speed), the zero speed delay function activates. During the delay the functions keeps the speed controller live: the inverter modulates, motor is magnetised and the drive is ready for a quick restart.	
	0.0 … 60.0 s	Delay time	10 = 1 s

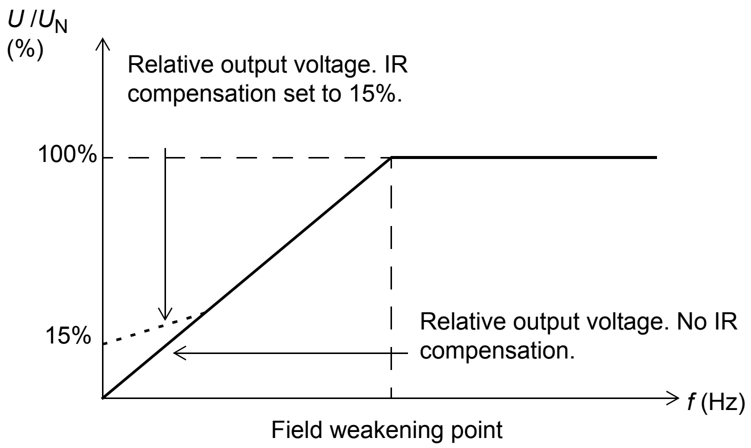
Index	Name/Selection	Description	FbEq
22 ACCEL/DECEL		Acceleration and deceleration times.	
22.01	ACC/DEC SEL	Selects the active acceleration/deceleration time pair.	
	ACC/DEC 1	Acceleration time 1 and deceleration time 1 are used. See parameters *22.02* and *22.03*.	1
	ACC/DEC 2	Acceleration time 2 and deceleration time 2 are used. See parameters *22.04* and *22.05*.	2
	ACC/DEC DIR	Acceleration time 1 and deceleration time 1 are used in forward direction and Acceleration time 2 and deceleration time 2 are used in reverse direction. See figure below. 	3
	PAR 22.08&09	Acceleration and deceleration times given with parameters 22.08 and 22.09	4
22.02	ACCEL TIME 1	Defines the acceleration time 1, that is 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 … 1800.00 s	Acceleration time	0 … 18000

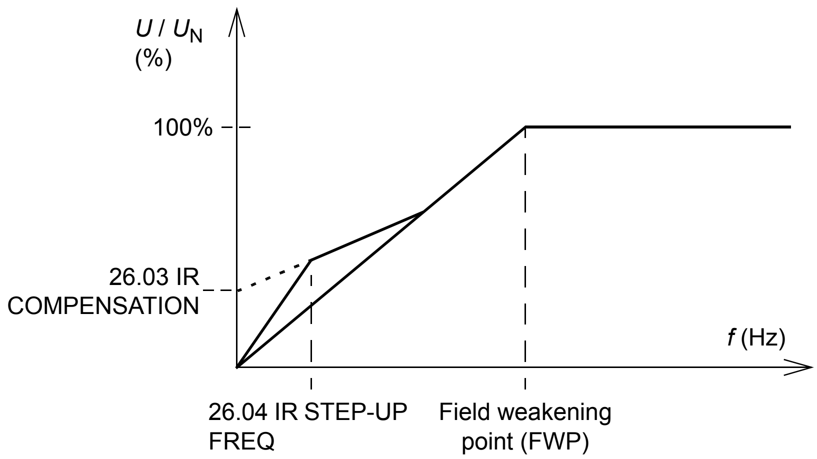
Index	Name/Selection	Description	FbEq
22.03	DECEL TIME 1	Defines the deceleration time 1, that is the time required for the speed to change from the maximum (see parameter *20.02*) to zero. - If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference signal. - If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. - If the deceleration time is set too short, the drive will automatically prolong the deceleration in order not to exceed drive operating limits. If there is any doubt about the deceleration time being too short, ensure that the DC overvoltage control is on (parameter *20.05*). **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with an electric braking option, for example, with a brake chopper and a brake resistor.	
	0.00 … 1800.00 s	Deceleration time	0 … 18000
22.04	ACCEL TIME 2	See parameter *22.02*.	
	0.00 … 1800.00 s	See parameter *22.02*.	0 … 18000
22.05	DECEL TIME 2	See parameter *22.03*.	
	0.00 … 1800.00 s	See parameter *22.03*.	0 … 18000
22.06	ACC/DEC RAMP SHPE	Selects the shape of the acceleration/deceleration ramp.	
	0.00 … 1000.00 s	0.00 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.01 … 1000.00 s: S-curve ramp. S-curve ramps are ideal for conveyors carrying fragile loads, or other applications where a smooth transition is required when changing from one speed to another. The S curve consists of symmetrical curves at both ends of the ramp and a linear part in between. A rule of thumb A suitable relation between the ramp shape time and the acceleration ramp time is 1/5. 	0 … 10000
22.07	EM STOP RAMP TIME	Defines the time inside which the drive is stopped if - the drive receives an emergency Stop command or - the Run Enable signal is switched off and the Run Enable function has value OFF3 (see parameter *21.07*). The emergency Stop command can be given through a fieldbus or an Emergency Stop module (optional). Consult the local ABB representative for more information on the optional module and the related settings of the Standard Application Program.	
	0.00 … 2000.00 s	Deceleration time	0 … 20000

Index	Name/Selection	Description	FbEq
22.08	ACC PTR	Defines the source or constant for value PAR 22.08&09 of parameter 22.01.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	100 = 1 s
22.09	DEC PTR	Defines the source or constant for value PAR 22.08&09 of parameter 22.01	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* EXT1 STRT PTR for information on the difference.	100 = 1 s
22.10	FST STP DCCL TIME	Defines the time inside which the drive is stopped if the drive receives an Fast Stop command (parameter *10.10*).	
	0.00 … 1800.00 s	Deceleration time	0 … 18000
23 SPEED CTRL		Speed controller variables. The parameters are not visible if parameter *99.04* = SCALAR. See section *Speed controller tuning* on page *71*.	
		Note: After the motor STANDARD ID run is successfully completed, the speed controller parameters 23.01 GAIN and 23.02 INTEGRATION TIME are updated to optimized crane application settings (parameter 23.01 to 15 and parameter 23.02 to 0.5). You can manually change these settings afterwards.	
23.01	GAIN	Defines a relative gain for the speed controller. Great gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant. 	
	0.0 … 250.0	Gain	0 … 25000

Index	Name/Selection	Description	FbEq
23.02	INTEGRATION TIME	Defines an integration time for the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant. The shorter the integration time, the faster the continuous error value is corrected. Too short an integration time makes the control unstable. The figure below shows the speed controller output after an error step when the error remains constant. 	
	0.01 … 999.97 s	Integration time	10 … 999970
23.03	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. 	
	0.0 … 9999.8 ms	Derivation time value.	1 = 1 ms

Index	Name/Selection	Description	FbEq
23.04	ACC COMPENSATION	Defines the derivation time for acceleration/(deceleration) compensation. In order to compensate inertia during acceleration a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described for parameter *23.03*. **Note:** As a general rule, set this parameter to the value between 50 … 100% of the sum of the mechanical time constants of the motor and the driven machine. (The speed controller Autotune Run does this automatically, see parameter *23.06*.) The figure below shows the speed responses when a high inertia load is accelerated along a ramp. 	
	0.00 … 999.98 s	Derivation time	0 … 9999
23.05	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.	0 … 400
23.06	AUTOTUNE RUN	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 auto tuning parameter *23.06* to YES. **Note:** The motor load must be connected to the motor.	
	NO	No auto tuning.	0
	YES	Activates the speed controller auto tuning. Automatically reverts to NO.	65535
23.07	SP ACT FILT TIME	Defines the time constant of the actual speed filter, that is time within the actual speed has reached 63% of the nominal speed.	
	0...1000000 ms	Time constant	1 = 1 ms
24 TORQUE CTRL		Torque control variables. Visible only if Master/Follower is Active (parameter *60.01* and parameter *99.04* = DTC.	
24.01	TORQ RAMP UP	Defines the torque reference ramp up time.	
	0.00 … 120.00 s	Time for the reference to increase from zero to the nominal motor torque.	0 … 12000
24.02	TORQ RAMP DOWN	Defines the torque reference ramp down time.	
	0.00 … 120.00 s	Time for the reference to decrease from the nominal motor torque to zero.	0 … 12000

Index	Name/Selection	Description	FbEq
26 MOTOR CONTROL			
26.01	FLUX OPTIMIZATION	Activates/deactivates the Flux optimisation function. See section *Flux optimisation* on page *68*. **Note:** The function cannot be used if parameter *99.04* = SCALAR. **Note:** The function should generally not be activated for crane application.	
	NO	Inactive	0
	YES	Active	65535
26.02	FLUX BRAKING	Activates/deactivates the Flux braking function. **Note:** The function cannot be used if parameter *99.04* = SCALAR. See section *Flux braking* on page *67*.	
	NO	Inactive	0
	YES	Active	65535
26.03	IR-COMPENSATION	Defines the relative output voltage boost at zero speed (IR compensation). The function is useful in applications with high break-away torque, but no DTC motor control cannot be applied. The figure below illustrates the IR compensation. **Note:** The function can be used only if parameter *99.04* is SCALAR. 	
	0 … 30%	Voltage boost at zero speed in percent of the motor nominal voltage	0 … 3000

Index	Name/Selection	Description	FbEq
26.04	IR STEP-UP FREQ	Defines the frequency at which the step-up IR compensation reaches the IR compensation used in Scalar control (26.03 IR COMPENSATION). A voltage boost is used in step-up applications to achieve higher break-away torque. Since voltage cannot be fed to the transformer at 0 Hz, special IR compensation is used in step-up applications. Full IR compensation starts around slip frequency. The figure below illustrates the step-up IR compensation.  For more information, see *Sine Filters User's Manual for ACS800 Drives* [3AFE68389178 (English)].	100 = 1
	0...50 Hz	Frequency	
26.05	HEX FIELD WEAKEN	Selects whether motor flux is controlled along a circular or a hexagonal pattern in the field weakening area of the frequency range (above 50/60 Hz). See section *Hexagonal motor flux* on page 74.	
	OFF	The rotating flux vector follows a circular pattern. Optimal selection in most applications: Minimal losses at constant load. Maximal instantaneous torque is not available in the field weakening range of the speed.	0
	ON	Motor flux follows a circular pattern below the field weakening point (typically 50 or 60 Hz) and a hexagonal pattern in the field weakening range. Optimal selection in the applications that require maximal instantaneous torque in the field weakening range of the speed. The losses at constant operation are higher than with the selection NO.	65535
26.06	FLUX REF PTR	Selects the source for the flux reference, or sets the flux reference value.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter 10.04 for information on the difference. The range of the flux is 25 … 140%. With constant value settings 100% = C.10000. Typically there is no need to change this value.	100 = 1%
26.07	FS METHOD	Activates the flux correction at low frequencies, < 10% of nominal frequency, when the torque exceeds 30%. Effective in the motoring and generating modes.	
	OFF	Inactive	0
	ON	Active.	1

Index	Name/Selection	Description	FbEq
27 BRAKE CHOPPER		Control of the brake chopper.	
27.01	BRAKE CHOPPER CTL	Activates the brake chopper control.	
	OFF	Inactive	0
	ON	Active. **Note:** Ensure the brake chopper and resistor are installed and the overvoltage control is switched off (parameter *20.05*).	65535
27.02	BR OVERLOAD FUNC	Activates the overload protection of the brake resistor. The user-adjustable variables are parameters *27.04* and *27.05*.	
	NO	Inactive	0
	WARNING	Active. If the drive detects an overload, it generates a warning.	1
	FAULT	Active. If the drive detects an overload, it trips on a fault.	2
27.03	BR RESISTANCE	Defines the resistance value of the brake resistor. The value is used for brake chopper protection.	
	0.00 … 100.00 ohm	Resistance value	0 … 100
27.04	BR THERM T CONST	Defines the thermal time constant of the brake resistor. The value is used in the overload protection. See parameter *27.02*. With the SACE brake resistors, the parameter setting must be 200 s. With the SAFUR brake resistors, the parameter setting must be 555 s.	
	0.000 … 10000.000 s	Time constant	1 = 1
27.05	MAX CONT BR POWER	Defines the maximum continuous braking power which will raise the resistor temperature to the maximum allowed value. The value is used in the overload protection. See parameter *27.02*.	
	0.00 …10000 kW	Power	1 = 1
27.06	BC CTRL MODE	Selects the control mode of the braking chopper.	
	AS GENERATOR	Chopper operation is allowed when the DC voltage exceeds the braking limit, the inverter bridge modulates and the motor generates power to the drive. The selection prevents the operation in case the intermediate circuit DC voltage rises due to abnormally high supply voltage level. Long time supply voltage rise would damage the chopper.	0
	COMMON DC	Chopper operation is allowed always when the DC voltage exceeds the braking limit. The selection is to be used in applications where several inverters are connected to the same intermediate circuit (DC bus). **WARNING!** Excessive supply voltage will raise the intermediate circuit voltage above the operation limit of the chopper. If the voltage remains abnormally high for a long period, the braking chopper will be overloaded and damaged.	65535
30 FAULT FUNCTIONS		Programmable protection functions	
30.01	AI<MIN FUNCTION	Selects how the drive reacts when an analogue input signal falls below the set minimum limit. **Note:** The analogue input minimum setting must be set to 0.5 V (1 mA) or above (see parameter group *13 ANALOGUE INPUTS*).	
	FAULT	The drive trips on a fault and the motor coasts to stop.	1
	NO	Inactive	2
30.02	PANEL LOSS	Selects how the drive reacts to a control panel communication break.	
	FAULT	Drive trips on a fault and the motor stops as defined with parameter *21.03*.	1
	NO	Inactive	2

Index	Name/Selection	Description	FbEq
30.03	EXTERNAL FAULT	Selects an interface for an External fault signal.	
	NOT SEL	Inactive	1
	PAR 30.24	External fault indication is given through pointer value in Par. *30.24*. 0: Fault trip. Motor coasts to stop. 1: No External fault.	2
30.04	MOTOR THERM PROT	Selects how the drive reacts when the motor overtemperature is detected by the function defined with parameter *30.05*.	
	FAULT	The drive generates a warning when the temperature exceeds the warning level (95% of the allowed maximum value). The drive trips on a fault when the temperature exceeds the fault level (100% of the allowed maximum value).	1
	WARNING	The drive generates a warning when the temperature exceeds the warning level (95% of the allowed maximum value).	2
	NO	Inactive	3
30.05	MOT THERM P MODE	Selects the thermal protection mode of the motor. When overtemperature is detected, the drive reacts as defined with parameter *30.04*.	
	DTC	The protection is based on the calculated motor thermal model. The following assumptions are used in the calculation: - The motor is at the estimated temperature (value of *01.37* 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 (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 finetune the model with parameter *30.07*. **Note:** The model cannot be used with high power motors (parameter *99.06* is higher than 800 A). **WARNING!** The model does not protect the motor if it does not cool properly due to dust and dirt.	1
	USER MODE	The protection is based on the user-defined motor thermal model and the following basic assumptions: - The motor is at the estimated temperature (value of *01.37* 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 (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 the motor thermal time constant (parameter *30.06*) and the motor load curve (parameters *30.07*, *30.08* and *30.09*). User tuning is typically needed only if the ambient temperature differs from the normal operating temperature specified for the motor. **WARNING!** The model does not protect the motor if it does not cool properly due to dust and dirt.	2

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

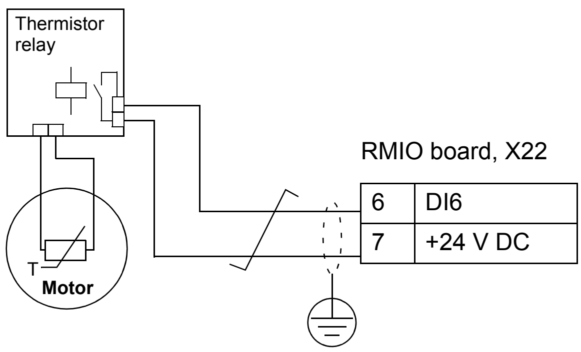
<table>
<tr><th>DI6 Status (Thermistor resistance)</th><th>Temperature</th></tr>
<tr><td>1 (0 … 1.5 kohm)</td><td>Normal</td></tr>
<tr><td>0 (4 kohm or higher)</td><td>Overtemperature</td></tr>
</table>

WARNING! According to IEC 664, the connection of the motor thermistor to the digital input requires double or reinforced insulation between motor live parts and the thermistor. Reinforced insulation entails a clearance and creeping distance of 8 mm (400 / 500 V AC 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.

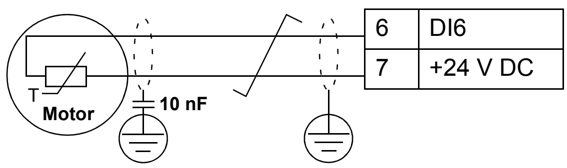
WARNING! Digital input DI6 may be selected for another use. Change these settings before selecting THERMISTOR. In other words, ensure that digital input DI6 is not selected with any other parameter.

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

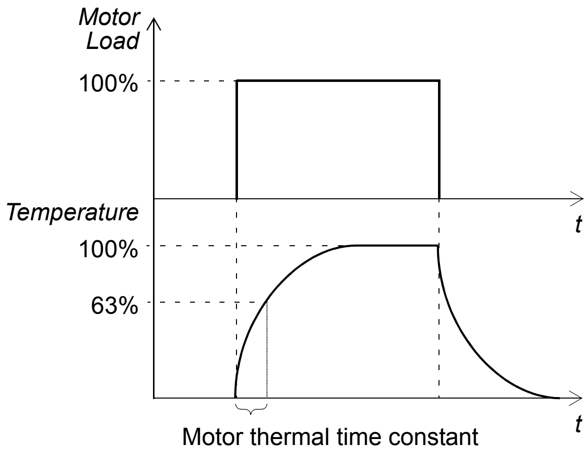
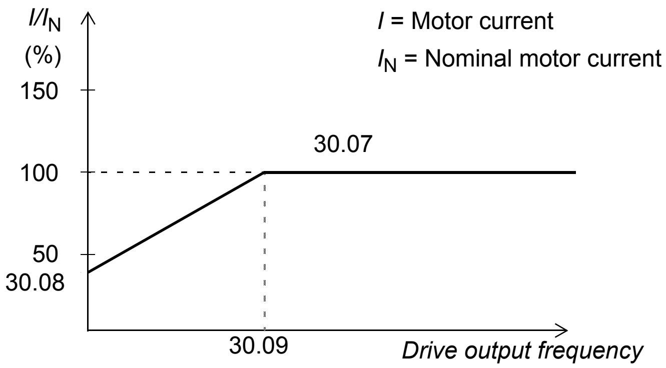
Alternative 1

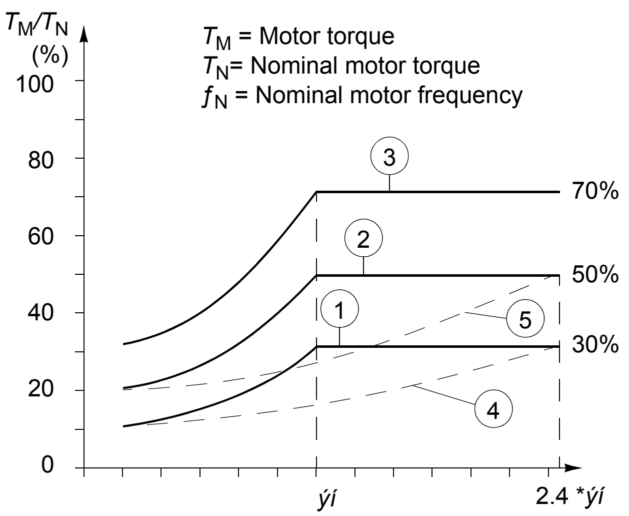


Alternative 2

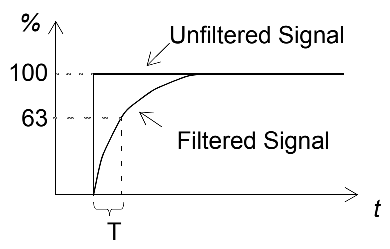


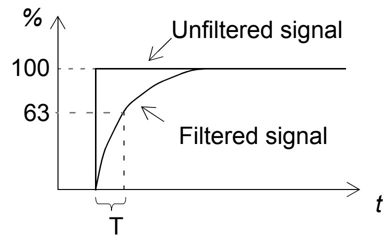
</td><td>3</td></tr>
</table>

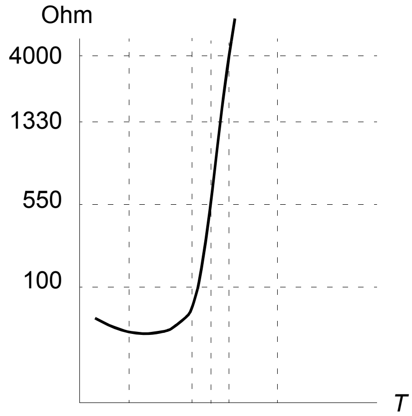
Index	Name/Selection	Description	FbEq
30.06	MOTOR THERM TIME	Defines the thermal time constant for the user-defined thermal model (see the selection USER MODE of parameter *30.05*).  	
	256.0 … 9999.8 s	Time constant	256 … 9999
30.07	MOTOR LOAD CURVE	Defines the load curve together with parameters *30.08*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

Index	Name/Selection	Description	FbEq
30.10	STALL FUNCTION	Selects how the drive reacts to a motor stall condition. The protection wakes up if: - the drive is at stall limit (defined with parameters *20.03*, *20.13* and *20.14*) - the output frequency is below the level set with parameter *30.11* and - the conditions above have been valid longer than the time set with parameter *30.12* STALL TIME. **Note:** Stall limit is restricted by internal current limit *03.04* TORQ_INV_CUR_LIM.	
	FAULT	The drive trips on a fault.	1
	WARNING	The drive generates a warning. The indication disappears in half of the time set with parameter *30.12* STALL TIME.	2
	NO	Protection is inactive.	3
30.11	STALL FREQ HI	Defines the frequency limit for the stall function. See parameter *30.10* STALL FUNCTION.	
	0.5 … 50.0 Hz	Stall frequency	50 … 5000
30.12	STALL TIME	Defines the time for the stall function. See parameter *30.10* STALL FUNCTION.	
	10.00 … 400.00 s	Stall time	10 … 400
30.13	UNDERLOAD FUNC	Selects how the drive reacts to underload. The protection wakes up if: - the motor torque falls below the curve selected with parameter *30.15*, - output frequency is higher than 10% of the nominal motor frequency and - the above conditions have been valid longer than the time set with parameter *30.14*.	
	NO	Protection is inactive.	1
	WARNING	The drive generates a warning.	2
	FAULT	The drive trips on a fault.	3
30.14	UNDERLOAD TIME	Time limit for the underload function. See parameter *30.13*.	
	0 … 600 s	Underload time	0 … 600
30.15	UNDERLOAD CURVE	Selects the load curve for the underload function. See parameter *30.13*. 	
	1 … 5	Number of the load curve	1 … 5

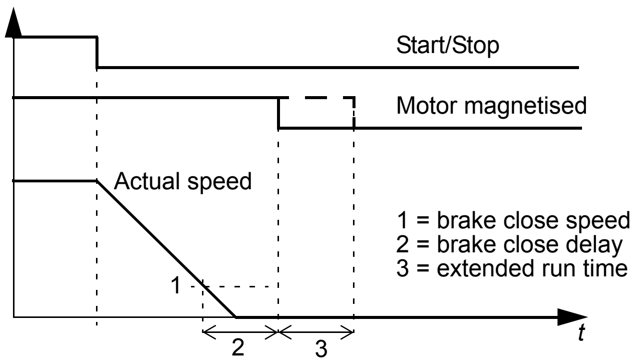
Index	Name/Selection	Description	FbEq
30.16	MOTOR PHASE LOSS	Activates the Motor phase loss supervision function.	
	NO	Inactive	0
	FAULT	Active. The drive trips on a fault.	65535
30.17	EARTH FAULT	Selects how the drive reacts when an earth fault is detected in the motor or the motor cable. See section *Earth fault protection* on page *77*.	
	WARNING	The drive generates a warning.	0
	FAULT	The drive trips on a fault.	65535
30.18	COMM FLT FUNC	Selects how the drive reacts in a fieldbus communication break, that is when the drive fails to receive the Main Reference Data Set or the Auxiliary Reference Data Set. The time delays are given with parameters *30.19* and *30.21*.	
	FAULT	Protection is active. The drive trips on a fault and stops the motor as defined with parameter *21.03*.	1
	NO	Protection is inactive.	2
30.19	MAIN REF DS T-OUT	Defines the time delay for the Main Reference data set supervision. See parameter *30.18*.	
	0.1 … 60.0 s	Time delay	10 … 6000
30.21	AUX DS T-OUT	Defines the delay time for the Auxiliary Reference data set supervision. See parameter *30.18*. The drive automatically activates the supervision 60 seconds after power switch-on if the value is other than zero. **Note:** The supervision can be displayed by setting the value to 0.	
	0.0 … 60.0 s	Time delay. 0.0 s = The function is inactive.	0 … 6000
30.22	IO CONFIG FUNC	Selects how the drive reacts in case an optional input or output channel has been selected as a signal interface, but the communication to the appropriate analogue or digital I/O extension module has not been set up accordingly in parameter group *98 OPTION MODULES*. **Example:** The supervision function wakes up if parameter *16.01* is set to DI7, but *98.03* is set to NO.	
	NO	Inactive.	1
	WARNING	Active. The drive generates a warning.	2
30.23	LIMIT WARNING	Activates/deactivates limit alarms INV CUR LIM, DC BUS LIM, MOT CUR LIM, MOT TORQ LIM and/or MOT POW LIM. For more information, see chapter *Fault tracing*.	
	0...255	Value in decimal. As default none of the alarms are active, that is, the parameter value is 0. bit 0 INV_CUR_LIM_IND bit 1 DC_VOLT_LIM_IND bit 2 MOT_CUR_LIM_IND bit 3 MOT_TORQ_LIM_IND bit 4 MOT_POW_LIM_IND **Example:** When parameter value is set to 3 (bit 0 and 1 values are 1), alarms INV CUR LIM and DC BUS LIM are active.	-
30.24	EXT FAULT PTR	Defines the source or constant for selection PAR 30.24 of parameter *30.03*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-

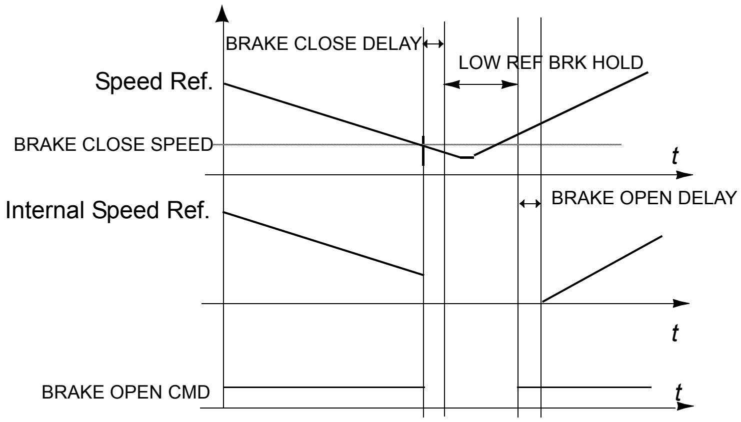
Index	Name/Selection	Description	FbEq
33 INFORMATION		Program versions, test date	
33.01	SOFTWARE VERSION	Displays the type and the version of the firmware package in the drive. **Note:** You cannot change the parameter setting.	
		Decoding key: AQCR716x Product Series A = ACS800 Product Q = ACS800 Crane Firmware Version 716x = Version 7.16x	
33.02	APPL SW VERSION	Displays the type and the version of the application program. **Note:** You cannot change the parameter setting.	
		Decoding key: AQCCxxyx Product Series A = ACS800 Product Q = ACS800 Crane Firmware Type C = Crane Application Program Firmware Version 7xyx = Version 7.xyx	
33.03	TEST DATE	Displays the test date. **Note:** You cannot change the parameter setting.	
		Date value in format DDMMYY (day, month, year)	-
34 PROCESS VARIABLE		- filtering for the actual signals speed and torque	
34.04	MOTOR SP FILT TIM	Defines a filter time constant for actual signal *01.02* SPEED. The time constant has an effect on all functions in which signal SPEED is used. The actual speed value is used, for example, in analogue output value (group *15 ANALOGUE OUTPUTS*) or as an actual signal shown on the control panel display or PC screen.	
	0 … 20000 ms	Filter time constant  $O = I \cdot (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant	0 … 20000

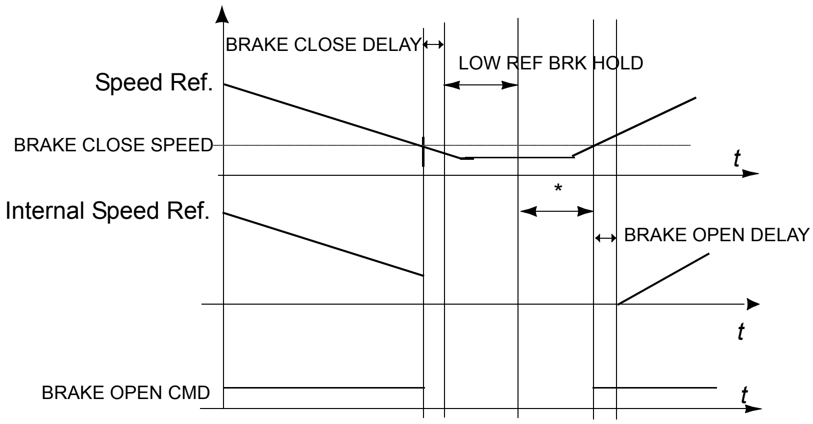
Index	Name/Selection	Description	FbEq
34.05	TORQ ACT FILT TIM	Defines a filter time for the actual signal torque (actual signal *01.05*). Affects also on the torque read through an analogue output.	
	0 … 20000 ms	Filter time constant  $O = I \cdot (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant	0 … 20000
35 MOT TEMP MEAS		Motor temperature measurement. For the function description, see sections *Motor temperature measurement through the standard I/O interface* on page *81* and *Motor temperature measurement through an analogue I/O extension* on page *83*.	
35.01	MOT 1 TEMP AI1 SEL	Activates the motor 1 temperature measurement function and selects the sensor type. **Note:** If an optional analogue I/O extension module RAIO is used for the temperature measurement and *35.01* MOT 1 TEMP AI1 SEL and/or *35.04* MOT 2 TEMP AI2 SEL are set to 1xPT100, analogue extension module input signal range must be set to 0 ... 2 V (instead of 0 ... 10 V) with DIP switches.	
	NOT IN USE	The function is inactive.	1
	1xPT100	The function is active. The temperature is measured with one Pt 100 sensor. Analogue output AO1 feeds constant current through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through analogue input AI1 and converts it to degrees centigrade.	2
	2XPT100	The function is active. Temperature is measured using two Pt 100 sensors. See selection *1xPT100*.	3
	3XPT100	The function is active. Temperature is measured using three Pt 100 sensors. See selection *1xPT100*.	4

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td></td><td>1...3 PTC</td><td>The function is active. The temperature is supervised using one to three PTC sensors. Analogue output AO1 feeds constant current through the sensor(s). The resistance of the sensor increases sharply as the motor temperature rises over the PTC reference temperature (T_{ref}), as does the voltage over the resistor. The temperature measurement function reads the voltage through analogue input AI1 and converts it into ohms. The figure below shows typical PTC sensor resistance values as a function of the motor operating temperature.
<table>
<tr><th>Temperature</th><th>Resistance</th></tr>
<tr><td>Normal</td><td>0 … 1.5 kohm</td></tr>
<tr><td>Excessive</td><td>≥ 4 kohm</td></tr>
</table>

</td><td>5</td></tr>
<tr><td>35.02</td><td>MOT 1 TEMP ALM L</td><td>Defines the alarm limit for motor 1 temperature measurement. The alarm indication is given when the limit is exceeded.</td><td></td></tr>
<tr><td></td><td>-10 … 5000 ohm/°C (PTC/Pt100)</td><td>Limit in °C or ohms. °C: parameter 35.01 is 1xPT100, 2XPT100, 3XPT100. Ohm: parameter 35.01 is 1...3 PTC.</td><td>-10 … 5000</td></tr>
<tr><td>35.03</td><td>MOT 1 TEMP FLT L</td><td>Defines the fault trip limit for motor 1 temperature measurement. The fault indication is given when the limit is exceeded.</td><td></td></tr>
<tr><td></td><td>-10 … 5000 ohm/°C (PTC/Pt100)</td><td>Limit in °C or ohms. °C: parameter 35.01 is 1xPT100, 2XPT100, 3XPT100. Ohm: parameter 35.01 is 1...3 PTC.</td><td>-10 … 5000</td></tr>
<tr><td>35.04</td><td>MOT 2 TEMP AI2 SEL</td><td>Activates the motor 2 temperature measurement function and selects the sensor type. Two motors can be protected only by using an optional analogue extension module. Parameter 98.12 needs to be activated.
Note: If 98.12 is activated, the analogue I/O extension is also used for motor 1 temperature measurement (the standard I/O terminals are not in use).
Note: If an optional analogue I/O extension module RAIO is used for the temperature measurement and 35.01 MOT 1 TEMP AI1 SEL and/or 35.04 MOT 2 TEMP AI2 SEL are set to 1xPT100, analogue extension module input signal range must be set to 0 ... 2 V (instead of 0 …10 V) with DIP switches.</td><td></td></tr>
<tr><td></td><td>NOT IN USE</td><td>See 35.01.</td><td>1</td></tr>
<tr><td></td><td>1xPT100</td><td>See 35.01.</td><td>2</td></tr>
<tr><td></td><td>2XPT100</td><td>See 35.01.</td><td>3</td></tr>
<tr><td></td><td>3XPT100</td><td>See 35.01.</td><td>4</td></tr>
<tr><td></td><td>1...3 PTC</td><td>See 35.01.</td><td>5</td></tr>
<tr><td>35.05</td><td>MOT 2 TEMP ALM L</td><td>Defines the alarm limit for the motor 2 temperature measurement function. The alarm indication is given when the limit is exceeded.</td><td></td></tr>
<tr><td></td><td>-10 … 5000 ohm/°C (PTC/Pt100)</td><td>See 35.02.</td><td>-10 … 5000</td></tr>
</table>

Index	Name/Selection	Description	FbEq
35.06	MOT 2 TEMP FLT L	Defines the fault trip limit for the motor 2 temperature measurement function. The fault indication is given when the limit is exceeded.	
	-10 … 5000 ohm/°C (PTC/Pt100)	See *35.03*.	-10 … 5000
35.07	MOT MOD COMPENSAT	Selects whether measured motor 1 temperature is used in the motor model compensation.	
	NO	The function is inactive.	1
	YES	The temperature is used in the motor model compensation. **Note:** Selection is possible only when Pt 100 sensor(s) are used.	2
42 BRAKE CONTROL		Control of a mechanical brake. The function operates on a 20 ms time level. For the function description, see section *Control of a mechanical brake* on page *112*.	
42.01	BRAKE CTRL	Activates the brake control function.	
	OFF	Inactive	1
	ON	Active	2
42.02	BRAKE ACKNOWLEDGE	Activates the external brake on/off supervision and selects the source for the signal. The use of the external on/off supervision signal is optional.	
	OFF	Inactive	1
	DI11	Active. Digital input DI11 is the signal source. DI11 = 1: Brake is open. DI11 = 0: Brake is closed.	2
	DI12	Digital input DI11 is the signal source. See selection DI11	3
	PAR 42.15	Signal source selected using Par. *42.15* BRAKE ACKN PTR. See selection DI11.	4
42.03	BRAKE OPEN DELAY	Defines the brake open delay (= the delay between the internal Open brake command and the release of the motor speed control). The delay counter starts when the drive has magnetised the motor and risen the motor torque to the level required at the brake release (parameters *42.07* and *42.08*). Simultaneously with the counter start, the brake function energises the relay output controlling the brake and the brake starts opening. **Note:** If DI is used for brake acknowledge, the speed control is released on the DI activation and does not wait for the complete time delay.	
	0.0 … 5.0 s	Delay time. Set the delay time to the same value as the mechanical opening delay of the brake specified by the brake manufacturer.	0 … 500
42.04	BRAKE CLOSE DELAY	Defines the brake close delay. The delay counter starts when the motor actual speed has fallen below the set level (parameter *42.05*) after the drive has received the Stop command. Simultaneously with the counter start, the brake control function de-energises the relay output controlling the brake, and the brake starts closing. During the delay, the brake function keeps the motor live preventing the motor speed from falling below zero. **Note:** See also Par. *78.13* POS HYSTERISIS.	
	0.0 … 60.0 s	Delay time. Set the delay time to the same value as the mechanical make-up time of the brake (= operating delay when closing) specified by the brake manufacturer.	0 … 6000
42.05	ABS BRAKE CLS SPD	Defines the brake close speed. See parameter *42.04*. **Note:** See also Par. *78.13* POS HYSTERISIS.	
	0 … 1000 rpm	Speed (an absolute value)	0 …10000

Index	Name/Selection	Description	FbEq
42.06	BRAKE FAULT FUNC	Defines how the drive reacts in case the status of the optional external Brake Acknowledge signal does not meet the status presumed by the brake control function.	
	FAULT	The drive trips on a fault: fault indication and drive stops the motor.	1
	WARNING	The drive generates a warning.	2
42.07	STRT TORQ REF SEL	Selects the source for the motor starting torque reference applied at the brake release. The value is read in percent of the motor nominal torque. **Note**: For all selections, the minimum value used will be the value defined in Par. *42.08*.	
	NO	No source selected. This is the default value.	1
	AI1	Analogue input AI1	2
	AI2	Analogue input AI2	3
	AI3	Analogue input AI3	4
	AI5	Analogue input AI5	5
	AI6	Analogue input AI6	6
	PAR 42.08	Defined with parameter *42.08*.	7
	MEMORY	The motor torque stored at the previous brake Close command.	8
42.08	START TORQ REF	Defines the motor starting torque at brake release if parameter *42.07* START TORQ REF SEL has value PAR 42.08.	
	10 … 300%	Torque value in percent of the motor nominal torque	1000 … 30000
42.09	EXTEND RUN T	Defines an extended run time for the brake control function at stop. During the delay, the motor is kept magnetised and ready for an immediate restart. **Note**: During operation in the local control mode, the magnetisation delay can be interrupted by giving a second Stop command from the panel. The second Stop command would be effective only to break the extended run time sequence when it is already in the extended run time phase.	
	0.0 …3600.0 s	0.0 s = Normal stop routine of the brake control function: The motor magnetisation is switched off after the brake close delay has passed. 0.1 … 3600.0 s = Extended stop routine of the brake control function: The motor magnetisation is switched off after the brake close delay and the extended run time have passed. During the extended run time, a zero torque reference is applied, and the motor is ready for an immediate restart. 	100 = 1 s

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td>42.10</td><td>LOW REF BRK HOLD</td><td>Activates a brake hold function and defines the hold delay for it. The function stabilises the operation of the brake control application when the motor operates near zero speed.</td><td></td></tr>
<tr><td></td><td>0.0 … 60.0 s</td><td>
0.0 s = inactive.
0.1 s … 60.0 s = active. When the absolute value of the motor speed reference falls below the brake close speed:
- The brake is closed according to the normal stop routine of the brake control function
- The brake hold delay counter starts after the brake close delay.
During the delay, the function keeps the brake closed despite the speed reference value and the value of the Start command. When the set delay has passed, the normal operation resumes if the absolute speed reference is greater than the brake close speed.
The following figures explain the two different scenarios that can occur in the LOW REF BRK HOLD function.
Case 1: The absolute speed reference goes above the brake close speed before the Low Ref Brk Hold time has elapsed.


Case 2: The absolute speed reference goes above the brake close speed after the Low Ref Brk Hold time has elapsed. The brake is opened only after the speed reference goes above the brake close speed. In this case the brake immediately opens when the speed ref is greater than the brake close speed, because the LOW REF BRK HOLD time has already elapsed.


* This time is the additional delay until the speed ref goes above the brake close speed.
</td><td>100 = 1 s</td></tr>
</table>

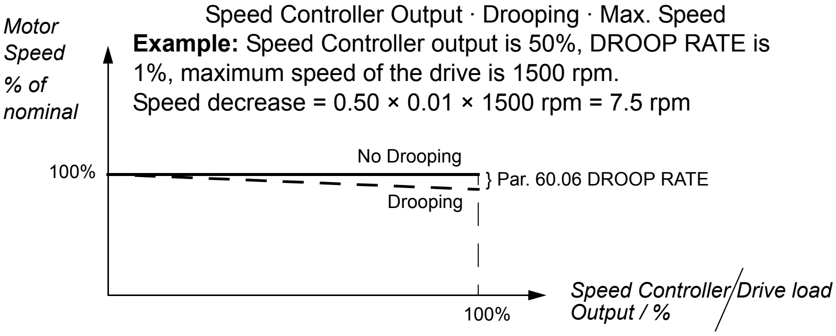
Index	Name/Selection	Description	FbEq
42.11	MOTOR SLIP SPD	Defines the motor slip speed allowed during brake opening. If the motor speed exceeds this level during brake opening, a brake slip fault will be generated. This function performs a mechanical system check of the brake during the Torque proving sequence, ensuring that the brake does not slip during the Torque proving sequence with the brake closed. Not applicable in Scalar mode.	
	0 … 100 rpm	Speed (an absolute value)	0 …1000
42.12	SLIP FAULT DELAY	Defines the motor slip time delay during brake opening. If the motor speed exceeds the slip speed during brake opening, BRAKE SLIP FAULT will be generated. Not applicable in Scalar mode.	
	0 … 60 s	Time	0 …6000
42.13	BRK LONG FLT DLY	Defines the time delay for generating a brake fault after the brake close delay has elapsed. This parameter is applicable only when encoder feedback is used and brake acknowledge DI is used. During the brake close delay, the drive checks whether the brake has physically closed by checking the status of the brake acknowledge DI. If the DI is still active after the brake close delay, the drive keeps the torque ON to the motor for the time defined. If the brake long fault delay time has elapsed and the DI is still active, the drive trips on a brake fault. A status bit (*03.32* bit 9) is available when the drive is operating at the brake long fault delay period along with a CDP message ‘BRK LONG TIME’, which can be used for safety interlock or generating alarms.	
	0 … 60 s	Time	0 …6000
42.14	SAFETY CLOSE CMD	Activates the Safety close function. This function monitors the actual speed of the motor when the drive is running without the encoder. When the actual speed is below 1% of the max speed for more than 2 seconds with the Start command active, the drive trips on SAFETYCLS FLT.	
	DISABLE	Function is inactive	1
	ENABLE	Function is active	2
42.15	BRAKE ACKN PTR	Defines the source or constant for value PAR 42.15 of parameter *42.02*	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
42.16	BRK REOPEN DLY	Defines the brake reopen delay time after a Stop command is issued. The brake is opened only after this time period after brake closing sequence is over with a Stop command. This function helps in improper brake opening and closing sequence due to immediate Start -> Stop -> Start sequence.	
	0 … 5 s	Time	0 …500

Index	Name/Selection	Description	FbEq
50 ENCODER MODULE		Encoder connection. Visible only when a pulse encoder module (optional) is installed and activated with parameter *98.01*. The settings will remain the same even though the application macro is changed.	
50.01	PULSE NR	States the number of encoder pulses per one revolution.	
	0 … 29999 ppr	Pulse number in pulses per round (ppr)	0 … 29999
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.	0
	A _‾_	Channel A: positive and negative edges calculated for speed. Channel B: not used.	1
	A _‾_ B DIR	Channel A: positive and negative edges are calculated for speed. Channel B: direction.	2
	A _‾_ B _‾_	All edges of the signals are calculated.	3
50.03	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 between the module and the drive. Encoder supervision function activates if either of the following conditions is valid: -The difference between the estimated and measured speed is greater than 20% of the motor nominal speed. - No pulses are received from the encoder within the defined time (see parameter *50.04*) and the drive is simultaneously at the current or torque limit. When the torque is zero or low, the shaft may not move and no pulses are detected. This means that at low torque/current the missing-pulse-supervision is not possible. Therefore there must be conditional torque or current limit in the pulse supervision. Now the limit is the maximum torque/current, because then the shaft is expected to move at least a little bit and at least some encoder pulses are detected.	
	WARNING	The drive generates a warning indication.	0
	FAULT	The drive trips on a fault, gives a fault indication and stops the motor.	65535
50.04	ENCODER DELAY	Defines the time delay for the encoder supervision function at start (See parameter *50.03*). **Note**: It the delay is set to 0 ms, encoder supervision at start is disabled.	
	0 … 50000 ms	Time delay	0 … 50000
50.05	ENCODER DDCS CH	Defines the fibre optic channel of the control board from which the drive program reads the signals coming from the pulse encoder interface module. The setting is valid only if the module is connected to the drive via the DDCS link (that is not to the option slot of the drive).	
	CH 1	Signals via channel 1 (CH1). The pulse encoder interface module must be connected to CH1 instead of CH2 in applications where CH2 is reserved by a Master station (For example, a Master/Follower application). See also parameter *70.03*.	1
	CH 2	Signals via channel 2 (CH2). Can be used in most cases.	2
50.06	SPEED FB SEL	Defines the speed feedback value used in control.	
	INTERNAL	Calculated speed estimate	65535
	ENCODER	Actual speed measured with an encoder	0

Index	Name/Selection	Description	FbEq
50.07	ENC CABLE CHECK	Selects the drive operation when encoder signal is missing. **Note:** Monitoring is only for RTAC-03. For more information, see *RTAC-03 TTT Pulse Encoder Interface Module User's Manual* [3AFE68650500 (English)]	
	DISABLED	Not active	1
	WARNING	Drive generates warning ENC CABLE.	2
	FAULT	The drive trips on ENC CABLE.	3
51 COMM MODULE DATA		The parameters are visible and need to be adjusted, only when a fieldbus adapter module (optional) is installed and activated with parameter *98.02*. For details on the parameters, refer to the manual of the fieldbus module and chapter *Fieldbus control*. These parameter settings will remain the same even though the macro is changed.	
52 STANDARD MODBUS		The settings for the Standard Modbus Link. See chapter *Fieldbus control*.	
52.01	STATION NUMBER	Defines the address of the device. Two units with the same address are not allowed on-line.	
	1 … 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 bit/s	6
52.03	PARITY	Defines the use of parity and stop bit(s). The same setting must be used in all on-line stations.	
	NONE1STOPBIT	No parity bit, one stop bit	1
	NONE2STOPBIT	No parity bit, two stop bits	2
	ODD	Odd parity indication bit, one stop bit	3
	EVEN	Even parity indication bit, one stop bit	4
60 MASTER/ FOLLOWER		Master/Follower application. For more information, see section *Master/ Follower use of several drives (Only in EXT2 Control)* on page *94* and a separate *Master/Follower Application Guide* [3AFE64590430 (English)].	
60.01	MASTER LINK MODE	Defines the role of the drive on the Master/Follower link. **Note:** Master/Follower configuration will work with complete functionality only when the drive is in **EXT2** control. EXT1 control can be used for the drive to be a stand-alone drive with M/F link active. Two Master stations are not allowed on-line. If a Follower drive is changed to be a Master drive (or vice versa) with this parameter, the RMIO board must be powered up again for the M/F link to work properly.	
	NOT IN USE	The Master/Follower link is not active.	1
	MASTER	Master drive	2
	FOLLOWER 1	Follower drive	3
	FOLLOWER 2	Follower drive	4
	FOLLOWER 3	Follower drive	5

Index	Name/Selection	Description	FbEq
	FOLLOWER 4	Follower drive	6
	STANDBY	Follower drive which reads the control signals through a fieldbus interface, not from the Master/Follower link as usual.	7
60.02	TORQUE SELECTOR	Selects the reference used in motor torque control. Typically, the value needs to be changed only in the Follower station(s). The parameter is visible only when Master/Follower is active (See Par. *60.01*).	
	ZERO	This selection forces the output of the torque selector to zero.	1
	SPEED	The Follower speed controller output is used as a reference for motor torque control. The drive is speed-controlled. SPEED can be used both in the Follower and in the Master if - the motor shafts of the Master and Follower are connected flexibly. (A slight speed difference between the Master and the Follower is possible/allowed.) - drooping is used (see parameter *60.06*).	2
	TORQUE	The drive is torque-controlled. The selection is used in the Follower(s) when the motor shafts of the Master and Follower are coupled solidly to each other by gearing, a chain or other means of mechanical power transmission and no speed difference between the drives is allowed or possible. **Note:** If TORQUE is selected, the drive does not restrict the speed variation as long as the speed is within the limits defined with parameters *20.01* and *20.02*. More definite speed supervision is often needed. In those cases, the selection ADD should be used instead of TORQUE. Par. *11.02* should be EXT2.	3
	MINIMUM	The torque selector compares the direct torque reference and the speed controller output, and the smaller of them is used as the reference for the motor torque control. MINIMUM is selected in special cases only. Par. *11.02* should be EXT2. Speed reference should be connected to EXT1 and torque reference to EXT2.	4
	MAXIMUM	The torque selector compares the direct torque reference and the speed controller output and the greater of them is used as the reference for the motor torque control. MAXIMUM is selected in special cases only. Par. *11.02* should be EXT2. Speed reference should be connected to EXT1 and torque reference to EXT2.	5
	ADD	The torque selector adds the speed controller output to the direct torque reference. The drive is torque-controlled in the normal operating range. The selection ADD, together with the window control, forms a speed supervision function for a torque-controlled Follower drive. See parameter *60.03*. Par. *11.02* should be EXT2. Speed reference should be connected to EXT1 and torque reference to EXT2.	6

Index	Name/Selection	Description	FbEq
60.03	WINDOW SEL ON	Activates the Window control function. The Window control, together with selection ADD at parameter *60.02*, forms a speed supervision function for a torque-controlled drive. The parameter is visible only when Master/Follower is active (See Par. *60.01*). External control location 2 (EXT2) must be active to enable window control.	
	NO	Inactive	0
	YES	Window control is active. Selection YES is used only when parameter *60.02* has value ADD. Window control supervises the speed error value (Speed Reference - Actual Speed). In the normal operating range, window control keeps the speed controller input at zero. The speed controller is evoked only if: - the speed error exceeds the value of parameter *60.04* or - the absolute value of the negative speed error exceeds the value of parameter *60.05*. When the speed error moves outside the window, the exceeding part of the error value is connected to the speed controller. The speed controller produces a reference term relative to the input and gain of the speed controller (parameter *23.01*) which the torque selector adds to the torque reference. The result is used as the internal torque reference for the drive. **Example:** In a load loss condition, the internal torque reference of the drive is decreased to prevent an excessive rise of the motor speed. If window control were inactivated, the motor speed would rise until a speed limit of the drive were reached.	65535
60.04	WINDOW WIDTH POS	Defines the supervision window width above the speed reference. See parameter *60.03*. The parameter is visible only when Master/Follower is active (See Par. *60.01*).	
	0 … 1500 rpm	Positive window width	0… 20000
60.05	WINDOW WIDTH NEG	Defines the supervision window width below the speed reference. See parameter *60.03*. The parameter is visible only when Master/Follower is active (See Par. *60.01*).	
	0 … 1500 rpm	Negative window width	0… 20000

Index	Name/Selection	Description	FbEq
60.06	DROOP RATE	Defines the droop rate. The parameter value needs to be changed only if both the Master and the Follower are speed-controlled: - External control location 1 (EXT1) is selected (see parameter *11.02* or - External control location 2 (EXT2) is selected (see parameter *11.02*) and parameter *60.02* is set to SPEED. 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, that is equal to the value of the DROOP RATE. The drooping effect decreases linearly to zero along with the decreasing load. **Speed Decrease =** Speed Controller Output · Drooping · Max. Speed **Example:** Speed Controller output is 50%, DROOP RATE is 1%, maximum speed of the drive is 1500 rpm. Speed decrease = 0.50 × 0.01 × 1500 rpm = 7.5 rpm 	
	0 … 100%	Droop rate in percent of the motor nominal speed.	0 … 1000
60.07	MASTER SIGNAL 2	Selects the signal that is sent by the Master to the Follower(s) as *Reference 1* (speed reference).	
	0000 … 9999	Parameter index	0000 … 9999
60.08	MASTER SIGNAL 3	Selects the signal that is sent by the Master to the Follower(s) as *Reference 2* (torque reference for load sharing or speed reference for Shaft synchronisation). **Note**: This has to be set to 202 when the Par. *60.11* is set as SPEED and has to be set 213 when the Par. *60.11* is set as TORQUE.	
	0000 … 9999	Parameter index	0000 … 9999
60.09	LOAD SHARE	Selects the scaling factor in percentage of the signal that is sent by the Master to the Follower(s) as *Reference 2* (torque reference). Active only in Follower drives.	
	0.... 400 %	Percentage	0.... 400
60.10	NO OF SLAVES	Selects the number of slaves when the drive is selected as the Master. Active only if selected as Master.	
	1.... 4	Setting range	1.... 4

Index	Name/Selection	Description	FbEq
60.11	SLAVE MODE	Defines the Follower control mode. To be defined only in the Master drive. This defines the Master signal 3 (see parameter *60.08*) to be used according to the slave mode.	
	SPEED	The Follower drives are configured for speed control. For example,: Follower drives are in Shaft synchro mode.	1
	TORQUE	The Follower drives are configured for torque control. For example, Follower drives are in load sharing mode.	2
70 DDCS CONTROL		Settings for the fibre optic channels 0, 1 and 3.	
70.01	CHANNEL 0 ADDR	Defines the node address for channel 0. No two nodes on-line may have the same address. The setting needs to be changed when a master station is connected to channel 0 and it does not automatically change the address of the slave. Examples of such masters are an ABB Advant Controller or another drive.	
	1 … 125	Address.	1 … 125
70.02	CHANNEL 3 ADDR	Node address for channel 3. No two nodes on-line may have the same address. Typically the setting needs to be changed when the drive is connected in a ring which consists of several drives and a PC with the DriveWindow program running.	
	1 … 254	Address.	1 … 254
70.03	CH1 BAUD RATE	The communication speed of channel 1. Typically the setting needs to be changed only if the pulse encoder interface module is connected to channel 1 instead of channel 2. Then the speed must be changed to 4 Mbit/s. See also parameter *50.05*.	
	8 Mbit/s	8 megabits per second	0
	4 Mbit/s	4 megabits per second	1
	2 Mbit/s	2 megabits per second	2
	1 Mbit/s	1 megabits per second	3
70.04	CH0 DDCS HW CONN	Selects the topology of the channel 0 link.	
	RING	Devices are connected in ring topology.	0
	STAR	Devices are connected in a star topology.	1
70.05	CH2 HW CONNECTION	Selects the topology of the channel 2 link. **Note:** Only the RING topology is supported.	
	RING	Devices are connected in ring topology.	0
	STAR	Devices are connected in a star topology. Not supported.	1
74 SPEED MONITOR		Settings for Speed monitoring. See section *External speed limitation* on page *85.*	
74.01	MOT OVERSPEED LEV	Defines the motor overspeed level in percentage of maximum speed (Par. *20.02*). The value is applicable in both forward and reverse direction. The drive trips indicating MOTOROVER SPD when the motor speed exceeds this level.	
	0 … 200 %	Percent.	0 … 2000

Index	Name/Selection	Description	FbEq
75 SPEED MATCHING		Settings for Speed matching. See section *Speed matching (internal overload protection)* on page *87.* **Note:** When Shaft synchronisation is active, avoid using this function as the speed correction from synchronisation block can do step speed corrections after the speed ramp.	
75.01	SPEED MATCH SEL	Selects whether Speed matching is active or not. **Note:** This function should be activated only for drives running in Speed mode.	
	TRUE	Active.	
	FALSE	Inactive.	
75.02	SP DEV LEV	Defines the motor speed deviation level in percentage of maximum speed (Par. *20.02*) when the drive is running at the set point. Value is applicable in both forward and reverse direction. A speed above this level when the drive is at set point, means that the speed error is too high. See also parameter *75.03*.	
	0 … 100 %	Percent.	0 … 1000
75.03	SPD MATCH FLT TD	Defines the Speed match fault delay time when the speed error is higher than defined in the parameter *75.02* SP DEV LEV. The drive trips on SPD MATCH FLT if the speed error is higher than the SP DEV LEV for more than the delay time defined.	
	0 … 60 s	Time. Defines the Speed match fault delay time.	0 … 600
75.04	SPD CHG PER SEC	Defines the Speed matching deviation when the drive is accelerating or decelerating. While accelerating/decelerating, if the absolute difference between the rate of ramped speed reference, and the rate of change of actual speed, is greater the defined value and continues for a period defined in the Par. *75.03* then the drive will trip on SPD MATCH FLT during acceleration/ deceleration. The rate of change of ramped speed reference is calculated using the active acceleration/deceleration time. See section *Speed matching (internal overload protection)* for more explanation.	
	0 … 100 %/s	Percent per second	0 … 1000
76 TORQUE PROVING		Settings for Torque proving. See section *Torque proving (Crane system check)* on page *88.*	
76.01	TORQ PROV SEL	Selects whether Torque proving is active or not.	
	TRUE	Active.	
	FALSE	Inactive.	
76.02	TORQ PROV FLT TD	Defines the Torque proving fault delay time. The drive trips on TORQ PROVE FLT if actual motor torque of 30% has not been attained in the time interval defined.	
	0 … 100 s	Time. Defines the Torque proving fault delay time.	0 … 1000

Index	Name/Selection	Description	FbEq
77 LOAD SPEED CTRL		Settings for Load speed control. See section *Load speed control* on page *123.* **Note:** The Base speed versus Motor current graph is plotted using the parameters *77.04* … *77.19*. These parameters have to be configured in the correct sequence and if the sequence of values in these parameters are not correct, the speed will be limited to Par. *77.04* Base speed. For more information, see section *Load speed control* on page *123.*	
77.01	LOAD SPD CTRL SEL	Defines the Load speed control function activation command. If this selection command is not active then the speed limit is not calculated with this function.	
	NOT SEL	No Load speed control.	1
	ENABLE	Load speed control always active.	2
	COMM.MODULE	Load speed control through APPL CONTROL WORD (3.34) bit 2.	3
	PARAM 77.02	Load speed selected with Par. *77.02* LOAD SPD CTRL PTR.	4
77.02	LOAD SPD CTRL PTR	Defines the source or constant for value Par. 77.02 LOAD SPD CTRL PTR of parameter *77.01* LOAD SPD CTRL SEL.	
	-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.	-
77.03	HOLD RAMP	Defines time period for holding the speed reference after which the motor has crossed the base speed to check for the motor current. This motor current after this time period delay is regarded by the function as the base speed current for the particular load used.	
	0.00 … 5.00 s	The speed reference holding time.	0 … 500
77.04	CURRENT X1 FWD	Defines the current in amps expected at the base speed in forward direction for limiting the speed reference to the value in parameter *77.05* REF Y1 FWD. This current can be the empty hook current at the base speed when running in the forward direction.	
	0.0 … 3000.0 A	Setting range in amps.	0 … 30000
77.05	REF Y1 FWD	Defines the speed in rpm to be used as the speed limit in forward direction, if the current at the base speed in forward direction is equal to the value in parameter *77.04* CURR X1 FWD. This value can be the maximum allowed speed in empty hook condition in the forward direction.	
	0.0 … 18000.0 rpm	Setting range in rpm.	0 … 180000
77.06	CURRENT X2 FWD	Defines the current in amps expected at the base speed in forward direction for limiting the speed reference to the value in parameter *77.07* REF Y2 FWD.	
	0.0 … 3000.0 A	Setting range in amps.	0 … 30000
77.07	REF Y2 FWD	Defines the speed in rpm to be used as the speed limit in forward direction, if the current at the base speed in forward direction is equal to the value in parameter *77.06* CURR X2 FWD.	
	0.0 … 18000.0 rpm	Setting range in rpm.	0 … 180000
77.08	CURRENT X3 FWD	Defines the current in amps expected at the base speed in forward direction for limiting the speed reference to the value in Parameter *77.09* REF Y3 FWD.	
	0.0 … 3000.0 A	Setting range in amps.	0 … 30000
77.09	REF Y3 FWD	Defines the speed in rpm to be used as the speed limit in forward direction, if the current at the base speed in forward direction is equal to the value in parameter *77.08* CURR X3 FWD.	
	0.0 … 18000.0 rpm	Setting range in rpm.	0 … 180000

Index	Name/Selection	Description	FbEq
77.10	CURRENT X4 FWD	Defines the current in amps expected at the base speed in forward direction for limiting the speed reference to the value in parameter *77.11* REF Y4 FWD. This current can be the current at the base speed with maximum load when running in the forward direction.	
	0.0 … 3000.0 A	Setting range in amps.	0 … 30000
77.11	REF Y4 FWD	Defines the speed in rpm to be used as the speed limit in forward direction, if the current at the base speed in forward direction is equal to the value in parameter *77.10* CURR X4 FWD. This value can be the minimum allowed speed in maximum load condition in the forward direction.	
	0.0 … 18000.0 rpm	Setting range in rpm.	0 … 180000
77.12	CURRENT X1 REV	Defines the current in amps expected at the base speed in reverse direction for limiting the speed reference to the value in parameter *77.13* REF Y1 REV. This current can be the empty hook current at the base speed when running in the reverse direction.	
	0.0 … 3000.0 A	Setting range in amps.	0 … 30000
77.13	REF Y1 REV	Defines the speed in rpm to be used as the speed limit in forward direction, if the current at the base speed in reverse direction is equal to the value in parameter *77.12* CURR X1 REV. This value can be the maximum allowed speed in empty hook condition in the reverse direction.	
	0.0 … 18000.0 rpm	Setting range in rpm.	0 … 180000
77.14	CURRENT X2 REV	Defines the current in amps expected at the base speed in reverse direction for limiting the speed reference to the value in parameter *77.15* REF Y2 REV.	
	0.0 … 3000.0 A	Setting range in amps.	0 … 30000
77.15	REF Y2 REV	Defines the speed in rpm to be used as the speed limit in reverse direction, if the current at the base speed in reverse direction is equal to the value in parameter *77.14* CURR X2 REV.	
	0.0 … 18000.0 rpm	Setting range in rpm.	0 … 180000
77.16	CURRENT X3 REV	Defines the current in amps expected at the base speed in reverse direction for limiting the speed reference to the value in parameter *77.17* REF Y3 REV.	
	0.0 … 3000.0 A	Setting range in amps.	0 … 30000
77.17	REF Y3 REV	Defines the speed in rpm to be used as the speed limit in reverse direction, if the current at the base speed in reverse direction is equal to the value in parameter *77.16* CURR X3 REV.	
	0.0 … 18000.0 rpm	Setting range in rpm.	0 … 180000
77.18	CURRENT X4 REV	Defines the current in amps expected at the base speed in reverse direction for limiting the speed reference to the value in parameter *77.19* REF Y4 REV. This current can be the current at the base speed with maximum load when running in the reverse direction.	
	0.0 … 3000.0 A	Setting range in amps.	0 … 30000
77.19	REF Y4 REV	Defines the speed in rpm to be used as the speed limit in reverse direction, if the current at the base speed in reverse direction is equal to the value in parameter *77.18* CURR X4 REV. This value can be the minimum allowed speed in maximum load condition in the reverse direction.	
	0.0 … 18000.0 rpm	Setting range in rpm.	0 … 180000

Index	Name/Selection	Description	FbEq
77.20	BASE SPEED	Defines the base speed in rpm. This value is used to check for the actual motor current when the motor speed crosses this value. The motor current when the actual speed crosses this base speed in either forward or reverse direction is checked for a period of Par. *77.03* HOLD RAMP. This motor current is further used along with parameters *77.04* … *77.19* to calculate the speed limit in forward and reverse directions. If the parameters *77.04* … *77.19* are not configured properly in the correct sequence, the speed is always limited to this value. For more information, see section *Load speed control* on page *123.*	
	0.0 … 18000.0 rpm	Setting range in rpm.	0 … 180000
78 SHAFT SYNCRO		Settings for Shaft synchronisation. See section *Control location EXT1/EXT2 supervision mismatch* on page *93.* The drive has to be in **EXT2** control location for the function to be active.	
78.01	SYNCRO CONTROL	Defines whether the Synchro control is active or not. If this parameter is set to OFF, the position error calculation, position correction, and synchronisation error fault functions are not operational. This parameter should be active for parameter *10.14* to be functional.	
	OFF	Synchro control is not selected	0
	ON	Synchro control is selected	1
78.02	SYNCRO GAIN	Defines the gain for the Synchro controller (P -Controller). Only used in Follower drives. See section *Control location EXT1/EXT2 supervision mismatch* on page *93.*	
	0... 100.00	Setting range	0... 10000
78.03	SHAFT SCALE	Defines the scaling factor used for the shaft position in the Follower drives. The scaling factor should be calculated as the ratio between the Master speed in m/min or mm/min at the maximum speed defined to that of the Follower drive. This factor is multiplied with the speed reference in the Follower drive only when the Synchro control is on. Used only in Follower drives. See section *Control location EXT1/EXT2 supervision mismatch* on page *93.*	
	0... 100.00	Setting range	0... 100000
78.04	POS SCALE	Defines the position scaling factor for the actual position value. The scaling factor should be calculated as number of Pulses Per Unit (Pulses/mm). See section *Actual position configuration based on a motor encoder signal* on page *91.*	
	0.1 … 10000.0 P/mm	Setting range in pulses/mm	1 … 100000
78.05	POS CORR MAX LIM	Defines the maximum limit for the position correction value. The difference between the Master and Follower position in unit (mm) is limited to this value before its given as a speed correction factor to the Follower speed loop.	
	0 … 100.0 mm	Setting range in mm	0 … 1000
78.06	POS CORR MIN LIM	Defines the minimum limit for the position correction value. The difference between the Master and Follower position in unit (mm) is limited to this value before its given as a speed correction factor to the Follower speed loop.	
	-100.0 … 0 mm	Setting range in mm	-1000 … 0
78.07	SYNC ERR FLT DLY	Defines the time delay for the generation of SYNC FAULT when the absolute difference between the Master and Follower position in unit (mm) is greater than what is defined in Par. *78.09*. The fault will be generated in respective Follower drives.	
	0 … 10 s	Setting range in seconds	0 … 100
78.08	SYNC CORR SCALE	Defines the scaling factor which will be used for the final speed correction reference in slave speed loop. Scaling value will correspond to a correction of that rpm for a position error of 1 mm.	

Index	Name/Selection	Description	FbEq
	0 ... 100.0 rpm	Setting range in rpm	0 … 1000
78.09	SYNC ERR LIM	Defines the Synchro error limit which will be used if configured as Follower drive for the SYNC FAULT fault generation. See Par. *78.07*.	
	0 ... 100.0 mm	Setting range in mm	0 … 1000
78.10	HOME POSITION	Defines the initial position value when a homing acknowledgment is done using Par. *10.15* selection. The actual position is initialized to this value.	
	-1000000.0 ... 1000000.0 mm	Setting range in mm **Note:** When using the Fieldbus communication to write to this parameter the value would be limited to -32768 … 32767	-1000000 … 1000000
78.12	SYNC CORR MODE	Defines the synchronisation correction mode to be used on the activation Synchro command through the signal defined in Par. *10.14* SYNC SEL. **Note**: The Synchro command should be reactivated using the signal defined in Par. *10.14* SYNC SEL, after the synchronisation mode is changed from OFFSET to DIRECT or from DIRECT to OFFSET.	
	OFFSET	The synchronisation correction is offset correction. In this mode, the difference between the Master position and the Follower position at the time of Synchro command activation is taken as an offset and is not considered as position error.	0
	DIRECT	The synchronisation correction is direct correction. In this mode, the difference between the Master position and the Follower position at the time of Synchro command activation is taken as position error. No permanent offset is calculated in this mode.	1
78.13	POS HYSTERISIS	Defines the position hysteresis for stopping sequence in synchronisation mode. This parameter is applicable only for Follower drives in synchronisation mode. The drive is stopped only when the absolute Synchro position error Par. *02.23* SYNC POS ERROR is in this range. When the brake control is active the drive issues a brake Closing command while in stopping sequence, only when the Master drive brake has closed and the absolute Synchro position error *02.23* SYNC POS ERROR is within this hysteresis value. When brake control is not active and the drive is a Follower, the drive stops only when the Master drive stops and then the Synchro position error Par. *02.23* SYNC POS ERROR is within this hysteresis value. **Note:** When brake control is active the brake closing speed *42.05* ABS BRAKE CLS SPD is not considered in this mode.	
	1.0 ... 50.0 mm	Setting range in mm	10 … 500
79 SERVICE COUNTER		Settings for Service Counter.	
79.01	BRAKE CTR RESET	Reset selection of brake open counts. Used to reset the brake open count value. Reset clears the value of signal *02.28*.	
	NO	No reset	0
	RESET	Resets the counter. Automatically reverts back to 0.	1
79.02	RESET OPT TIME	Crane operation time reset selection. Used to reset the crane operation timer value. Reset clears the value of signal *01.43*.	
	NO	No reset	0
	RESET	Reset value. Automatically reverts back to 0.	1
83 ADAPT PROG CTRL		Control of the Adaptive Program execution. For more information, see the *Adaptive Program Application Guide* [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

Index	Name/Selection	Description	FbEq
	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 with parameter *83.03*. The program must be in the editing mode (see parameter *83.01*).	
	NO	Home value. The value automatically restores to NO after an editing command has been executed.	1
	PUSH	Shifts the block in location defined with parameter *83.03* 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 with parameter *83.01*. - Select location number five as the desired location for the new block with parameter *83.03*. - Shift the block in location number 5 and the following blocks one location forward with parameter *83.02*. (selection PUSH) - Program the emptied location number 5 with parameters 84.25 to 84.29 as usual.	2
	DELETE	Deletes the block in location defined with parameter *83.03* 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 START or STOP (parameter *83.01*). - Set the passcode (parameter *83.05*). - Change parameter *83.02* 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 (parameter *83.01*). - Parameter *83.05* is set to 0.	4
	UNPROTECT	Inactivation of the Adaptive Program protection. Inactivate as follows: - Ensure the Adaptive Program operation mode is START or STOP (parameter *83.01*). - Set the passcode (parameter *83.05*). - Change parameter *83.02* to UNPROTECT. **Note:** If the passcode is lost, it is possible to reset the protection also by changing the application macro setting (parameter *99.02* APPLICATION MACRO).	5
83.03	EDIT BLOCK	Defines the block location number for the command selected with parameter *83.02*.	
	1 … 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

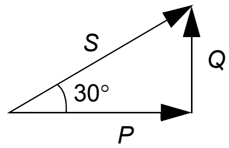
Index	Name/Selection	Description	FbEq
83.05	PASSCODE	Sets the passcode for the Adaptive Program protection. The passcode is needed at activation and inactivation of the protection. See parameter *83.02*.	
	0 …	Passcode. The setting restores to 0 after the protection is activated/inactivated. **Note:** When activating, write down the passcode and store it in a safe place.	
84 ADAPTIVE PROGRAM		- selections of the function blocks and their input connections. - diagnostics For more information, see the *Adaptive Program Application Guide* [3AFE64527274 (English)].	
84.01	STATUS	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>Initialising</td></tr></table>	
84.02	FAULTED PAR	Points out the faulted parameter in the Adaptive Program.	-
84.05	BLOCK1	Selects the function block for Block Parameter Set 1. See the *Adaptive Program Application Guide* [3AFE64527274 (English)].	
	ABS		11
	ADD		10
	AND		2
	BITWISE		26
	COMPARE		16
	COUNT		21
	DPOT		23
	EVENT		20
	FILTER		13
	MASK-SET		24
	MAX		17
	MIN		18
	MULDIV		12
	NO		1
	OR		3
	PI		14
	PI-BAL		15
	PI BIPOLAR		25
	RAMP		22
	SR		5
	SWITCH-B		7
	SWITCH-I		19

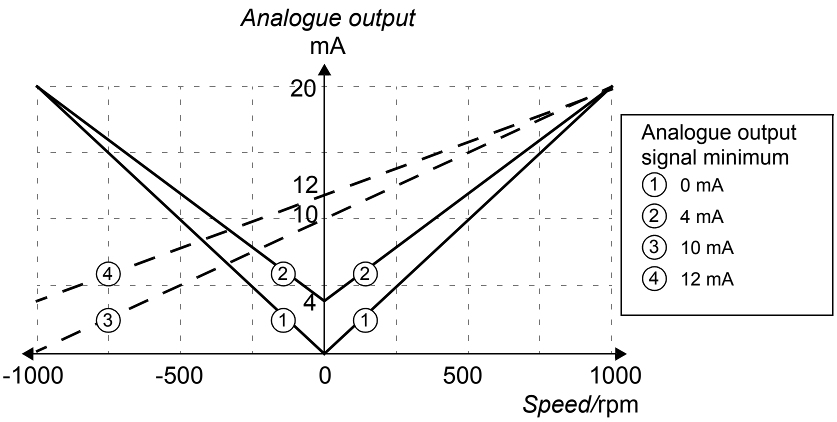
Index	Name/Selection	Description	FbEq
	TOFF		9
	TON		8
	TRIGG		6
	XOR		4
84.06	INPUT1	Selects the source for input I1 of Block Parameter Set 1.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value: - Parameter pointer: Inversion, group, index and bit fields. The bit number 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 application 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 parameter *84.06*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	See parameter *84.06*.	-
84.08	INPUT3	See parameter *84.06*.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	See parameter *84.06*.	-
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 the *Adaptive Program Application Guide* [3AFE64527274 (English)].	
85.01	CONSTANT1	Sets a constant for the Adaptive Program.	
	-8388608 to 8388607	Integer value	1 = 1
85.02	CONSTANT2	Sets a constant for the Adaptive Program.	
	-8388608 to 8388607	Integer value	1 = 1
85.03	CONSTANT3	Sets a constant for the Adaptive Program.	
	-8388608 to 8388607	Integer value	1 = 1
85.04	CONSTANT4	Sets a constant for the Adaptive Program.	
	-8388608 to 8388607	Integer value	1 = 1
85.05	CONSTANT5	Sets a constant for the Adaptive Program.	
	-8388608 to 8388607	Integer value	1 = 1
85.06	CONSTANT6	Sets a constant for the Adaptive Program.	
	-8388608 to 8388607	Integer value	1 = 1
85.07	CONSTANT7	Sets a constant for the Adaptive Program.	
	-8388608 to 8388607	Integer value	1 = 1
85.08	CONSTANT8	Sets a constant for the Adaptive Program.	
	-8388608 to 8388607	Integer value	1 = 1

Index	Name/Selection	Description	FbEq
85.09	CONSTANT9	Sets a constant for the Adaptive Program.	
	-8388608 to 8388607	Integer value	1 = 1
85.10	CONSTANT10	Sets a constant for the Adaptive Program.	
	-8388608 to 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	-
90 D SET REC ADDR		- Addresses into which the received fieldbus data sets are written. - Numbers of the main and auxiliary data sets. The parameters are visible only when a fieldbus communication is activated with parameter *98.02*. For more information, see chapter *Fieldbus control*.	
90.01	AUX1 DS REF3	Selects the address into which the value of fieldbus reference REF3 is written.	
	0 … 8999	Parameter index	
90.02	AUX1 DS REF4	Selects the address into which the value of fieldbus reference REF4 is written.	
	0 … 8999	Parameter index	
90.03	AUX1 DS REF5	Selects the address into which the value of fieldbus reference REF5 is written.	
	0 … 8999	Parameter index	
90.04	AUX2 DS REF6	Selects the address into which the value of fieldbus reference REF6 is written.	
	0 … 8999	Parameter index	
90.05	AUX2 DS REF7	Selects the address into which the value of fieldbus reference REF7 is written.	
	0 … 8999	Parameter index	
90.06	AUX2 DS REF8	Selects the address into which the value of fieldbus reference REF8 is written.	
	0 … 8999	Parameter index	
90.07	START DS REC	Defines the starting data set from which the drive reads the Control Word, Reference REF1 and Reference REF2.	
	1	Data set number 1 is the starting address. Can be used for standard drives.	1
	10	Data set number 10 is the starting address. Can be used for multidrives.	2
92 D SET TR ADDR		Main and Auxiliary Data Sets which the drive sends to the fieldbus master station. The parameters are visible only when a fieldbus communication is activated with parameter *98.02*. For more information, see chapter *Fieldbus control*.	
92.01	MAIN DS STATUS WORD	Stores the address from which the Main Status Word is read from. Fixed value, not visible.	
	302 (fixed)	Parameter index	
92.02	MAIN DS ACT1	Selects the address from which the Actual signal 1 is read to the Main Data Set.	
	0 … 9999	Parameter index	

Index	Name/Selection	Description	FbEq
92.03	MAIN DS ACT2	Selects the address from which the Actual signal 2 is read to the Main Data Set.	
	0 … 9999	Parameter index	
92.04	AUX1 DS ACT3	Selects the address from which the Actual signal 3 is read to the Auxiliary Data Set.	
	0 … 9999	Parameter index	
92.05	AUX1 DS ACT4	Selects the address from which the Actual signal 4 is read to the Auxiliary Data Set.	
	0 … 9999	Parameter index	
92.06	AUX1 DS ACT5	Selects the address from which the Actual signal 5 is read to the Auxiliary Data Set.	
	0 … 9999	Parameter index	
92.07	AUX2 DS ACT6	Selects the address from which the Actual signal 6 is read to the Auxiliary Data Set.	
	0 … 9999	Parameter index	
92.08	AUX2 DS ACT7	Selects the address from which the Actual signal 7 is read to the Auxiliary Data Set.	
	0 … 9999	Parameter index	
92.09	AUX2 DS ACT8	Selects the address from which the Actual signal 8 is read to the Auxiliary Data Set.	
	0 … 9999	Parameter index	
92.10	MSW B10 PTR	Selects the address from which the *03.02* Main Status Word bit 10 is read from.	
	-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.	
92.11	MSW B13 PTR	Selects the address from which the *03.02* Main Status Word bit 13 is read from.	
	-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.	
92.12	MSW B14 PTR	Selects the address from which the *03.02* Main Status Word bit 14 is read from.	
	-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.	
92.13	START DS TRA	Defines the starting data set where the drive writes the Status Word, Actual signal 1 and Actual signal 2.	
	2	Data set number 2 is the starting address. Can be used for Standard drives.	1
	11	Data set number 11 is the starting address. Can be used for multidrives.	2

Index	Name/Selection	Description	FbEq
95 HARDWARE SPECIF		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
95.02	FUSE SWITCH CTRL	Activates the inverter DC switch (switch fuse) monitoring function. The monitoring must be active when the Switch Fuse Control Board (ASFC) is in use and connected to the inverter AINT board, that is in all frame R8i inverters equipped with the DC switch. The function must be inactive in units that do not use the ASFC board with the DC switch, that is for frame R2i…R7i inverters and all single drive units where no DC switch exists. The default setting (ON or OFF) for each unit is set accordingly at the factory as default. ACS800 IGBT pulses are always blocked when the program detects that the DC switch is opened or inverter charging is ongoing (at power switch on). The application program generates alarm INV DISABLED if the DC switch is opened when the inverter is stopped. The inverter trips to fault INV DISABLED if the DC switch is opened when the inverter is running.	
	OFF	Inactive	0
	ON	Active	1
95.03	INT CONFIG USER	Number of parallel connected inverter modules. Activates the Reduced run function. See section *Reduced run function* on page *116*.	
	1...12	Number of parallel connected inverter modules	
95.04	EX/SIN REQUEST	Activates the sine filter or Ex-motor application.	
	NO	Inactive	1
	EX	Ex-motor application. Used with motors which comply with the ATEX directive.	2
	SIN	Sine filter application. See *Sine Filters User's Manual for ACS800 Drives* [3AFE68389178 (English)].	3
	EX&SIN	EX-motor and sine filter applications. See *Sine Filters User's Manual for ACS800 Drives* [3AFE68389178 (English)].	4
95.05	ENA INC SW FREQ	Activates the minimum switching frequency limitation for Ex-motor applications. Parameter is visible if parameter *95.04* EX/SIN REQUEST is set to EX.	
	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.	1

Index	Name/Selection	Description	FbEq
95.06	LCU Q PW 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 parameter *24.02* Q POWER REF2. For more information, see *IGBT Supply Control Program 7.x Firmware manual* [3AFE68315735 (English)]. **Example 1:** When parameter 24.03 Q POWER REF2 SEL is set to PERCENT, value 10000 of parameter 24.02 Q POWER REF2 equals to value 100% of parameter 24.01 Q POWER REF (that is 100% of the converter nominal power given in signal 04.06 CONV NOM POWER). **Example 2:** When parameter 24.03 Q POWER REF2 SEL is set to kVAr, value 1000 of parameter 24.02 Q POWER REF2 equals to parameter 24.01 Q POWER REF value calculated with the following equation: 100 · (1000 kVAr divided by converter nominal power in kVAr)%. **Example 3:** When parameter 24.03 Q POWER REF2 SEL is set to PHI, value 3000 of parameter 24.02 POWER REF2 equals approximately to parameter 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 Parameter 24.03 values are converter to degrees by the line-side converter application program: -3000 ... 30000 ≙ -30°... 30°. Value -10000/10000 equals to -30° / 30°, since the range is limited to -3000/3000.	
	-10000...10000	Reference value.	See par. description.
95.07	LCU DC REF	Defines the intermediate circuit DC voltage reference for the line-side converter. This reference is written into line-side converter parameter 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 the actual signal *09.15* LCU ACT SIGNAL1 is read from.	
	0…9999	Line-side converter parameter index. For more information, see *IGBT Supply Control Program 7.x Firmware manual* [3AFE68315735 (English)].	0…9999
95.09	LCU PAR2 SEL	Selects the line-side converter address from which the actual signal *09.16* LCU ACT SIGNAL2 is read from.	
	0…9999	Line-side converter parameter index. For more information, see *IGBT Supply Control Program 7.x Firmware manual* [3AFE68315735 (English)].	0…9999
95.10	TEMP INV AMBIENT	Defines the ambient temperature for the Enhanced drive temperature monitoring function. **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

Index	Name/Selection	Description	FbEq
96 EXTERNAL AO		Output signal selection and processing for the analogue extension module (optional). The parameters are visible only when the module is installed and activated with parameter *98.06*.	
96.01	EXT AO1 PTR	Defines the source or constant for value.	1000 = 1 mA
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
96.02	INVERT EXT AO1	Activates the inversion of analogue output AO1 of the analogue I/O extension module.	
	NO	Inactive	0
	YES	Active. The analogue signal is at a minimum level when the drive signal indicated is at its maximum and vice versa.	65535
96.03	MINIMUM EXT AO1	Defines the minimum value for the analogue output AO1 of the analogue I/O extension module. **Note:** Actually, the setting 10 mA or 12 mA does not set the AO1 minimum but fixes 10/12 mA to actual signal value zero. **Example:** Motor speed is read through the analogue output. - The motor nominal speed is 1000 rpm (parameter *99.08*). - *96.02* is NO. - *96.05* is 100%. The analogue output value as a function of the speed is shown below. 	
	0 mA	0 mA	1
	4 mA	4 mA	2
	10 mA	10 mA	3
	12 mA	12 mA	4
96.04	FILTER EXT AO1	Defines the filtering time constant for analogue output AO1 of the analogue I/O extension module. See parameter *15.04*.	
	0.00 … 10.00 s	Filtering time constant	0 … 1000
96.05	SCALE EXT AO1	Defines the scaling factor for analogue output AO1 of the analogue I/O extension module. See parameter *15.05*.	
	10 … 1000%	Scaling factor	100 … 10000

Index	Name/Selection	Description	FbEq
96.06	EXT AO2 PTR	Defines the source or constant for value.	1000 = 1 mA
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value. See parameter *10.04* for information on the difference.	-
96.07	INVERT EXT AO2	Activates the inversion of analogue output AO2 of the analogue I/O extension module. The analogue signal is at its minimum level when the drive signal indicated is at its maximum and vice versa.	
	NO	Inactive	0
	YES	Active	65535
96.08	MINIMUM EXT AO2	Defines the minimum value for analogue output AO2 of the analogue I/O extension module. See parameter *96.03*.	
	0 mA	0 mA	1
	4 mA	4 mA	2
	10 mA	10 mA	3
	12 mA	12 mA	4
96.09	FILTER EXT AO2	Defines the filtering time constant for analogue output AO2 of the analogue I/O extension module. See parameter *15.04*.	
	0.00 … 10.00 s	Filtering time constant	0 … 1000
96.10	SCALE EXT AO2	Defines the scaling factor for analogue output AO2 of the analogue I/O extension module. See parameter *15.05*.	
	10 … 1000%	Scaling factor	100 … 10000
97 MOTOR MODEL			
97.12	EM STOP DIO	Enables emergency stop commands through the RDIO module located on the RMIO board (RDIO-SLOT1 or RDIO-SLOT2) or in the external I/O Module Adapter AIMA (RDIO-DDCS). - RDIO digital input 1 (DI1) = OFF2 STOP - RDIO digital input 2 (DI2) = OFF3 STOP The OFF3 deceleration time is defined by parameter *22.07* EM STOP RAMP TIME.	
	NO	Emergency stop through the RDIO module is not in use.	1
	RDIO-SLOT1	OFF2 STOP (through DI1) and/or OFF3 STOP (through DI2) is taken from the RDIO module located in option SLOT 1.	2
	RDIO-SLOT2	OFF2 STOP (through DI1) and/or OFF3 STOP (through DI2) is taken from the RDIO module located in option SLOT 2.	3
	RDIO-DDCS	OFF2 STOP (through DI1) and/or OFF3 STOP (through DI2) is taken from the RDIO module located on the AIMA I/O Module Adapter (RDIO-DDCS). **Note:** If RDIO-DDCS is selected, the module node number must be set to 7.	4
97.16	SPD CORR PTR	Speed correction pointer. Default: +.000.000.00. Defines external speed correction by writing it to signal SPEED CORR BUFF (*03.35*). Speed correction pointer is to be used only when Synchro control is not used.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value.	
97.17	APL LIM WRN MASK	Application limit warning mask. Default 0000 0001 1111 1000 b (binary mode). This parameter can block application messages not required for the control panel display.	

Index	Name/Selection	Description	FbEq
		See *Application message blocking* on page *127*.	
97.18	PWRON STRTINT PTR	PowerON start interlock pointer. Power ON start interlock pointer can be programmed for another use. Default: DI_IL (+.001.017.06) (start interlock input on the RMIO board). If you need to use DIL input for some other purpose than Power ON acknowledge, set parameter 97.18 to 0 (= +.000.000.00) to disable Power ON acknowledge.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value.	
97.19	SYNC ERR BLK LVL	Blocking level of speed correction signal *03.35* SPEED CORR BUFF in millimetres. The default value is 0. If the change in signal *02.23* SYNC POS ERROR is bigger than the value of 97.19 SYNC ERR BLK LVL, signal *03.35* SPEED CORR BUFF is blocked and no synchronisation correction is performed during that period. For more information, see section *Synchro error blocking* on page *109*.	1 = 1 mm
	0 … 200 mm	Setting range in mm	
97.20	PWR ACK START DLY	Power acknowledge start delay, that is, the time before the drive is ready to start after the DI_IL circuit is closed. (DI_IL is the start interlock input of the RMIO board.)	
	0 … 5 s	Setting range in seconds.	100 = 1 s
97.21	ZERO SPEED PTR	Zero speed pointer input for restarting the drive with the zero speed reference used with the Brake match function created by DriveAP.	
	-255.255.31 … +255.255.31 / C.-32768 … C.32767	Parameter index or a constant value.	
98 OPTION MODULES		Activation of the option modules. The parameter settings will remain the same even though the application macro is changed (parameter *98.02*).	
98.01	ENCODER MODULE	Activates the communication to the optional pulse encoder module. See also parameter group *50 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 the *NTAC-0x Module Installation and Start-up Guide* [3AFY58919730 (English)].	0
	NO	Inactive	1
	RTAC-SLOT1	Communication active. Module type: RTAC. Connection interface: Option slot 1 of the drive.	2
	RTAC-SLOT2	Communication active. Module type: RTAC. Connection interface: Option slot 2 of the drive.	3
	RTAC-DDCS	Communication active. Module type: RTAC. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 16. For directions, see *RTAC-01 Pulse Encoder Interface User's Manual* [3AFE64486853 (English)].	4
	RRIA-SLOT1	Communication active. Module type: RRIA. Connection interface: Option Slot 1 of the drive.	5
	RRIA-SLOT2	Communication active. Module type: RRIA. Connection interface: Option Slot 2 of the drive.	6

Index	Name/Selection	Description	FbEq
	RRIA-DDCS	Communication active. Module type: RRIA. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link.	7
	RTAC03-SLOT1	Communication active. Module type: RTAC03. Connection interface: Option Slot 1 of the drive.	8
	RTAC03-SLOT2	Communication active. Module type: RTAC03. Connection interface: Option Slot 2 of the drive.	9
	RTAC03-DDCS	Communication active. Module type: RTAC03. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link.	10
98.02	COMM. MODULE LINK	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 parameter group *51 COMM MODULE DATA*.	2
	ADVANT	The drive communicates with an ABB Advant OCS system via CH0 on the RDCO board (optional). See also parameter group *70 DDCS CONTROL*.	3
	STD MODBUS	The drive communicates with a Modbus controller via the Modbus Adapter Module (RMBA) in option slot 1 of the drive. See also parameter *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. Module outputs: See parameters *14.10* and *14.11* for selecting the drive states that are indicated through the relay outputs.	
	NO	Inactive	1
	RDIO-SLOT1	Communication active. Module type: RDIO. Connection interface: Option slot 1 of the drive.	2
	RDIO-SLOT2	Communication active. Module type: RDIO. Connection interface: Option slot 2 of the drive.	3
	RDIO-DDCS	Communication active. Module type: RDIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 2. For directions, see *RDIO Module User's Manual* [3AFE64485733 (English)].	4
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. Module outputs: See parameters *14.12* and *14.13* for selecting the drive states that are indicated through the relay outputs.	
	NO	Inactive	1
	RDIO-SLOT1	Communication active. Module type: RDIO. Connection interface: Option slot 1 of the drive.	2
	RDIO-SLOT2	Communication active. Module type: RDIO. Connection interface: Option slot 2 of the drive.	3
	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 *RDIO Module User's Manual* [3AFE64485733 (English)].	4

Index	Name/Selection	Description	FbEq
98.05	DI/O EXT MODULE 3	Activates the communication to the digital I/O extension module 3 (optional) and defines the type and connection interface of the module. Module outputs: See parameters *14.14* and *14.15* for selecting the drive states that are indicated through the relay outputs.	
	NO	Inactive	1
	RDIO-SLOT1	Communication active. Module type: RDIO. Connection interface: Option slot 1 of the drive.	2
	RDIO-SLOT2	Communication active. Module type: RDIO. Connection interface: Option slot 2 of the drive.	3
	RDIO-DDCS	Communication active. Module type: RDIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 4. For directions, see *RDIO Module User's Manual* [3AFE64485733 (English)].	4
98.06	AI/O EXT MODULE	Activates the communication to the analogue I/O extension module (optional), and defines the type and connection interface of the module. Module inputs: - Values AI5 and AI6 in the drive application program are connected to module inputs 1 and 2. - See parameters *98.13* and *98.14* for the signal type definitions. Module outputs: - See parameters *96.01* and *96.06* for selecting the drive signals that are indicated through module outputs 1 and 2.	
	NO	Communication inactive	1
	RAIO-SLOT1	Communication active. Module type: RAIO. Connection interface: Option Slot 1 of the drive.	2
	RAIO-SLOT2	Communication active. Module type: RAIO. Connection interface: Option Slot 2 of the drive.	3
	RAIO-DDCS	Communication active. Module type: RAIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link. **Note:** Module node number must be set to 5. For directions, see *RAIO Module User's Manual* [3AFE64484567 (English)].	4
98.07	COMM PROFILE	Defines the profile on which the communication with the fieldbus or another drive is based. Visible only when fieldbus communication is activated with parameter *98.02*.	
	ABB DRIVES	ABB Drives profile	1
	GENERIC	Generic drive profile. Typically used with the fieldbus modules that have the type designation of form **R**xxx (installed in the option slot of the drive).	2
	CSA 2.8/3.0	Communication profile used by application program versions 2.8 and 3.0.	3

<table>
<tr><th>Index</th><th>Name/Selection</th><th>Description</th><th>FbEq</th></tr>
<tr><td>98.12</td><td>AI/O MOTOR TEMP</td><td>Activates the communication to the analogue I/O extension module and reserves the module for the use of the motor temperature measurement function. The parameter also defines the type and connection interface of the module.

For more information on the temperature measurement function, see parameter group 35 MOT TEMP MEAS.

The use of the analogue inputs (AI) and outputs (AO) of the module is shown in the table below.

<table>
<tr><th colspan="2">Motor 1 temperature measurement</th></tr>
<tr><td>AO1</td><td>Feeds a constant current to motor 1 temperature sensor. The current value depends on the setting of parameter 35.01:
- AO1 is 9.1 mA with selection 1xPT100
- AO1 is 1.6 mA with selection 1...3 PTC</td></tr>
<tr><td>AI1</td><td>Measures voltage over motor 1 temperature sensor.</td></tr>
<tr><th colspan="2">Motor 2 temperature measurement</th></tr>
<tr><td>AO2</td><td>Feeds a constant current to motor 2 temperature sensor. The current value depends on the setting of parameter 35.04:
- AO2 is 9.1 mA with selection 1xPT100,
- AO2 is 1.6 mA with selection 1...3 PTC</td></tr>
<tr><td>AI2</td><td>Measures voltage over motor 2 temperature sensor.</td></tr>
</table>

Before setting the drive parameters, ensure the module hardware settings are appropriate for the motor temperature measurement:
1. The module node number is 9.
2. The input signal type selections are the following:
- for one Pt 100 sensor measurement, set the range to 0 … 2 V.
- for two to three Pt 100 sensors or one to three PTC sensors, set the range to 0 … 10 V.
3. The operation mode selection is unipolar.</td><td></td></tr>
<tr><td></td><td>NO</td><td>Inactive</td><td>1</td></tr>
<tr><td></td><td>RAIO-SLOT1</td><td>Communication active. Module type: RAIO. Connection interface: Option Slot 1 of the drive.

Note: Make the module hardware settings as described above. The node number is not required. For directions, see RAIO Module User’s Manual [3AFE64484567 (English)].</td><td>2</td></tr>
<tr><td></td><td>RAIO-SLOT2</td><td>Communication active. Module type: RAIO. Connection interface: Option Slot 2 of the drive.

Note: Make the module hardware settings as described above. The node number is not required. For directions, see RAIO Module User’s Manual [3AFE64484567 (English)].</td><td>3</td></tr>
<tr><td></td><td>RAIO-DDCS</td><td>Communication active. Module type: RAIO. Connection interface: Optional I/O module adapter (AIMA) that communicates with the drive through a fibre optic DDCS link.

Note: Set the module node number to 9. For directions, see RAIO Module User’s Manual [3AFE64484567 (English)].</td><td>4</td></tr>
</table>

Index	Name/Selection	Description	FbEq
98.13	AI/O EXT AI1 FUNC	Defines the signal type for input 1 of the analogue I/O extension module (AI5 in the drive application program). The setting must match the signal connected to the module. **Note:** The communication must be activated with parameter *98.06*.	
	UNIPOLAR AI5	Unipolar	1
	BIPOLAR AI5	Bipolar	2
98.14	AI/O EXT AI2 FUNC	Defines the signal type for input 2 of the analogue I/O extension module (AI6 in the drive application program). The setting must match the signal connected to the module. **Note:** The communication must be activated with parameter *98.06*.	
	UNIPOLAR AI6	Unipolar	1
	BIPOLAR AI6	Bipolar	2
98.16	SIN FILT SUPERV	Activates the communication to the digital I/O extension module and reserves the module for the use of the sine-filter temperature measurement. Parameter is visible if parameter *98.04* is set to SIN or EX&SIN. Parameter value is automatically set to NO, when parameter 95.04 value is changed. **Note:** This parameter is used only in special applications.	
	NO	Supervision disabled.	1
	RDIO-SLOT1	Module type: RDIO. Connection interface: Option slot 1 of the drive.	2
	RDIO-SLOT2	Module type: RDIO. Connection interface: Option slot 2 of the drive.	3
	RDIO-DDCS	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 8. For directions, see *RDIO Module User's Manual* [3AFE64485733 (English)].	4
99 START-UP DATA		Language selection. Definition of motor set-up data. This group gets write protect locked once the motor data is entered and the drive is initialized. The lock can be opened with passcode 584.	
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

Index	Name/Selection	Description	FbEq
99.02	APPLICATION MACRO	Selects the application macro. See chapter *Application macros, control location EXT1/EXT2* for more information. **Note:** When you change the default parameter values of a macro, the new settings become valid immediately and stay valid even if the power of the drive is switched off and on. However, backup of the default parameter settings (factory settings) of each standard macro is still available. See parameter *99.03*.	
	CRANE	For Crane application	1
	USER 1 LOAD	User 1 macro loaded into use. Before loading, check that the saved parameter settings and the motor model are suitable for the application.	2
	USER 1 SAVE	Save User 1 macro. Stores the current parameter settings and the motor model. **Note:** There are parameters that are not included in the macros. See parameter *99.03*.	3
	USER 2 LOAD	User 2 macro loaded into use. Before loading, check that the saved parameter settings and the motor model are suitable for the application.	4
	USER 2 SAVE	Save User 2 macro. Stores the current parameter settings and the motor model. **Note:** There are parameters that are not included in the macros. See parameter *99.03*.	5
99.03	APPLIC RESTORE	Restores the original settings of the active application macro (*99.02*). - If a CRANE macro is active, the parameter values are restored to the default settings (factory settings). Exceptions: parameter settings in parameter group 99 remain unchanged. The motor model remains unchanged. - If User Macro 1 or 2 is active, the parameter values are restored to the last saved values. In addition, the last saved motor model are restored. Exceptions: Settings of parameters *16.05* and *99.02* remain unchanged. **Note:** The parameter settings and the motor model are restored according to the same principles when a macro is changed to another.	
	NO	No action	0
	YES	Restoring	65535
99.04	MOTOR CTRL MODE	Selects the motor control mode.	
	DTC	Direct torque control mode is suitable for most applications.	0

Index	Name/Selection	Description	FbEq
	SCALAR	Scalar control is suitable in special cases where the DTC cannot be applied. The Scalar control mode is recommended: - for multimotor drives with variable number of motors - when the nominal current of the motor is less than 1/6 of the nominal output current of the drive (inverter) - the drive is used for test purposes with no motor connected. **Note:** The outstanding motor control accuracy of the DTC cannot be achieved in Scalar control. The differences between the scalar and DTC control modes are pointed out in this manual in relevant parameter lists. There are some standard features that are disabled in the Scalar control mode: Motor identification run (group *99 START-UP DATA*), Speed Limits (group *20 LIMITS*), Torque Limit (group *20 LIMITS*), DC hold (group *21 START/STOP*), DC Magnetizing (group *21 START/STOP*), Speed Controller Tuning (group *23 SPEED CTRL*), Torque Control (group *24 TORQUE CTRL*), Flux optimisation (group *26 MOTOR CONTROL*), Flux braking (group *26 MOTOR CONTROL*), Underload Function (group *30 FAULT FUNCTIONS*), Motor phase loss Protection (group *30 FAULT FUNCTIONS*), Motor Stall protection (group *30 FAULT FUNCTIONS*). For more information, see section *Scalar control* on page *73*.	65535
99.05	MOTOR NOM VOLTAGE	Defines the nominal motor voltage. Must be equal to the value on the motor rating plate.	
	1/2 … 2 · UN	Voltage. Allowed range is 1/2 … 2 · U_N of the drive. **Note:** The stress on the motor insulations is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than the rating of the drive and the supply of the drive.	1 = 1 V
99.06	MOTOR NOM CURRENT	Defines the nominal motor current. Must be equal to the value on the motor rating plate. **Note:** Correct motor run requires that the magnetizing current of the motor does not exceed 90 percent of the nominal current of the inverter.	
	0 … 2 · I_{2hd}	Allowed range: approx. 1/6 … 2 · I_{2hd} of ACS800 (parameter *99.04* = DTC). Allowed range: approx. 0 … 2 · I_{2hd} of ACS800 (parameter *99.04* = SCALAR).	1 = 0.1 A
99.07	MOTOR NOM FREQ	Defines the nominal motor frequency.	
	8 … 300 Hz	Nominal frequency (50 or 60 Hz typically)	800 … 30000
99.08	MOTOR NOM SPEED	Defines the nominal motor speed. Must be equal to the value on the motor rating plate. The motor synchronous speed or another approximate value must not be given instead! **Note:** If the value of parameter *99.08* is changed, the speed limits in parameter group *20 LIMITS* change automatically as well.	
	1 … 18000 rpm	Nominal motor speed	1 … 18000
99.09	MOTOR NOM POWER	Defines the nominal motor power. Set exactly as on the motor rating plate.	
	0 … 9000 kW	Nominal motor power	0 … 90000

Index	Name/Selection	Description	FbEq
99.10	MOTOR ID RUN MODE	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 and control through the I/O interface*. **Note:** The ID run (STANDARD or REDUCED) should be selected if: - The operation point is near zero speed, and/or - Operation at torque range above the motor nominal torque within a wide speed range and without any measured speed feedback is required. **Note:** The ID run (STANDARD) cannot be performed if parameter *99.04* = SCALAR.	
	ID MAGN	No ID run. The motor model is calculated at first start by magnetising the motor for 20 to 60 s at zero speed. This can be selected in most applications. The brake is kept closed during ID MAGN Run.	1
	STANDARD	Standard ID run. Guarantees the best possible control accuracy. The ID run takes about one minute. The brake is opened when STANDARD ID run is selected. The brake gets closed once the STANDARD ID run is performed. **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
99.11	DEVICE NAME	Defines the name for the drive or application. The name is visible on the control panel display in the Drive Selection Mode. **Note:** The name can be typed only by using a drive PC tool.	
99.12	OEM SIGNAL	Defines the text for the OEM signal. The signal can be displayed on the control panel display by selecting the actual parameter *01.46*. **Note:** The name can be entered only by using a drive PC tool.	

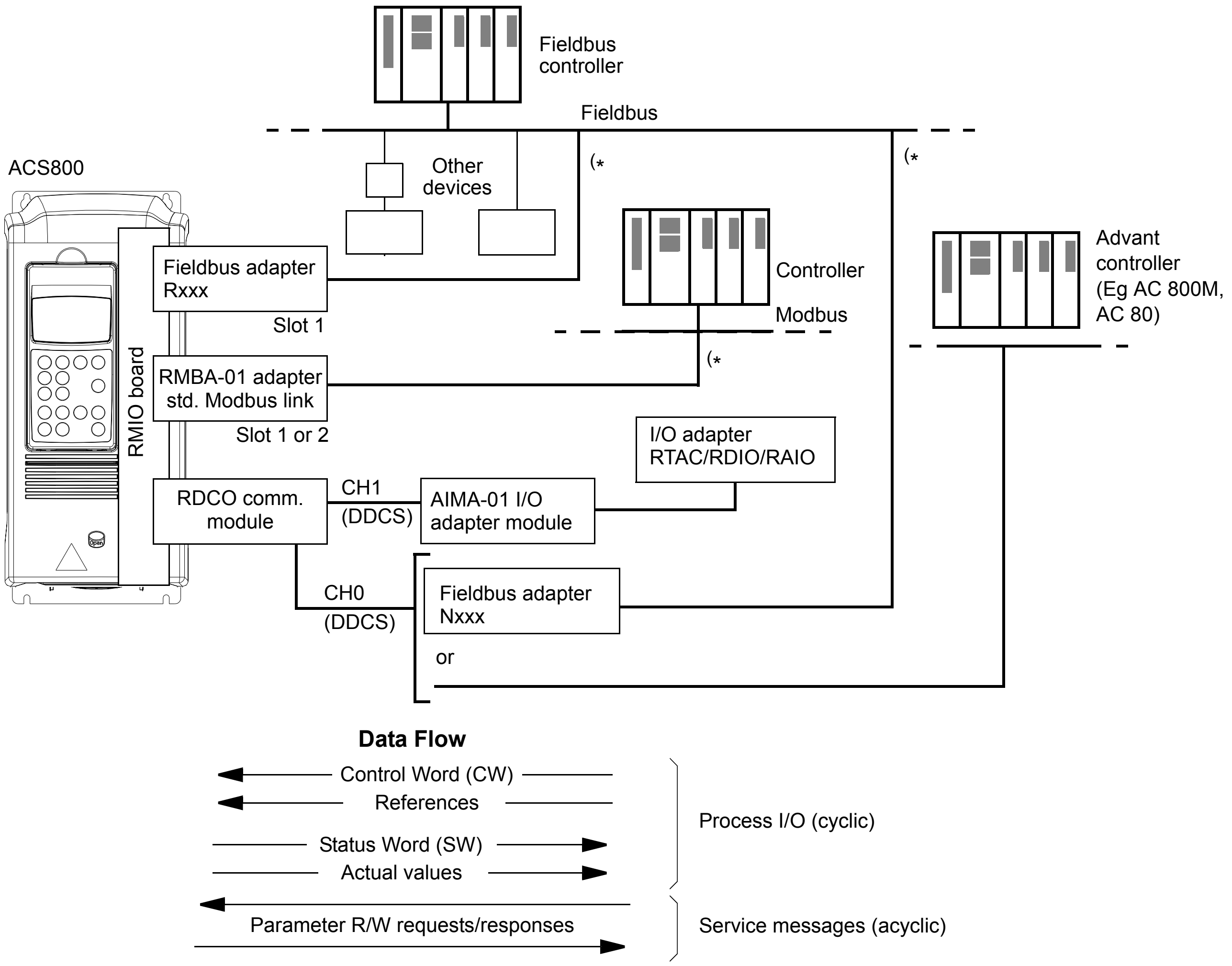
Fieldbus control

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 analogue inputs. The following diagram shows the control interfaces and I/O connections of the drive.

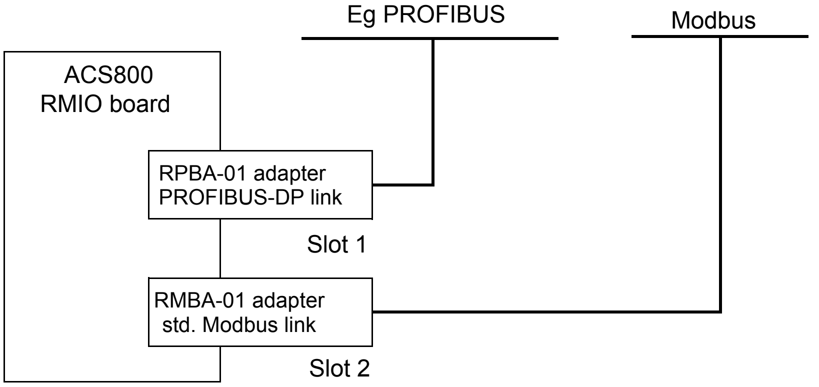


(* Either an Rxxx **or** Nxxx, **and** an RMBA-01 adapter can be connected to the drive simultaneously.

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 (that is, the Main Reference data set, see section *The fieldbus control interface* on page *241*) is activated by setting parameter *98.02* COMM MODULE LINK 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, for example, 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 (for example, 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 233.

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.

<table>
<tr><th>Parameter</th><th>Alternative settings</th><th>Setting for fieldbus control</th><th>Function/Information</th></tr>
<tr><td colspan="4">COMMUNICATION INITIALISATION</td></tr>
<tr><td>98.02</td><td>NO
FIELDBUS
ADVANT
STD MODBUS
CUSTOMISED</td><td>FIELDBUS</td><td>Initialises communication between drive and fieldbus adapter module. Activates module set-up parameters (Group 51).</td></tr>
<tr><td>98.07</td><td>ABB DRIVES
GENERIC
CSA 2.8/3.0</td><td>ABB DRIVES
GENERIC or
CSA 2.8/3.0</td><td>Selects the communication profile used by the drive. See section Communication profiles on page 249. 249</td></tr>
<tr><td colspan="4">ADAPTER MODULE CONFIGURATION</td></tr>
<tr><td>51.01 MODULE TYPE</td><td>–</td><td>–</td><td>Displays the type of the fieldbus adapter module.</td></tr>
<tr><td>51.02 (FIELDBUS PARAMETER 2)</td><td colspan="3" rowspan="3">These parameters are adapter-module-specific. For more information, see the module manual. Note that not all of these parameters are necessarily visible.</td></tr>
<tr><td>• • •</td></tr>
<tr><td>51.26 (FIELDBUS PARAMETER 26)</td></tr>
<tr><td>51.27 FBA PAR REFRESH*</td><td>(0) DONE
(1) REFRESH</td><td>–</td><td>Validates any changed adapter module configuration parameter settings. After refreshing, the value reverts automatically to DONE.</td></tr>
<tr><td>51.28 FILE CPI FW REV*</td><td>xyz (binary coded decimal</td><td>–</td><td>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 Par. 51.32) must contain the same or a later CPI version to be compatible. x = major revision number; y = minor revision number; z = correction number. Example: 107 = revision 1.07.</td></tr>
</table>

Parameter	Alternative settings	Setting for fieldbus control	Function/Information
51.29 FILE CONFIG ID*	xyz (binary coded decimal)	–	Displays the fieldbus adapter module configuration file identification stored in the memory of the drive. This information is drive application program-dependent.
51.30 FILE CONFIG REV*	xyz (binary coded decimal)	–	Displays the fieldbus adapter module configuration file revision stored in the memory of the drive. **x** = major revision number; **y** = minor revision number; **z** = correction number. **Example**: **1** = revision 0.01.
51.31 FBA STATUS*	**(0)** IDLE **(1)** EXEC. INIT **(2)** TIME OUT **(3)** CONFIG ERROR **(4)** OFF-LINE **(5)** ON-LINE **(6)** RESET	–	Displays the status of the adapter module. IDLE = Adapter not configured. EXEC. INIT = Adapter initialising. TIME OUT = A timeout has occurred in the communication between the adapter and the drive. CONFIG ERROR = Adapter configuration error. The major or minor revision code of the CPI program revision in the drive is not the revision required by the module (refer to par. 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 application 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 *Drive control parameters* on page *237*) 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 INITIALISATION			
98.02	NO FIELDBUS ADVANT STD MODBUS CUSTOMISED	STD MODBUS	Initialises communication between drive (Standard Modbus Link) and Modbus-protocol controller. Activates communication parameters in group 52.
98.07	ABB DRIVES GENERIC CSA 2.8/3.0	ABB DRIVES	Selects the communication profile used by the drive. See section *Communication profiles* on page *249*.
COMMUNICATION PARAMETERS			
52.01	1 to 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 STANDARD MODBUS have been set, the drive control parameters (section *Drive control parameters* on page *237*) 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
40013	Reference 6	40016	Actual 6
40014	Reference 7	40017	Actual 7
40015	Reference 8	40018	Actual 8

More information on Modbus communication is available on the http://www.modbus.org/ website.

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**

Optical ModuleBus connection: TB811 (5 MBd) or TB810 (10 MBd) Optical ModuleBus Port Interface required. See section *Optical ModuleBus connection* 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 section *Optical ModuleBus connection* 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.

Parameter	Alternative settings	Setting for control through CH0	Function/Information
COMMUNICATION INITIALISATION			
98.02	NO FIELDBUS ADVANT STD MODBUS CUSTOMISED	ADVANT	Initialises communication between drive (fibre optic channel CH0) and Advant controller. The transmission speed is 4 Mbit/s.
98.07	ABB DRIVES GENERIC CSA 2.8/3.0	ABB DRIVES	Selects the communication profile used by the drive. See section *Communication profiles* on page *249*.
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.
70.04	RING STAR		Selects the topology of the channel CH0 link.

After the communication initialisation parameters have been set, the drive control parameters (section *Drive control parameters* on page *237*) 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.

Drive control parameters

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

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

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

Parameter	**Setting for fieldbus control**	**Function/Information**
CONTROL COMMAND SOURCE SELECTION		
10.01	COMM.CW	Enables the fieldbus Control Word (except 03.01 Main Control Word bits 3 and 11) when EXT1 is selected as the active control location. See also par. 10.07.
10.02	COMM.CW	Enables the fieldbus Control Word (except 03.01 Main Control Word bits 3 and 11) when EXT2 is selected as the active control location.
10.03	FORWARD REVERSE or REQUEST	Enables rotation direction control as defined with parameters 10.01 and 10.02. The direction control is explained in section *Reference handling* on page *242*.
10.07	0 or 1	Setting the value to 1 overrides the setting of par. 10.01 so that the fieldbus Control Word (except 03.01 Main Control Word bit 11) is enabled when EXT1 is selected as the active control location. **Note 1:** Only visible with the Generic Drive communication profile selected (see par. 98.07). **Note 2:** Setting not saved into permanent memory.
10.08	0 or 1	Setting the value to 1 overrides the setting of par. 11.03 so that Fieldbus reference REF1 is used when EXT1 is selected as the active control location. **Note 1:** Only visible with the Generic Drive communication profile selected (see par. 98.07). **Note 2:** Setting not saved into permanent memory.
11.02	COMM.CW	Enables EXT1/EXT2 selection by fieldbus Control Word bit 11 EXT CTRL LOC.
11.03	COMM. REF1 FAST COMM	Fieldbus reference REF1 is used when EXT1 is selected as the active control location. See section *References* on page *242* for information on the alternative settings.
11.06	COMM. REF2 FAST COMM	Fieldbus reference REF2 is used when EXT2 is selected as the active control location. See section *References* on page *242* for information on the alternative settings.

Parameter	Setting for fieldbus control	Function/Information
SYSTEM CONTROL INPUTS		
16.01	COMM.CW	Enables the control of the Run Enable signal through fieldbus 03.01 Main Control Word bit 3. **Note:** Must be set to YES when the Generic Drive communication profile is selected (see Par. *98.07*).
16.04	COMM.CW	Enables fault reset through fieldbus 03.01 Main Control Word bit 7. **Note:** Reset through fieldbus Control Word (03.01 bit 7) is enabled automatically and it is independent of parameter *16.04* setting if parameter *10.01* or *10.02* is set to COMM.CW.
16.07	DONE; SAVE	Saves parameter value changes (including those made through fieldbus control) to permanent memory.
COMMUNICATION FAULT FUNCTIONS		
30.18	FAULT NO	Determines drive action in case fieldbus communication is lost. **Note:** The communication loss detection is based on monitoring of received Main and Auxiliary data sets (whose sources are selected with parameters 90.04 and 90.05 respectively).
30.19	0.1 … 60.0 s	Defines the time between Main Reference data set loss detection and the action selected with parameter 30.18.
30.21	0.0 … 60.0 s	Defines the time between Auxiliary Reference data set loss detection and the action selected with parameter 30.18. **Note:** This supervision function is disabled if this parameter, or parameters 90.01, 90.02 and 90.03 are set to 0.
FIELDBUS REFERENCE TARGET SELECTION		
90.01	0 … 8999	Defines the drive parameter into which the value of fieldbus reference REF3 is written. **Format: xxyy**, where **xx** = parameter group (10 to 89), **yy** = parameter Index. For example, **3001** = parameter 30.01.
90.02	0 … 8999	Defines the drive parameter into which the value of fieldbus reference REF4 is written. **Format:** see parameter 90.01.
90.03	0 … 8999	Defines the drive parameter into which the value of fieldbus reference REF5 is written. **Format:** see parameter 90.01.
90.04	0 … 8999	Defines the drive parameter into which the value of fieldbus reference REF6 is written. **Format:** see parameter 90.01.
90.05	0 … 8999	Defines the drive parameter into which the value of fieldbus reference REF7 is written. **Format:** see parameter 90.01.

Parameter	Setting for fieldbus control	Function/Information
90.06	0 … 8999	Defines the drive parameter into which the value of fieldbus reference REF8 is written. **Format:** see parameter 90.01.
90.07	1 (Standard) or 10 (Multidrive)	This parameter selects the source from which the drive reads the Main Reference data set (comprising the fieldbus Control Word, fieldbus reference REF1, REF2, REF3, REF4 and REF5).
ACTUAL SIGNAL SELECTION FOR FIELDBUS		
92.01	302 (Fixed)	The Status Word is transmitted to as the first word of the Main Actual Signal data set.
92.02	0 … 9999	Selects the Actual signal or parameter value to be transmitted as the second word (ACT1) of the Main Actual Signal data set. **Format:** (**x**)**xyy,** where (**x**)**x** = actual signal group or parameter group, **yy** = actual signal or parameter index. For example, **103** = actual signal 1.03 FREQUENCY; **2202** = parameter 22.02 ACCEL TIME 1. **Note:** With the Generic Drive communication profile active (Par. 98.07 = GENERIC), this parameter is fixed to **102** (actual signal 1.02 SPEED – in DTC motor control mode) or **103** (1.03 FREQUENCY – in Scalar mode).
92.03	0 … 9999	Selects the actual signal or parameter value to be transmitted as the third word (ACT2) of the Main Actual Signal data set. **Format:** see parameter 92.02.
92.04	0 … 9999	Selects the actual signal or parameter value to be transmitted as the first word (ACT3) of the Auxiliary1 Actual Signal data set. **Format:** see parameter 92.02.
92.05	0 … 9999	Selects the actual signal or parameter value to be transmitted as the second word (ACT4) of the Auxiliary1 Actual Signal data set. **Format:** see parameter 92.02.
92.06	0 … 9999	Selects the actual signal or parameter value to be transmitted as the third word (ACT5) of the Auxiliary1 Actual Signal data set. **Format:** see parameter 92.02.
92.07	0 … 9999	Selects the actual signal or parameter value to be transmitted as the first word (ACT6) of the Auxiliary2 Actual Signal data set. **Format:** see parameter 92.02.
92.08	0 … 9999	Selects the actual signal or parameter value to be transmitted as the second word (ACT7) of the Auxiliary2 Actual Signal data set. **Format:** see parameter 92.02.
92.09	0 … 9999	Selects the actual signal or parameter value to be transmitted as the third word (ACT8) of the Auxiliary2 Actual Signal data set. **Format:** see parameter 92.02.
92.10	-255.255.31…+255.255.31 / C.-32768 … C.32767	Selects the address from which the 03.02 Main Status Word bit 10 is read from.
92.11	-255.255.31…+255.255.31 / C.-32768 … C.32767	Selects the address from which the 03.02 Main Status Word bit 13 is read from.

Parameter	Setting for fieldbus control	Function/Information
92.12	-255.255.31…+255.255.31 / C.-32768 … C.32767	Selects the address from which the 03.02 Main Status Word bit 14 is read from.
92.13	2 (Standard) or 11 (Multidrive)	This parameter selects the source to which the drive writes the Main Status data set (comprising the Status Word, Actual Signal1, Actual Signal2, and the Auxillary signals.

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 Crane control program supports the use of four data sets, two in each direction.

The three data sets for controlling the drive are referred to as the Main Reference data set, the Auxiliary1 Reference data set, and the Auxiliary2 Reference data set. The source from which the drive reads the Main and Auxiliary Reference data sets is defined with parameter 90.07. The contents of the Main Reference data set are fixed. The contents of the Auxiliary Reference data sets can be selected using parameters 90.01, 90.02, 90.03, 90.04, 90.05 and 90.06.

The three data sets containing actual information on the drive are referred to as the Main Actual Signal data set, the Auxiliary1 Actual Signal data set, and the Auxiliary2 Actual Signal data set. The contents of these data sets are partly selectable with the parameters in group 92.

	Data from fieldbus controller to drive		
	Word	**Contents**	**Selector**
***Index**	**Main Reference data set DS1**		
1	1st word	Control Word	(Fixed)
2	2nd word	Reference 1	(Fixed)
3	3rd word	Reference 2	(Fixed)
***Index**	**Auxiliary Reference data set DS3**		
7	1st word	Reference 3	Par. 90.01
8	2nd word	Reference 4	Par. 90.02
9	3rd word	Reference 5	Par. 90.03
***Index**	**Auxiliary Reference data set DS5**		
13	1st word	Reference 6	Par. 90.04
14	2nd word	Reference 7	Par. 90.05
15	3rd word	Reference 8	Par. 90.06

	Data from drive to fieldbus controller		
	Word	**Contents**	**Selector**
***Index**	**Main Actual Signal data set DS2**		
4	1st word	Status Word	(Fixed)
5	2nd word	Actual 1	**Par. 92.02
6	3rd word	Actual 2	Par. 92.03
***Index**	**Aux. Actual Signal data set DS4**		
10	1st word	Actual 3	Par. 92.04
11	2nd word	Actual 4	Par. 92.05
12	3rd word	Actual 5	Par. 92.06
***Index**	**Aux. Actual Signal data set DS6**		
16	1st word	Actual 6	Par. 92.07
17	2nd word	Actual 7	Par. 92.08
18	3rd word	Actual 8	Par. 92.09

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

**With the Generic Drive communication profile active, Actual 1 is fixed to the actual signal 01.02 SPEED (in DTC motor control mode) or 01.03 FREQUENCY (in scalar mode).

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

The Control Word and the Status Word

The Control Word (CW) is the principal means of controlling the drive from a fieldbus system. It is effective when the active control location (EXT1 or EXT2, see parameters 10.01 and 10.02) is set to COMM.CW, or if Par. 10.07 is set to 1 (with Generic Drive communication profile only).

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

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

See section *Communication profiles* on page *249* for information on the composition of the Control Word and the Status Word.

References

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

Fieldbus reference selection

Fieldbus reference (called COMM. REF in signal selection contexts) is selected by setting a Reference selection parameter – 11.03 or 11.06 – to COMM. REFx or FAST COMM. (With Generic Drive communication profile, fieldbus reference is also selected when Par. 10.08 is set to 1.)

COMM. REF1 (in 11.03) or COMM. REF2 (in 11.06)
The fieldbus reference is forwarded.

FAST COMM
The fieldbus reference is forwarded. The reference is read every 2 milliseconds if either of the following conditions is met:

- Control location is **EXT1**, Par. 99.04 MOTOR CTRL MODE is **DTC**
- Control location is **EXT2**, Par. 99.04 MOTOR CTRL MODE is **DTC** and a **torque reference** is used.

In any other event, the fieldbus reference is read every 6 milliseconds.

Reference handling

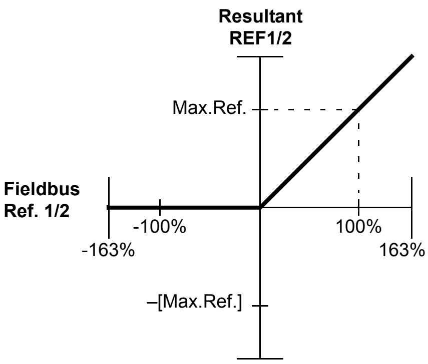
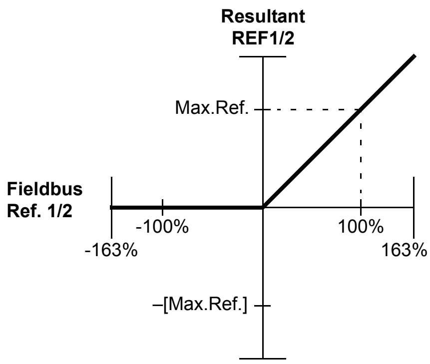
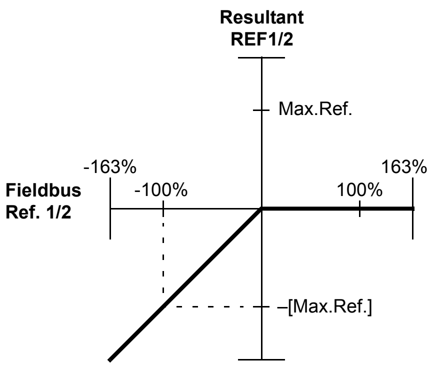
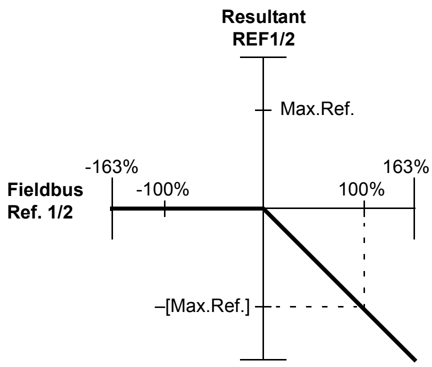
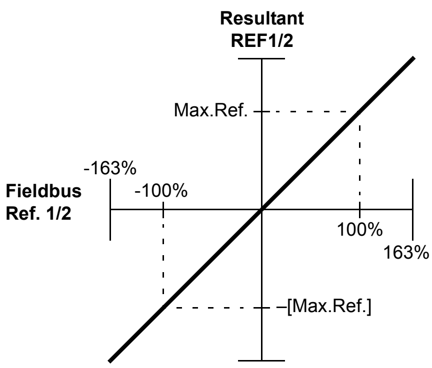
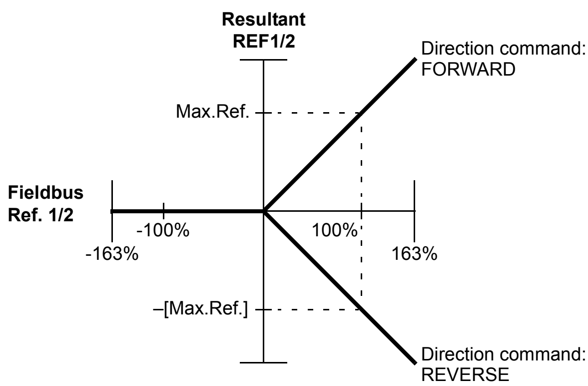
The control of rotation direction is configured for each control location (EXT1 and EXT2) using the parameters in group 10. Fieldbus references are bipolar, that is they can be negative or positive. The following diagrams illustrate how group 10 parameters and the sign of the fieldbus reference interact to produce the reference REF1/REF2.

Notes:

- With the ABB Drives communication profile, 100% reference is defined with parameters *11.05* (REF1) and *11.08* (REF2).

- With the Generic Drive communication profile, 100% reference is defined with parameter *99.08* in DTC motor control mode (REF1), or *99.07* in the Scalar control mode (REF1), and with parameter *11.08* (REF2).
- External reference scaling parameters *11.04* and *11.07* are also in effect.

For information on the scaling of the fieldbus reference, see section *Fieldbus reference scaling* on page *253* (for ABB Drives profile) or *Fieldbus reference scaling* on page *259* (for Generic Drive profile).

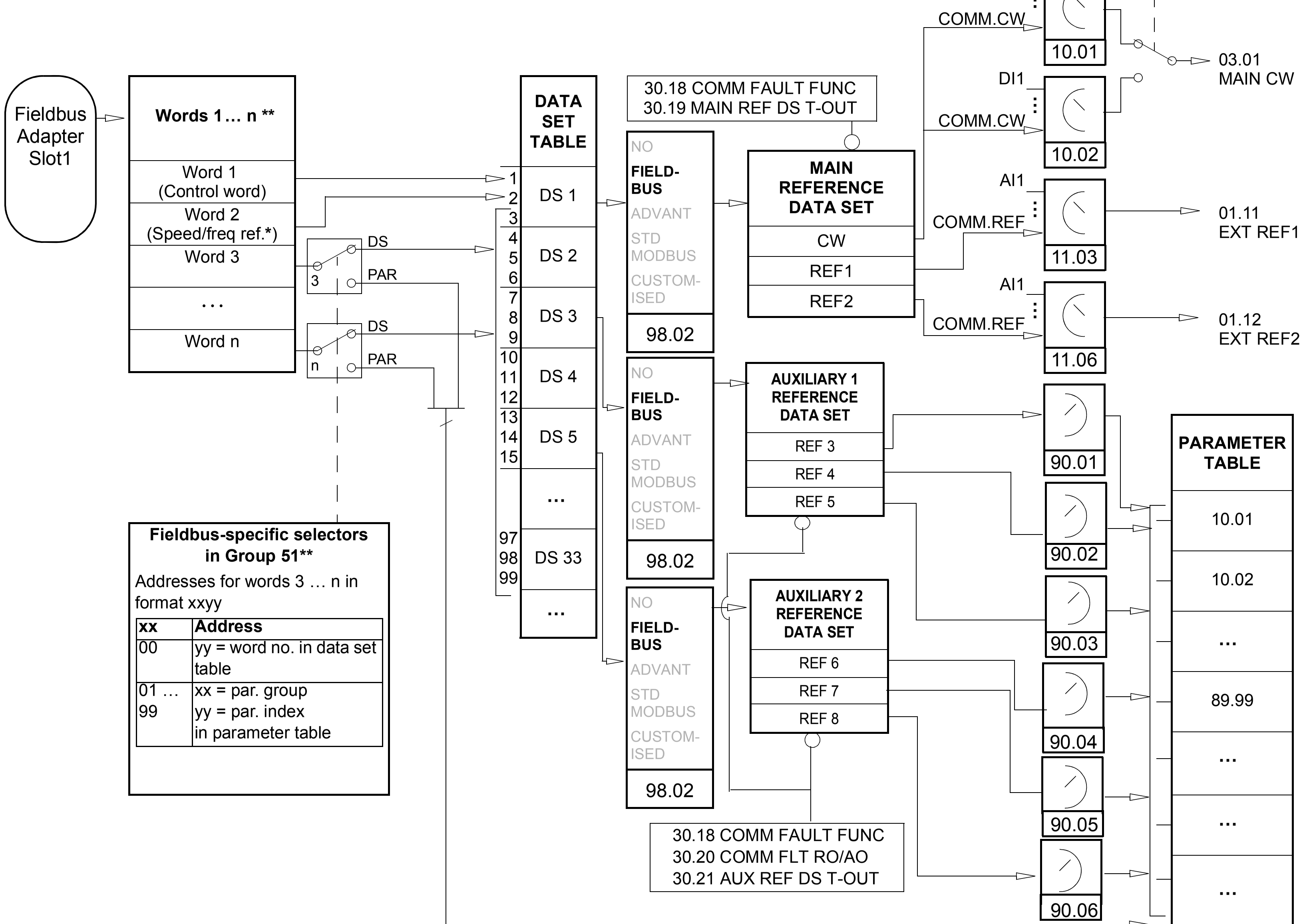
	***Direction determined by the sign of COMM. REF**	**Direction determined by digital command, for example, digital input, control panel**
Par. 10.03 REF DIRECTION = FORWARD		
Par. 10.03 REF DIRECTION = REVERSE		
Par. 10.03 REF DIRECTION = REQUEST		

*Direction is determined by the sign of COMM. REF when Par. 10.01 / 10.02 EXTx STRT/STP/DIR is set to COMM.CW OR Par. 11.03 / 11.06 EXT REFx SELECT is set to FAST COMM.

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*.

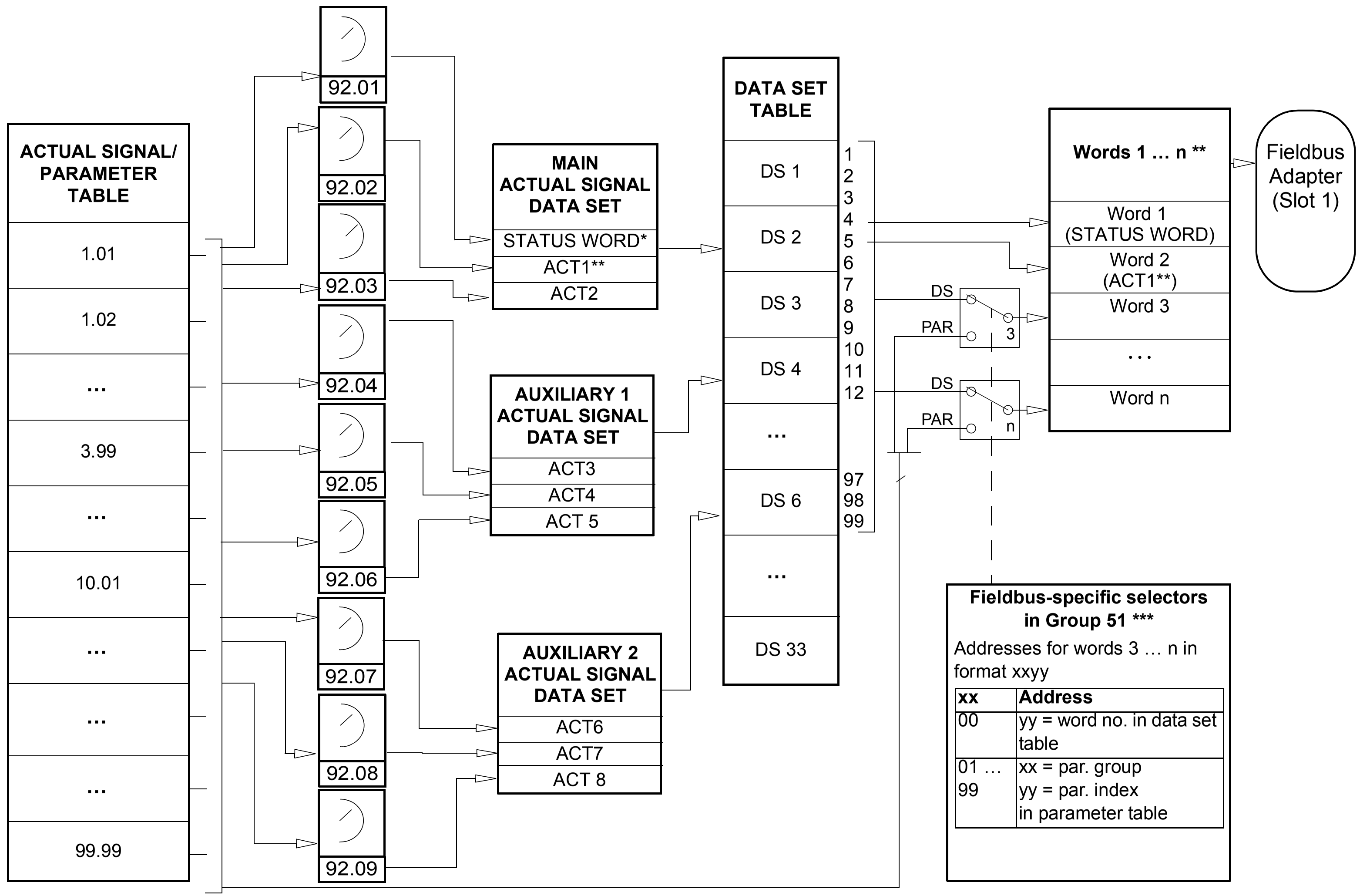
Block diagram: Control data input from fieldbus when a type Rxxx fieldbus adapter is used



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

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

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

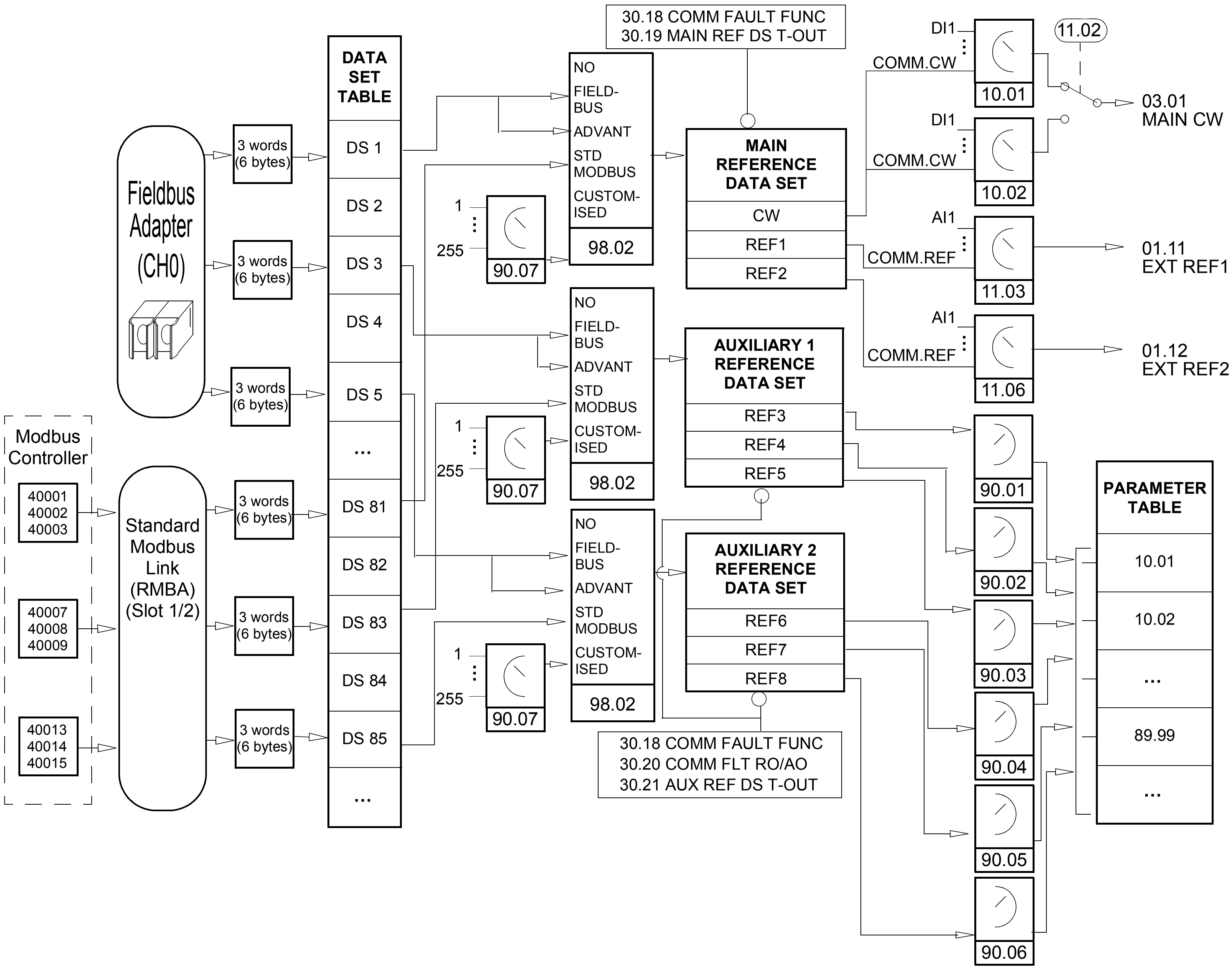


* Fixed to 03.02 MAIN STATUS WORD (bits 10, 13 and 14 are programmable).

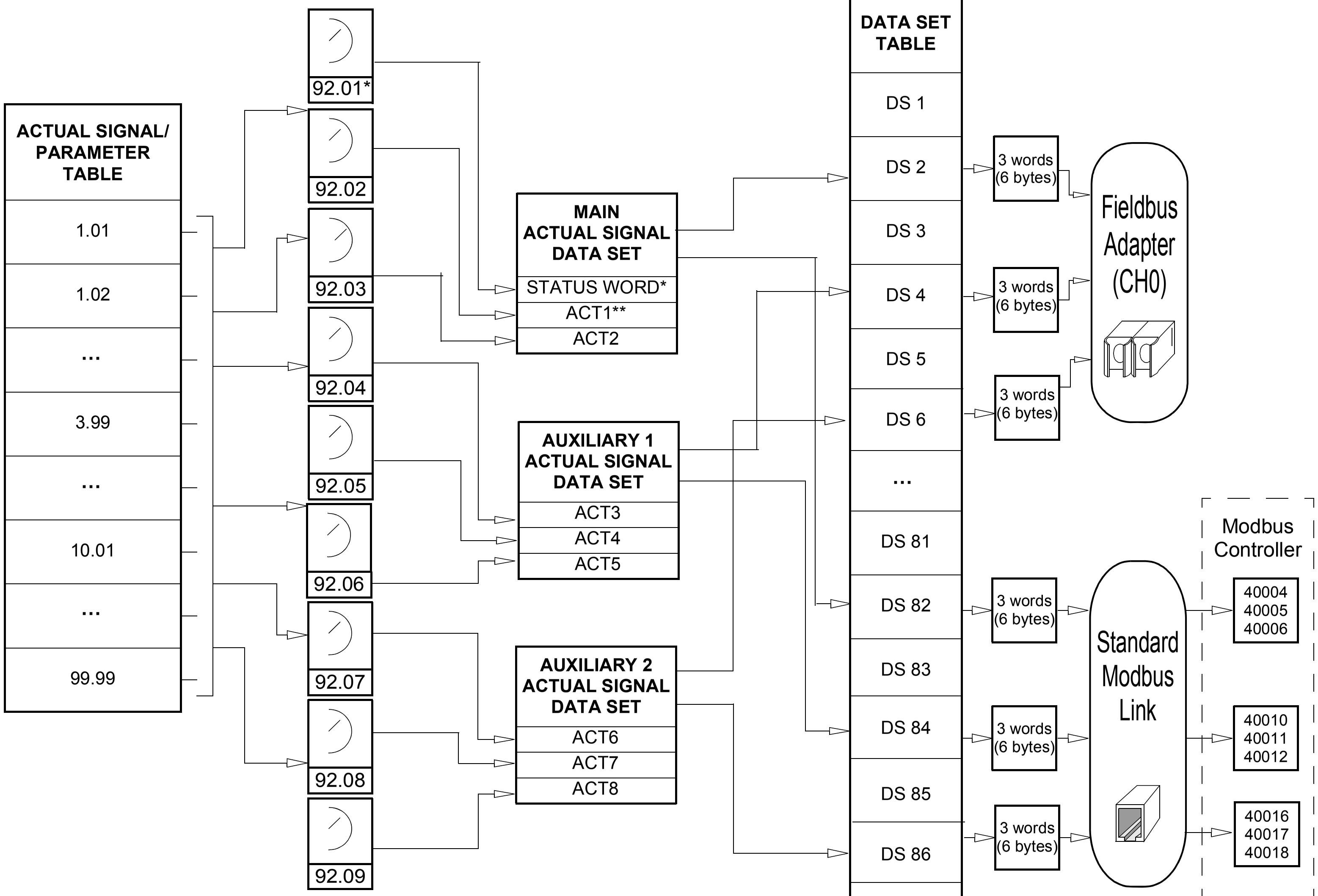
** Fixed to 01.02 SPEED (DTC control) or 01.03 FREQUENCY (Scalar control) when Generic communication profile is used.

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

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



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



* Fixed to 03.02 MAIN STATUS WORD (bits 10, 13 and 14 are programmable).

** Fixed to 01.02 SPEED (DTC motor control) or 0103 FREQUENCY (Scalar control) when Generic communication profile is used.

Communication profiles

The ACS800 supports three communication profiles:

- ABB Drives communication profile
- Generic Drive communication profile.
- CSA 2.8/3.0 communication profile.

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

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

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

ABB Drives communication profile

The ABB Drives communication profile is active when parameter *98.07* is set to ABB DRIVES. The Control Word, Status Word, and reference scaling for the profile are described below.

The ABB Drives communication profile can be used through both EXT1 and EXT2. The Control Word commands are in effect when Par. *10.01* or *10.02* (whichever control location is active) is set to COMM.CW.

03.01 MAIN CONTROL WORD

The upper case boldface text refers to the states shown in the *State Machine for the ABB Drives communication profile* on page *252*.

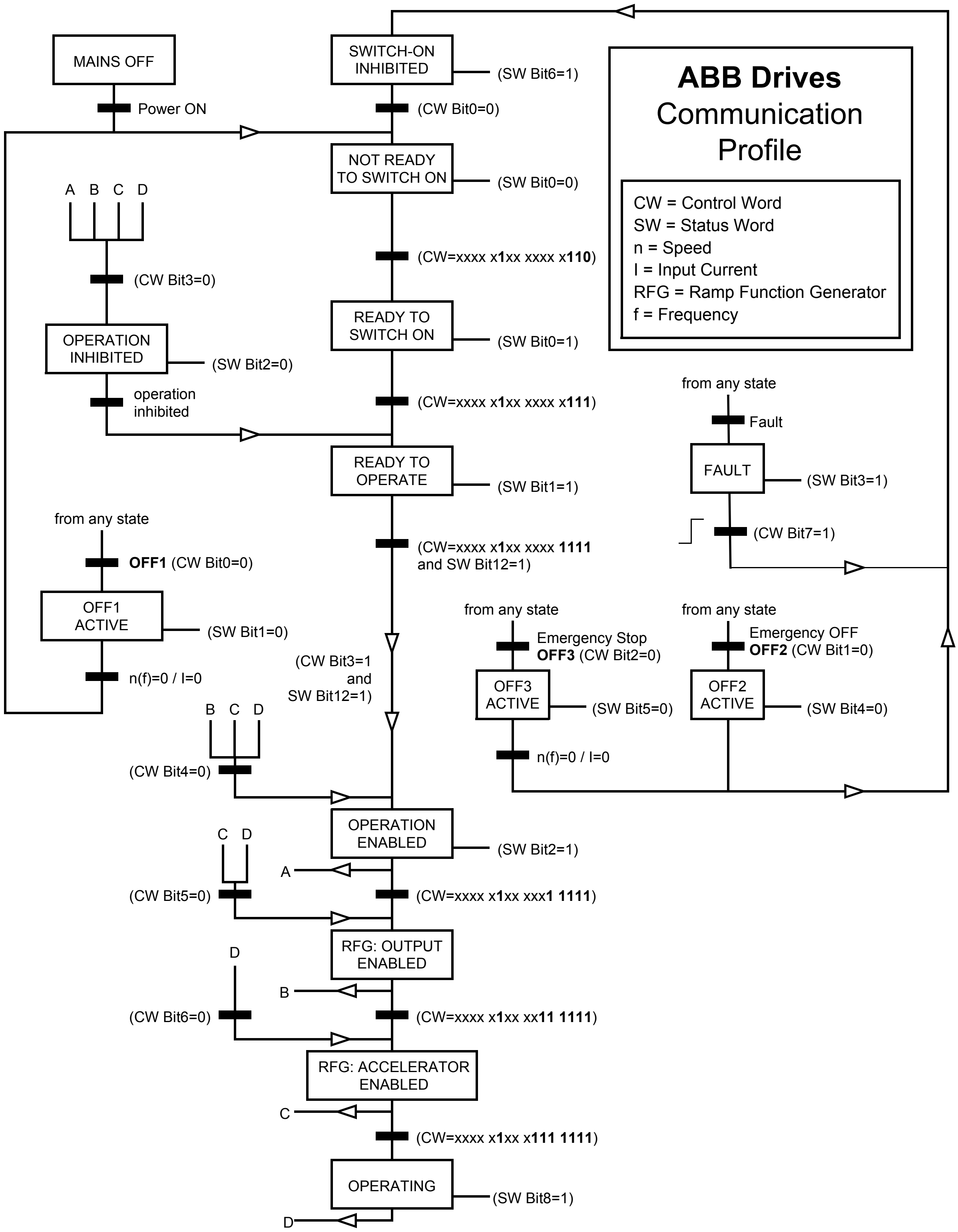
Bit	Name	Value	Enter STATE/Description
0	OFF1 CONTROL	1	Enter **READY TO OPERATE.**
		0	Stop along currently active deceleration ramp (22.03/22.05). Enter **OFF1 ACTIVE;** proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2 CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Enter **OFF2 ACTIVE**; proceed to **SWITCH-ON INHIBITED.**
2	OFF3 CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined with Par. *22.07*. Enter **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED.** **Warning:** Ensure motor and driven machine can be stopped using this stop mode.
3	INHIBIT_ OPERATION	1	Enter OPERATION ENABLED. (Note: The Run Enable signal must be active; see parameter *16.01*. If Par. *16.01* is set to COMM.CW, this bit also activates the Run Enable signal.)
		0	Inhibit operation. Enter **OPERATION INHIBITED.**
4	RAMP_OUT_ ZERO	1	Normal operation. Enter **RAMP FUNCTION GENERATOR: OUTPUT ENABLED.**
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Enable ramp function. Enter **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED.**
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Enter **OPERATING.**
		0	Force Ramp Function Generator input to zero.
7	RESET	0 ⇒ 1	Fault reset if an active fault exists. Enter **SWITCH-ON INHIBITED.**
		0	Continue normal operation.
8	INCHING_1	1	Not in use.
		1 ⇒ 0	Not in use.
9	INCHING_2	1	Not in use.
		1 ⇒ 0	Not in use.
10	REMOTE_CMD	1	Fieldbus control enabled.
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus control enabled. Reference and deceleration/acceleration ramp are locked.
11	EXT CTRL LOC	1	Select External Control Location EXT2. Effective if Par. *11.02* is set to COMM.CW.
		0	Select External Control Location EXT1. Effective if Par. *11.02* is set to COMM.CW.
12	USER MACRO CHANGE	0 ⇒ 1	User Macro 2 loaded. Effective if Par. *16.05* is set to COMM.CW.
		1 ⇒ 0	User Macro 1 loaded. Effective if Par. *16.05* is set to COMM.CW.
12 … 15	Reserved		

03.02 MAIN STATUS WORD

The upper case boldface text refers to the states shown in the *State Machine for the ABB Drives communication profile* on page 252.

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 i.e in speed control the speed error is less than or equal to 10% of the nominal motor speed).
		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		1	Bit is read from the address defined with parameter *92.10* MSW B10 PTR. By default no address has been selected.
		0	Actual frequency or speed value is within supervision limit.
11	EXT CTRL LOC	1	External Control Location EXT2 selected.
		0	External Control Location EXT1 selected.
12	EXT RUN ENABLE	1	External Run Enable signal received.
		0	No External Run Enable received.
13			Bit is read from the address defined with parameter *92.11* MSW B13 PTR. By default no address has been selected.
14			Bit is read from the address defined with parameter *92.12* MSW B14 PTR. By default no address has been selected.
15		1	Communication error detected by fieldbus adapter module (on fibre optic channel CH0).
		0	Fieldbus adapter (CH0) communication OK.

State Machine for the ABB Drives communication profile



Fieldbus reference scaling

With the ABB Drives communication profile active, fieldbus references REF1 and REF2 are scaled as shown in the table below.

Note: Any correction of the reference is applied before scaling. See section *References* on page *242*.

Ref. No.	Application Macro used (par. 99.02)	Range	Reference type	Scaling	Notes
REF1	(any)	-32768 ... 32767	Speed or Frequency (not with FAST COMM)	-20000 = **-[par. 11.05]** -1 = **-[par. 11.04]** 0 = **[par. 11.04]** 20000 = **[par. 11.05]**	Final reference limited with 20.01/20.02 [speed] or 20.07/20.08 [frequency].
			Speed or Frequency with FAST COMM	-20000 = **-[par. 11.05]** 0 = 0 20000 = **[par. 11.05]**	Final reference limited with 20.01/20.02 [speed] or 20.07/20.08 [frequency].
REF2	Crane macro with speed mode	-32768 ... 32767	Speed or Freq. (not with FAST COMM)	-20000 = **-[par. 11.08]** -1 = **-[par. 11.07]** 0 = **[par. 11.07]** 20000 = **[par. 11.08]**	Final reference limited with 20.01/20.02 [speed] or 20.07/20.08 [frequency].
			Speed or Freq. with FAST COMM	-20000 = **-[par. 11.08]** 0 = 0 20000 = **[par. 11.08]**	Final reference limited with 20.01/20.02 [speed] or 20.07/20.08 [frequency].
	Crane macro with M/F in torque mode	-32768 ... 32767	Torque (not with FAST COMM)	-10000 = **-[par. 11.08]** -1 = **-[par. 11.07]** 0 = **[par. 11.07]** 10000 = **[par. 11.08]**	Final reference limited with Par. 20.04.
			Torque with FAST COMM	-10000 = **-[par. 11.08]** 0 = 0 10000 = **[par. 11.08]**	Final reference limited with Par. 20.04.

Start/Stop sequence using communication bits

This section describes the sequence of the 03.01 MAIN CONTROL WORD bits used for starting, stopping and restarting after a fault condition or an abnormal stop, when the drive is configured in the ABB Drives communication profile. For the flow sequence of the communication bits, see *Flow chart for Main Control Command Bit sequence* on page *255*.

Normal starting sequence

You can start the drive through the controlling device by giving the following main command word bit sequence:

- Enable Bit 10 (Bit 10 = 1) to activate the fieldbus command.
- Enable Bit 4, Bit 5 and Bit 6 (Bit 4, Bit 5 and Bit 6 = 1) to activate the normal ramp block functions.
- Enable Bit 1 (Bit 1 = 1) to deactivate the OFF2 command.
- Enable Bit 2 (Bit 2 = 1) to deactivate the OFF3 command.
- Enable Bit 0 (Bit 0 = 1) to deactivate the OFF1 command.
- Enable Bit 3 (Bit 3 = 1) to issue the start command.

Normal stopping sequence and restarting

You can stop and restart the drive through the controlling device by giving the following main command word bit sequence:

- Disable Bit 3 (Bit 3 = 1 -> 0) to issue a stop command. Brake control must be activated, or else the drive will stop by coasting.
- Enable Bit 3 (Bit 3 = 0 -> 1) to issue the start command.

OFF1, OFF2, OFF3 stopping sequence and restarting

You can stop and restart the drive through the controlling device by giving the following main command word bit sequence:

- Disable Bit 0 (Bit 0 = 1 -> 0) to issue an OFF1 stop command, disable Bit 1 (Bit 1 = 1 -> 0) to issue an OFF2 stop command and Disable Bit 2 (Bit 2 = 1 -> 0) to issue an OFF3 stop command, respectively.
- The drive can be started again only after the drive has stopped.
- To issue a start command again, disable Bit 3 (Bit 3 = 1 -> 0).
- Disable Bit 0 (Bit 0 = 1 -> 0) if the OFF2/OFF3 command was issued.
- Enable Bit 0 (Bit 0 = 0 -> 1) again if the OFF1 stop command was issued, or Bit 1 (Bit 1 = 0 -> 1) if the OFF2 stop command was issued, or Bit 2 (Bit 2 = 0 -> 1) if the OFF3 stop command was issued.
- Enable Bit 0 (Bit 0 = 1) to make the drive ready to start.
- Enable Bit 3 (Bit 3 = 1) to issue the start command.

Fault condition/abnormal stop and restarting

After a drive fault condition or an abnormal stop, the drive can be restarted through the controlling device by giving the following main command word bit sequence:

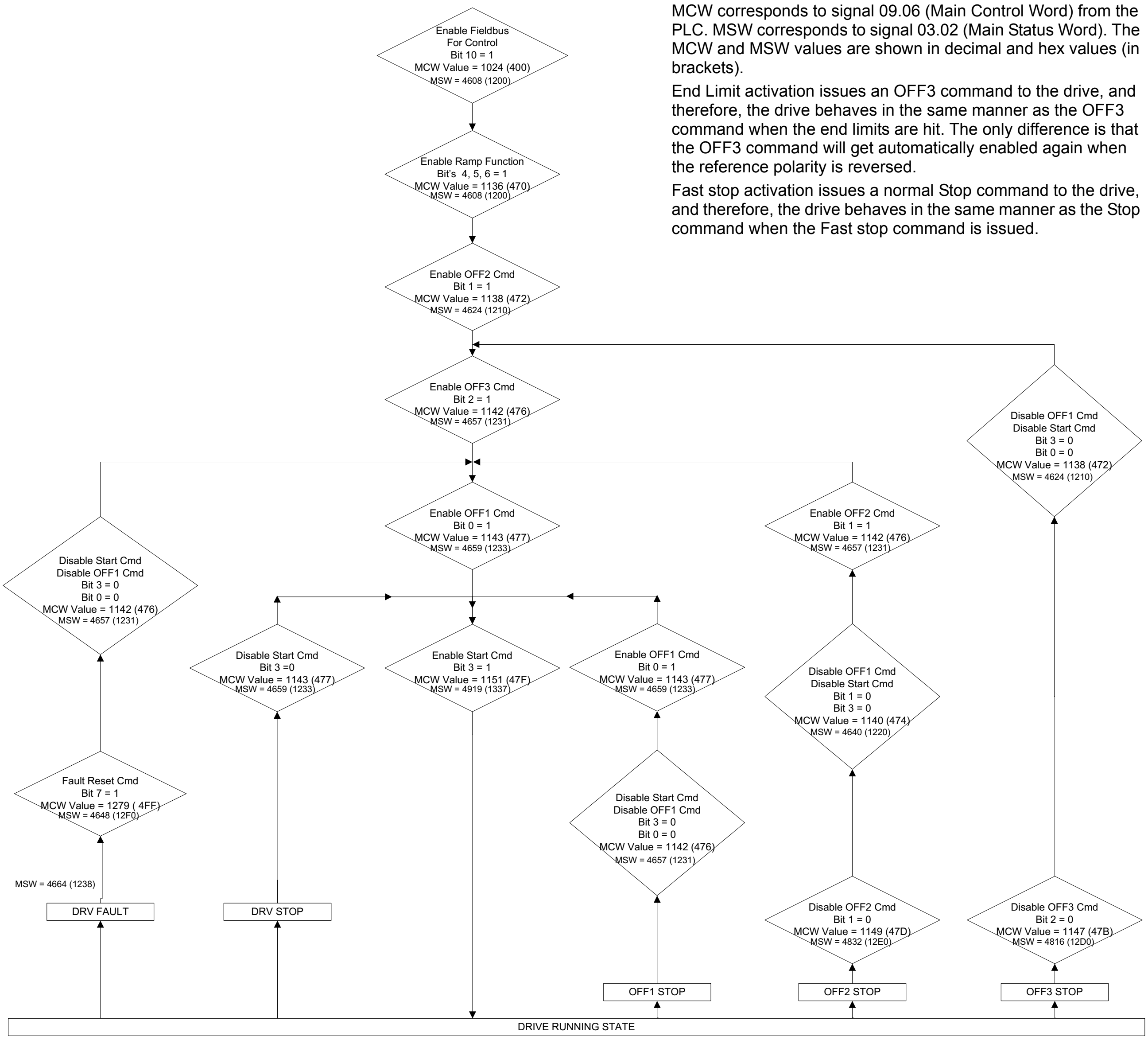
- Enable Bit 7 (Bit 7 = 1) to issue the fault reset command if the drive has tripped on a fault.
- Disable Bit 3 (Bit 3 = 1 -> 0) to remove the drive start command. Else the drive will not start, and the *START HIGH (FFB3)* warning will be displayed.
- Disable Bit 0 (Bit 0 = 1 -> 0), and then enable this bit (Bit 0 = 0 -> 1) again to make the drive ready to accept the start command.
- Enable Bit 3 (Bit 3 = 1) to issue the start command.

Flow chart for Main Control Command Bit sequence

MCW corresponds to signal 09.06 (Main Control Word) from the PLC. MSW corresponds to signal 03.02 (Main Status Word). The MCW and MSW values are shown in decimal and hex values (in brackets).

End Limit activation issues an OFF3 command to the drive, and therefore, the drive behaves in the same manner as the OFF3 command when the end limits are hit. The only difference is that the OFF3 command will get automatically enabled again when the reference polarity is reversed.

Fast stop activation issues a normal Stop command to the drive, and therefore, the drive behaves in the same manner as the Stop command when the Fast stop command is issued.



Fieldbus references in a Master/Follower configuration

When the ABB Drives communication profile is active, the fieldbus interface uses the following references in the Master drive:

- When the Master is in control location EXT1 (stand-alone, speed-controlled), the fieldbus interface uses REF1 for the speed reference.
- When the Master is in control location EXT2 (Master/Follower, either speed-controlled or torque-controlled depending on the selection of Par. 60.02 TORQUE SELECTOR), the fieldbus interface uses REF2 for the speed or torque reference.

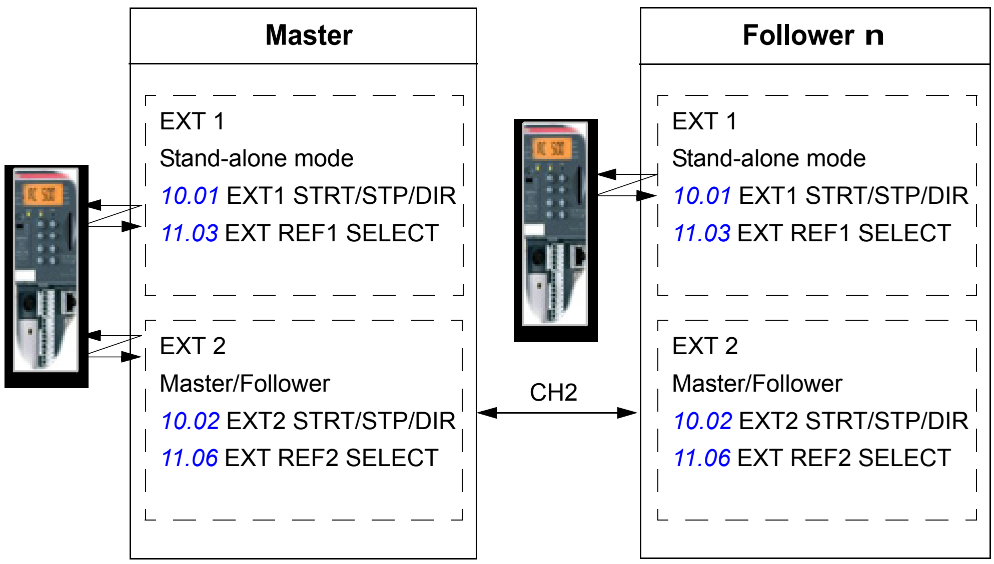
When the ABB Drives communication profile is active, the fieldbus interface uses the following references in the Follower drives:

- When Follower n is in control location EXT1 (stand-alone, speed-controlled), the fieldbus interface uses REF1 for the speed reference.

  Note: For the fieldbus interface to work in follower drives in EXT1, Par. 60.01 MASTER LINK MODE must be set to value NOT IN USE in the follower drives. Ensure this either through the fieldbus (parameter writing) or DriveAP's Write block.

- When Follower n is in control location EXT2 (Master/Follower, either speed-controlled or torque-controlled depending on the selection of Par. 60.02 TORQUE SELECTOR), the fieldbus interface cannot control the references because they come through the M/F link (CH).

The figure below illustrates the use of fieldbus references in a Master/Follower configuration.



Note: In follower drives in EXT1, Par. 60.01 must have value NOT IN USE for the fieldbus interface to work.

Generic Drive communication profile

The Generic Drive communication profile is active when parameter *98.07* is set to GENERIC. The Generic Drive profile realises the device profile for drives – speed control only – as defined by specific fieldbus standards such as PROFIDRIVE for PROFIBUS, AC/DC Drive for DeviceNet, Drives and Motion Control for CANopen, etc. Each device profile specifies its Control and Status Words, Reference and Actual value scaling. The profiles also define Mandatory services which are transferred to the application interface of the drive in a standardised way.

The Generic Drive communication profile can be used through both EXT1 and EXT2*. The proper functioning of the Generic Drive profile requires that Control Word commands are enabled by setting parameter *10.01* or *10.02* (whichever control location is active) to COMM.CW (or Par. *10.07* to 1) and by setting parameter *16.01* to YES.

*For vendor-specific support of EXT2 reference, see the appropriate fieldbus manual.

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

Drive commands supported by the Generic Drive communication profile

Name	Description
STOP	The drive decelerates the motor to zero speed according to the active deceleration ramp (parameter 22.03 or 22.05).
START	The drive accelerates to the set reference value according to the active acceleration ramp (Par. 22.02 or 22.04). The direction of rotation is determined by the sign of the reference value and the setting of par. 10.03.
COAST STOP	The drive coasts to stop, that is the drive stops modulating. However, this command can be overridden by the Brake Control function, which forces the drive to decelerate to zero speed by the active deceleration ramp. When the Brake Control function is active, Coast stop and Emergency coast stop (OFF2) commands given after the Emergency ramp stop (OFF3) coast the drive to a stop.
QUICK STOP	The drive decelerates the motor to zero speed within the emergency stop deceleration time defined with Par. 22.07.
CURRENT LIMIT STOP (CLS)	The drive decelerates the motor to zero speed according to the set current limit (Par. 20.03) or torque limit (20.04), whichever is first reached. The same procedure is valid in case of a Voltage Limit Stop (VLS).
INCHING1	With this command active, the drive accelerates the motor to Step reference 3 (defined with Par. 12.04). After the command is removed, the drive decelerates the motor to zero speed. **Note:** The speed reference ramps are not effective. The speed change rate is only limited by the current (or torque) limit of the drive. **Note:** Inching 1 takes priority over Inching 2. **Note:** Not effective in Scalar control mode.
INCHING2	With this command active, the drive accelerates the motor to Step reference 4 (defined with Par. 12.05). After the command is removed, the drive decelerates the motor to zero speed. **Note:** The speed reference ramps are not effective. The speed change rate is only limited by the current (or torque) limit of the drive. **Note:** Inching 1 takes priority over Inching 2. **Note:** Not effective in Scalar control mode.
RAMP OUT ZERO	When active, forces the output of the reference function generator to zero.
RAMP HOLD	When active, freezes the reference function generator output.
FORCED TRIP	Trips the drive. The drive will indicate fault FORCED TRIP.
RESET	Resets an active fault.

Fieldbus reference scaling

With the Generic Drive communication profile active, the speed reference value received from the fieldbus and the actual speed value received from the drive are scaled as shown in the table below.

Note: Any correction of the reference (see section *References* on page 242) is applied before scaling.

Ref. No.	**Application Macro used (par. 99.02)**	**Range**	**Reference type**	**Speed reference scaling**	**Actual speed scaling***	**Notes**
REF1	(any)	-32768... 32767	Speed or Frequency	0 = 0 20000 = **[par. 99.08 (DTC) / 99.07 (scalar)]****	0 = 0 20000 = **[par. 99.08 (DTC) / 99.07 (scalar)]****	
REF2	Crane macro with speed mode	-32768... 32767	Speed or Freq. (not with FAST COMM)	-20000 = **-[par. 11.08]** -1 = **-[par. 11.07]** 0 = **[par. 11.07]** 20000 = **[par. 11.08]**	0 = 0 20000 = **[par. 99.08 (DTC) / 99.07 (scalar)]****	Final reference limited with 20.01/20.02 [speed] or 20.07/20.08 [frequency]
			Speed or Freq. with FAST COMM	-20000 = **-[par. 11.08]** 0 = 0 20000 = **[par. 11.08]**	0 = 0 20000 = **[par. 99.08 (DTC) / 99.07 (scalar)]****	Final reference limited with 20.01/20.02 [speed] or 20.07/20.08 [frequency]
	Crane macro with M/F in torque mode	-32768... 32767	Torque (not with FAST COMM)	-10000 = **-[par. 11.08]** -1 = **-[par. 11.07]** 0 = **[par. 11.07]** 10000 = **[par. 11.08]**	0 = 0 20000 = **[par. 99.08 (DTC) / 99.07 (scalar)]****	Final reference limited with 20.04
			Torque with FAST COMM	-10000 = **-[par. 11.08]** 0 = 0 10000 = **[par. 11.08]**	0 = 0 20000 = **[par. 99.08 (DTC) / 99.07 (scalar)]****	Final reference limited with 20.04

* With DTC the filter time of the actual speed value can be adjusted using parameter 34.04.

** **Note:** The maximum reference value is 163% (that is,163% = 1.63 · value of parameter 99.08/99.07 value).

CSA 2.8/3.0 communication profile

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

CONTROL WORD for the CSA 2.8/3.0 communication profile

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

STATUS WORD for the CSA 2.8/3.0 communication profile

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

The reference and actual scaling is equal to that of the ABB Drives profile.

Diverse control, status, fault, alarm and limit words

03.03 AUXILIARY STATUS WORD

Bit	Name	Description
0	Reserved	
1	OUT OF WINDOW	Speed difference is out of the window (in speed control)*.
2	Reserved	
3	MAGNETIZED	Flux has been formed in the motor.
4	Reserved	
5	SYNC RDY	Position counter synchronised.
6	1 START NOT DONE	Drive has not been started after changing the motor parameters in group 99.
7	IDENTIF RUN DONE	Motor ID run successfully completed.
8	START INHIBITION	Safe Torque Off active.
9	LIMITING	Control at a limit. See actual signal 3.04 LIMIT WORD 1 below.
10	TORQ CONTROL	Torque reference is followed*.
11	ZERO SPEED	Absolute value of motor actual speed is below zero speed limit (4% of synchronous speed).
12	INTERNAL SPEED FB	Internal speed feedback followed.
13	M/F COMM ERR	Master/Follower link (on CH2) communication error*.
14 … 15	Reserved	

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

03.04 LIMIT WORD 1

Bit	Name	Active Limit
0	TORQ MOTOR LIM	Pull-out limit
1	SPD_TOR_MIN_LIM	Speed control torque min. limit
2	SPD_TOR_MAX_LIM	Speed control torque max. limit
3	TORQ_USER_CUR_LIM	User-defined current limit
4	TORQ_INV_CUR_LIM	Internal current limit
5	TORQ_MIN_LIM	Any torque min. limit
6	TORQ_MAX_LIM	Any torque max. limit
7	TREF_TORQ_MIN_LIM	Torque reference min. limit
8	TREF_TORQ_MAX_LIM	Torque reference max. limit
9	FLUX_MIN_LIM	Flux reference min. limit
10	FREQ_MIN_LIMIT	Speed/frequency min. limit
11	FREQ_MAX_LIMIT	Speed/frequency max. limit
12	DC_UNDERVOLT	DC undervoltage limit
13	DC_OVERVOLT	DC overvoltage limit
14	TORQUE LIMIT	Any torque limit
15	FREQ_LIMIT	Any speed/frequency limit

03.05 FAULT WORD 1

Bit	Name	Description
0	SHORT CIRC	For the possible causes and remedies, see chapter *Fault tracing*.
1	OVERCURRENT	
2	DC OVERVOLT	
3	ACS800 TEMP	
4	EARTH FAULT	
5	THERMISTOR	
6	MOTOR TEMP	
7	SYSTEM_FAULT	A fault is indicated by the System Fault Word (Actual Signal 03.07).
8	UNDERLOAD	For the possible causes and remedies, see chapter *Fault tracing*.
9	OVERFREQ	
10 … 15	Reserved	

03.06 FAULT WORD 2

Bit	Name	Description
0	SUPPLY PHASE	For the possible causes and remedies, see chapter *Fault tracing*.
1	NO MOT DATA	
2	DC UNDERVOLT	
3	Reserved	
4	Not Used	For the possible causes and remedies, see chapter *Fault tracing*.
5	ENCODER ERR	
6	I/O COMM	
7	CTRL B TEMP	
8	EXTERNAL FLT	
9	OVER SWFREQ	
10	AI < MIN FUNC	
11	PPCC LINK	
12	COMM MODULE	
13	PANEL LOSS	
14	MOTOR STALL	
15	MOTOR PHASE	

03.07 SYSTEM FAULT WORD

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

03.08 ALARM WORD 1

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

03.09 ALARM WORD 2

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

03.11 FOLLOWER MAIN COMMAND WORD

This signal is sent from the Master drive to the Follower drive as the command word for the Follower drives.

Bit	Name	Description
0	OFF1	Not in use (Internally forced to "1")
1	OFF2	Not in use (Internally forced to "1")
2	OFF3	Not in use (Internally forced to "1")
3	RUNNING	Master drive running bit. This bit is used to issue the start command in the Follower drive based on the Master drive running status (1 = Start (Master running), 0 = Stop (Master stopped). The start command is issued in the Follower drive only when the Master drive is in the EXT2 control. If the Master drive is in the EXT1 control, the start command is blocked and the Follower does not start.
4	RAMP_OUT_ZERO	Not in use (Internally forced to "1")
5	RAMP_HOLD	Not in use (Internally forced to "1")
6	RAMP_IN_ZERO	Not in use (Internally forced to "1")
7	FAULT RESET	Drive fault reset. This bit issues a fault reset command in the Follower drive when a fault reset command is issued in the Master drive. 0 = Fault reset inactive 1 = Fault reset active

Bit	Name	Description
8	INCHING_1	Not in use (Inching function is not available in crane control)
9	INCHING_2	Not in use (Inching function is not available in crane control)
10	REMOTE_CMD	Fieldbus control enabled (Set to "1")
11	START REQ	Start request status in the Master. Used to check whether the Master drive has an active start request. Used for interlocking in the Follower drive for position hysteresis and Synchro control. 0 = No start request in the Master 1 = Start request active in the Master
12	REF UNDER LIM	Master speed reference is under the brake close speed limit. Used for the low reference brake hold function in the Follower drive in the Master/Follower configuration. 0 = Speed reference not under the brake close speed 1 = Speed reference under the brake close speed
13	RMP REF LIMIT	Master ramped speed reference is under the brake close speed limit. Used for low reference brake hold function in the Follower drive in the Master/Follower configuration. 0 = Ramped speed reference not under the brake close speed 1 = Ramped speed reference under the brake close speed
14	BRAKE CLOSED	Master brake is closed. Used for forced brake closing in the Follower drive in the torque mode in the Master/Follower configuration. 0 = Master brake open 1 = Master brake closed
15	Not used	

03.13 AUXILIARY STATUS WORD 3

Bit	Name	Description
0	REVERSED	Motor rotates in reverse direction.
1	EXT CTRL	External control is selected.
2	REF 2 SEL	Reference 2 is selected.
3	STEP REF	A Step reference (1 … 4) is selected.
4	STARTED	The drive has received a Start command.
5	USER 2 SEL	User Macro 2 has been loaded.
6	OPEN BRAKE	The Open brake command is ON. See group *42 BRAKE CONTROL*.
7	LOSS OF REF	The reference has been lost.
8	STOP DI STATUS	The state of the interlock input on the RMIO board.
9	READY	Ready to function: Run enable signal on, no fault
10	DATASET STATUS	Data set has not been updated.
11	MACRO CHG	Macro is changing or is being saved.
12…15	Reserved	

03.14 AUXILIARY STATUS WORD 4

Bit	Name	Description
0 ... 6	Unused	
7 ... 9	Reserved	
10	EXT SPD MAX LIMIT	Speed is limited in the forward direction according to the value set in par *20.22*.
11	EXT SPD MIN LIMIT	Speed is limited in the reverse direction according to the value set in par *20.23*.

03.15 FAULT WORD 4

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

03.16 ALARM WORD 4

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

03.17 FAULT WORD 5

Bit	Name	Description
0	BR BROKEN	For the possible causes and remedies, see chapter *Fault tracing*.
1	BR WIRING	
2	BC SHORT CIR	
3	BR OVERHEAT	
4	BC OVERHEAT	
5	IN CHOKE TEMP	
6	PP OVERLOAD	
7	INV DISABLED	
8	TEMP DIF	
9	POWERF INV xx/ POWERFAIL	
10	INT CONFIG	
11	USER L CURVE	
12	Reserved	
13	INV OVERTEMP	For the possible causes and remedies, see chapter *Fault tracing*.
14...15	Reserved	

03.18 ALARM WORD 5

Bit	Name	Description
0	REPLACE FAN	For the possible causes and remedies, see chapter *Fault tracing*.
1	SYNCRO SPEED	
2	BR OVERHEAT	
3	BC OVERHEAT	
4	IN CHOKE TEMP	
5	PP OVERLOAD	
6	INV DISABLED	
7	CUR UNBAL	
8	INV CUR LIM	
9	DC BUS LIM	
10	MOT CUR LIM	
11	MOT TORQ LIM	
12	MOT POW LIM	
13	USER L CURVE	
14	Reserved	
15	BATT FAILURE	For the possible causes and remedies, see chapter *Fault tracing*.

03.19 INT INIT FAULT

Bit	Name	Description
0	AINT FAULT	Wrong EPLD version
1	AINT FAULT	Wrong AINT board revision
2	AINT FAULT	Du/dt limitation hardware failure
3	AINT FAULT	Current measurement scaling error
4	AINT FAULT	Voltage measurement scaling error
5 … 15	Reserved	
This signal is active with AINT board.		

03.20...03.24 Fault codes

Code	Description	Application/Fault Word Status Bit
4210	ACS800 TEMP	*03.05 FAULT WORD 1* bit 3
4210	ACS TEMP xx y	*03.05 FAULT WORD 1* bit 3 and *04.01 FAULTED INT INFO*
8110	AI < MIN FUNC	*03.06 FAULT WORD 2* bit 10
FFA2	BACKUP ERROR	

Code	Description	Application/Fault Word Status Bit
7114	BC OVERHEAT	*03.17 FAULT WORD 5* bit 4
7113	BC SHORT CIR	*03.17 FAULT WORD 5* bit 2
FF74	BRAKE ACKN	*03.15 FAULT WORD 4* bit 3
FFF3	BRAKE SLIP FLT	*03.33 CRANE FAULT WORD* bit 3
7110	BR BROKEN	*03.17 FAULT WORD 5* bit 0
7112	BR OVERHEAT	*03.17 FAULT WORD 5* bit 3
7111	BR WIRING	*03.17 FAULT WORD 5* bit 1
FF82	CHOKE OTEMP	
7510	COMM MODULE	*03.06 FAULT WORD 2* bit 12
4110	CTRL B TEMP	*03.06 FAULT WORD 2* bit 7
2211	CURR MEAS	
2330	CUR UNBAL xx	*03.05 FAULT WORD 1* bit 4 and *04.01 FAULTED INT INFO*
FF80	DC HIGH RUSH	
3210	DC OVERVOLT	*03.05 FAULT WORD 1* bit 2
3220	DC UNDERVOLT	*03.06 FAULT WORD 2* bit 2
2330	EARTH FAULT	*03.05 FAULT WORD 1* bit 4
7302	ENCODER A<>B	
7301	ENCODER ERR	*03.06 FAULT WORD 2* bit 5
9000	EXTERNAL FLT	*03.06 FAULT WORD 2* bit 8
FF83	FAN OVERTEMP	
FF8F	FORCED TRIP	
FFBA	FLWR1 COM FLT	
FFBB	FLWR2 COM FLT	
FFBC	FLWR3 COM FLT	
FFBD	FLWR4 COM FLT	
	GD DISABLED X	
FF84	ID RUN FAIL	
FF81	IN CHOKE TEMP	*03.17 FAULT WORD 5* bit 5
5410	INT CONFIG	*03.17 FAULT WORD 5* bit 10
3200	INV DISABLED	*03.17 FAULT WORD 5* bit 7
FFBF	INV LIMIT	*03.33 CRANE FAULT WORD* bit 5
4290	INV OVERTEMP	*03.17 FAULT WORD 5* bit 13
7000	I/O COMM ERR	*03.06 FAULT WORD 2* bit 6

Code	Description	Application/Fault Word Status Bit
FF51	LINE CONV	
FFF0	MOTOROVER SPD	
FF56	MOTOR PHASE	*03.06 FAULT WORD 2* bit 15
4310	MOTOR TEMP	*03.05 FAULT WORD 1* bit 6
4312	MOTOR 1 TEMP	*03.15 FAULT WORD 4* bit 1
4313	MOTOR 2 TEMP	*03.15 FAULT WORD 4* bit 2
FF52	NO MOT DATA	*03.06 FAULT WORD 2* bit 1
2310	OVERCURR xx	*03.05 FAULT WORD 1* bit 1 and *04.01 FAULTED INT INFO*
2310	OVERCURRENT	*03.05 FAULT WORD 1* bit 1
7123	OVERFREQ	*03.05 FAULT WORD 1* bit 9
FF55	OVER SWFREQ	*03.06 FAULT WORD 2* bit 9
5300	PANEL LOSS	*03.06 FAULT WORD 2* bit 13
6320	PARAM CRC	
3381	POWERFAIL	*03.17 FAULT WORD 5* bit 9
3381	POWERF INV xx	*03.17 FAULT WORD 5* bit 9 and *04.01 FAULTED INT INFO*
5210	PPCC LINK	*03.06 FAULT WORD 2* bit 11
5210	PPCC LINK xx	*03.06 FAULT WORD 2* bit 11 and *04.01 FAULTED INT INFO*
5482	PP OVERLOAD	*03.17 FAULT WORD 5* bit 6
FF54	RUN DISABLED	
FF7D	SAFETYCLS FLT	
FFF1	SPD MATCH FLT	*03.33 CRANE FAULT WORD* bit 1
2340	SC INV xx y	*03.05 FAULT WORD 1* bit 0, *04.01 FAULTED INT INFO* and *04.02 INT SC INFO*
2340	SHORT CIRC	*03.05 FAULT WORD 1* bit 0 and *04.01 FAULTED INT INFO*
FF8A	SLOT OVERLAP	
FF7A	START INHIBI	*03.03 AUXILIARY STATUS WORD* bit 8
3130	SUPPLY PHASE	*03.06 FAULT WORD 2* bit 0
FFBE	SYNC FAULT	*03.33 CRANE FAULT WORD* bit 4
4380	TEMP DIF xx y	*03.17 FAULT WORD 5* bit 8 and *04.01 FAULTED INT INFO*
FF50	THERMAL MODE	
4311	THERMISTOR	*03.05 FAULT WORD 1* bit 5
FFF2	TORQ PROVE FLT	
FF6A	UNDERLOAD	*03.05 FAULT WORD 1* bit 8

Code	Description	Application/Fault Word Status Bit
FFA1	USER MACRO	*03.07 SYSTEM FAULT WORD* bit 1

03.25...03.29 Warning codes

Code	Description	Application/Fault Word Status Bit
4210	ACS800 TEMP	*03.08 ALARM WORD 1* bit 4
8110	AI < MIN FUNC	*03.09 ALARM WORD 2* bit 10
FFA3	BACKUP USED	
5581	BATT FAILURE	*03.18 ALARM WORD 5* bit 15
7114	BC OVERHEAT	*03.18 ALARM WORD 5* bit 3
FF74	BRAKE ACKN	*03.16 ALARM WORD 4* bit 3
FFFC	BRK LONG TIME	*03.32 CRANE STATUS WORD* bit 9
7112	BR OVERHEAT	*03.18 ALARM WORD 5* bit 2
FF37	CALIBRA DONE	
FF36	CALIBRA REQ	
7510	COMM MODULE	*03.08 ALARM WORD 1* bit 12
2330	CUR UNBAL xx	*03.08 ALARM WORD 1* bit 14 and *04.01 FAULTED INT INFO*
3211	DC BUS LIM	*03.18 ALARM WORD 5* bit 9
2330	EARTH FAULT	*03.08 ALARM WORD 1* bit 14
7302	ENCODER A<>B	*03.09 ALARM WORD 2* bit 4
7301	ENCODER ERR	*03.08 ALARM WORD 1* bit 5
FFF8	FAST STOP	
FFFD	FLWR1 LIM/FLT	
FFFE	FLWR2 LIM/FLT	
FFB5	FLWR3 LIM/FLT	
FFB4	FLWR4 LIM/FLT	
FF38	HW RECONF RQ	
FFF6	HIGHEND LIMIT	
FFB1	HOMING ACTIVE	
FFB0	HOMING DONE	
FFF7	LOWEND LIMIT	
FF32	ID DONE	
FF31	ID MAGN	

Code	Description	Application/Fault Word Status Bit
FF30	ID MAGN REQ	
FF68	ID N CHANGED	
FF35	ID RUN	
FF33	ID RUN SEL	
FF81	IN CHOKE TEMP	*03.18 ALARM WORD 5* bit 4
2212	INV CUR LIM	*03.18 ALARM WORD 5* bit 8
3200	INV DISABLED	*03.18 ALARM WORD 5* bit 6
4290	INV OVERTEMP	*03.31 ALARM WORD 6* bit 0
FF8B	IO CONFIG	
FFFA	JOYSTICK CHECK	
FFB8	LOAD SP UP LIM	*03.32 CRANE STATUS WORD* bit 5
FFB9	LOAD SP DW LIM	
FF69	MACRO CHANGE	
FFB2	MASTERLIM/FLT	
2300	MOT CUR LIM	*03.18 ALARM WORD 5* bit 10
7121	MOTOR STALL	*03.09 ALARM WORD 2* bit 9
FF34	MOTOR STARTS	
4310	MOTOR TEMP	*03.08 ALARM WORD 1* bit 3
4312	MOTOR 1 TEMP	*03.16 ALARM WORD 4* bit 1
4313	MOTOR 2 TEMP	*03.16 ALARM WORD 4* bit 2
FF86	MOT POW LIM	*03.18 ALARM WORD 5* bit 12
FF85	MOT TORQ LIM	*03.18 ALARM WORD 5* bit 11
5300	PANEL LOSS	*03.09 ALARM WORD 2* bit 13
FFD0	POINTER ERROR	
FF39	->POWEROFF!	
5482	PP OVERLOAD	*03.18 ALARM WORD 5* bit 5
4280	REPLACE FAN	*03.18 ALARM WORD 5* bit 0
FF7A	START INHIBI	*03.08 ALARM WORD 1* bit 0
FFB3	START HIGH	*03.32 CRANE STATUS WORD* bit 14
FF8D	START INTERL	*03.32 CRANE STATUS WORD* bit 8
FFF4	SLOW DOWN UP	
FFF5	SLOW DOWN DOWN	
FF87	SYNCRO SPEED	*03.18 ALARM WORD 5* bit 1

Code	Description	Application/Fault Word Status Bit
4380	TEMP DIF xx y	*04.01 FAULTED INT INFO*
4311	THERMISTOR	*03.08 ALARM WORD 1* bit 2
FF91	T MEAS ALM	*03.08 ALARM WORD 1* bit 6
FF6A	UNDERLOAD	*03.09 ALARM WORD 2* bit 1
FFFB	ZERO POS WARN	
FFEF	CTRL LOC DIFF	*03.32 CRANE STATUS WORD* bit 12

03.30 LIMIT WORD INV

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

Bit	Name	Description
0	INTEGRAT 200	Current limit at 200% integrator overload. Temperature model is not active.*
1	INTEGRAT 150	Current limit at 150% integrator overload. Temperature model is not active.*
2	INT LOW FREQ	Current limit at high IGBT temperature with low output frequency (<10 Hz). Temperature model is not active.*
3	INTG PP TEMP	Current limit at high IGBT temperature. Temperature model is not active.*
4	PP OVER TEMP	Current limit at high IGBT temperature. Temperature model is active.
5	PP OVERLOAD	Current limit at high IGBT junction to case temperature. Temperature model is active. If the IGBT junction to case temperature continues to rise in spite of the current limitation, the PP OVERLOAD alarm or fault occurs. See chapter *Fault tracing*.
6	INV POW LIM	Current limit at inverter output power limit.
7	INV TRIP CUR	Current limit at inverter overcurrent trip limit.
8	OVERLOAD CUR	Maximum inverter overload current limit. See par. *20.03*.
9	CONT DC CUR	Continuous dc-current limit.
10	CONT OUT CUR	Continuous output current limit ($I_{cont.max}$).
11 … 15	Reserved	
*Not active with ACS800 Default settings.		

03.31 ALARM WORD 6

Bit	Name	Description
0	INV OVERTEMP	For the possible causes and remedies, see chapter *Fault tracing*.
1 … 15	Reserved	

03.32 CRANE STATUS WORD

Bit	Name	Description
0	SLOW DOWN ENABLED	Slow down enabled by the activation of the configured input. See Par. *10.09*
1	FAST STOP ENABLED	Fast Stop enabled by the activation of the configured input. See Par. *10.10*
2	HIGH END LIMIT INPUT ENABLED	High-end limit enabled by the activation of the configured input. See Par *10.12*
3	LOW END LIMIT INPUT ENABLED	Low-end limit enabled by the activation of the configured input. See Par. *10.13*
4	LOAD SPEED CTRL ENABLED	The Load speed control function is activated using Par *77.01.*
5	LOAD SP UP LIM	The speed is limited in the forward direction by the Load speed control function. See chapter *Fault tracing* for more details.
6	LOAD SP DW LIM	The speed is limited in the reverse direction by the Load speed control function. See chapter *Fault tracing* for more details.
7	SYNC ENABLED	Synchro control active. See Par. *78.01*
8	POWER ON ACK SIGNAL	Start Interlock DI active.
9	BRK LONG TIME	Brake long time sequence active. See Par. *42.13*
10	LOAD SPEED CTRL ERR	The Load speed control function is activated but not able to calculate the speed limit according to the motor current because of wrong configuration of parameters in group *77.* See chapter *Fault tracing* for more details.
11	WATCH DOG BIT-N	Watch dog bit. See section *Watchdog function*
12	CTRL LOC DIFF	EXT1/EXT2 mismatch. For more information, see sections *Master/Follower use of several drives (Only in EXT2 Control)* and *Control location EXT1/EXT2 supervision mismatch*.
13	ZERO POS WARN	Zero position warning from joystick Zero position. For more information, see Par. *10.16*.
14	START HIGH	Crane start signal high when power is switched on, or running to direction where end limit sensor is high.
15	SYNCH ERROR BLOCK LEVEL	Synch error correction is blocked.

03.33 CRANE FAULT WORD

Bit	Name	Description
0	MOTOR OVER SPD	For the possible causes and remedies, see chapter *Fault tracing*.
1	SPD MATCH FLT	For the possible causes and remedies, see chapter *Fault tracing*.
2	TRQ PROVE FLT	For the possible causes and remedies, see chapter *Fault tracing*.
3	BRAKE SLIP FLT	For the possible causes and remedies, see chapter *Fault tracing*.
4	SYNC FAULT	For the possible causes and remedies, see chapter *Fault tracing*.
5	INV LIMIT	For the possible causes and remedies, see chapter *Fault tracing*.
6	SAFETY CLS FLT	For the possible causes and remedies, see chapter *Fault tracing*.
7 … 15	Reserved	

03.34 APPL CONTROL WORD

Bit	Name	Description
0	SYNC ENABLE	Used when selection of Par 10.14 is COMM.MODULE. Bit = 1 Synchro command is active, Bit = 0 Synchro command is inactive. See Par. *10.14*.
1	HOMING ACK	Used when selection of Par. 10.15 is COMM.MODULE. Bit = 1; Homing Ackn command is active, Bit = 0; Homing Ackn command is inactive. A pulse signal is required for initializing the position value. See Par. *10.15*.
2 … 15	Not Used	

03.36 M F STATUS WORD

Bit	Name	Description
0	STANDBY	The drive is configured as standby. See Par. *60.01*.
1	STANDALONE IN M/F	The drive is configured as Master or Follower but not in EXT2 control
2	ACTIVE MASTER	The drive is configured as Master and in EXT2 control
3	ACTIVE FOLLOWER	The drive is configured as Follower and in EXT2 control
4	SYNC FOLLOWER	The drive is configured as Follower, in EXT2 control and in shaft synchronisation mode
5 … 15	Not Used	

03.37 FCW WITH POS

Bit	Name	Description
0 … 2	Reserved	
3	START	Follower Start command from Master
4	POS BIT 0	Position multiplying factor bit 0. For more details see section *Control location EXT1/EXT2 supervision mismatch*
5	POS BIT 1	Position multiplying factor bit 1. For more details see section *Control location EXT1/EXT2 supervision mismatch*
6	POS BIT 2	Position multiplying factor bit 2. For more details see section *Control location EXT1/EXT2 supervision mismatch*
7	RESET	Follower drive Reset command from Master
8	POS BIT 3	Position multiplying factor bit 3. For more details see section *Control location EXT1/EXT2 supervision mismatch*
9	POS BIT 4	Position multiplying factor bit 4. For more details see section *Control location EXT1/EXT2 supervision mismatch*
10	POS BIT 5	Position multiplying factor bit 5. For more details see section *Control location EXT1/EXT2 supervision mismatch*
11 … 15	Reserved	

04.01 FAULTED INT INFO

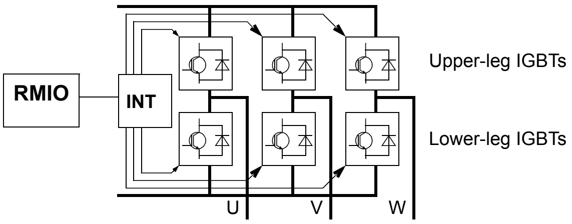
The FAULTED INT INFO Word includes information on the location of faults PPCC LINK, OVERCURRENT, EARTH FAULT, SHORT CIRCUIT, ACS800 TEMP, TEMP DIF and POWERF INV (see *03.05 FAULT WORD 1*, *03.06 FAULT WORD 2*, *03.17 FAULT WORD 5* and chapter *Fault tracing*).

Bit	Name	Description
0	INT 1 FLT	INT 1 board fault
1	INT 2 FLT	INT 2 board fault
2	INT 3 FLT	INT 3 board fault
3	INT 4 FLT	INT 4 board fault
4	INT 5 FLT	INT 5 board fault
5	INT 6 FLT	INT 6 board fault
6	INT 7 FLT	INT 7 board fault
7	INT 8 FLT	INT 8 board fault
8	INT 9 FLT	INT 9 board fault
9	INT 10 FLT	INT 10 board fault
10	INT 11 FLT	INT 11 board fault
11	INT 12 FLT	INT 12 board fault
12 … 14	Reserved	

Bit	Name	Description
15	PBU FLT	PBU board fault

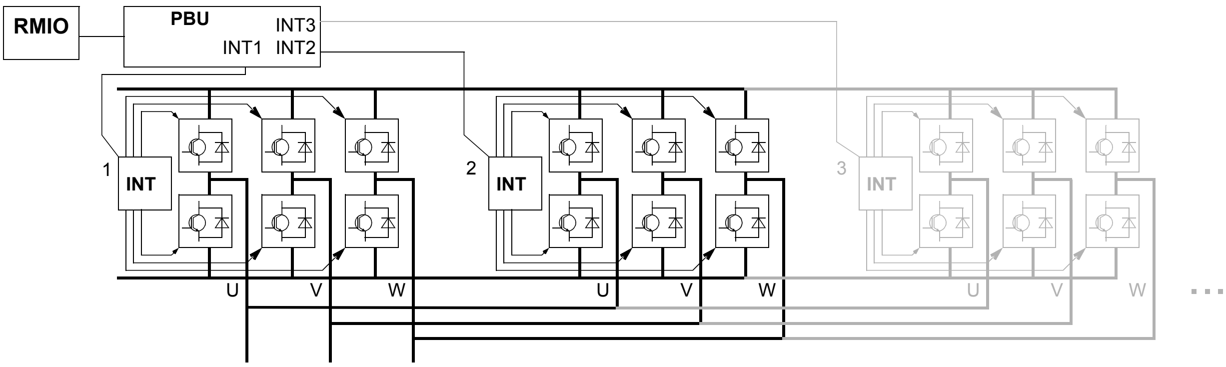
Used only with parallel connected inverters.

Inverter Block Diagram



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

Inverter Unit Block Diagram (2 to 12 parallel inverters)



04.02 INT SC INFO

The INT SC INFO Word includes information on the location of the SHORT CIRCUIT fault (see *03.05 FAULT WORD 1* and chapter *Fault tracing*).

Bit	Name	Description
0	U-PH SC U	Phase U upper-leg IGBT(s) short circuit
1	U-PH SC L	Phase U lower-leg IGBT(s) short circuit
2	V-PH SC U	Phase V upper-leg IGBT(s) short circuit
3	V-PH SC L	Phase V lower-leg IGBT(s) short circuit
4	W-PH SC U	Phase W upper-leg IGBT(s) short circuit
5	W-PH SC L	Phase W lower-leg IGBT(s) short circuit
6 … 15	Reserved	

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 an abnormal drive status. Most warning and fault causes can be identified and corrected using this information. If not, you must contact an ABB representative.

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) 3.08 AW 1 bit 4	Drive IGBT temperature is excessive. Fault trip limit is 100%.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against unit power.
AI < MIN FUNC (8110) 3.09 AW 2 bit 10 (programmable Fault Function *30.01*)	Analogue control signal is below minimum allowed value due to incorrect signal level or failure in control wiring.	Check for proper analogue control signal levels. Check control wiring. Check Fault Function parameters.
AP [message]	Message generated by an EVENT block in the Adaptive Program.	Consult the documentation or author of the Adaptive Program.
BACKUP USED (FFA3)	PC stored backup of drive parameters is downloaded into use.	Wait until download is completed.
BATT FAILURE (5581) 3.18 AW 5 bit 15	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) 3.18 AW 5 bit 3	Brake chopper overload	Stop drive. Let chopper cool down. Check parameter settings of resistor overload protection function (see parameter group *27 BRAKE CHOPPER*). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
BRAKE ACKN (FF74) 3.16 AW 4 bit 3	Unexpected state of brake acknowledge signal	See parameter group *42 BRAKE CONTROL*. Check connection of brake acknowledgement signal.
BRK LONG TIME (FFFC) 3.32 Crane SW bit 9	Brake acknowledge active after brake close delay has elapsed. Drive active with zero speed reference.	See parameter group *42 BRAKE CONTROL*. Check connection of brake acknowledgement signal. Check mechanical brake.
BR OVERHEAT (7112) 3.18 AW 5 bit 2	Brake resistor overload	Stop drive. Let resistor cool down. Check parameter settings of resistor overload protection function (see parameter group *27 BRAKE CHOPPER*). Check that braking cycle meets allowed limits.
CALIBRA DONE (FF37)	Calibration of output current transformers is completed.	Continue normal operation.

WARNING	CAUSE	WHAT TO DO
CALIBRA REQ (FF36)	Calibration of output current transformers is required. Displayed at start if drive is in Scalar control (parameter *99.04*) and scalar fly start feature is on (parameter *21.08*).	Calibration starts automatically. Wait for a while.
COMM MODULE (7510) 3.08 AW 1 bit 12 (programmable Fault Function *30.18*, *30.19*)	Cyclical communication between drive and master is lost.	Check status of fieldbus communication. See chapter *Fieldbus control*, or appropriate fieldbus adapter manual. Check parameter settings: - group *51 COMM MODULE DATA* (for fieldbus adapter) - group *52 STANDARD MODBUS* (for Standard Modbus Link). Check Fault Function parameters. Check cable connections. Check if master can communicate.
CTRL LOC DIFF 3.32 bit 12	Master and Follower are not in the same control location.	Check that the Master and the Follower are both in EXT2.
CUR UNBAL xx (2330) 3.08 AW1 bit 14 and 4.01 (programmable Fault Function *30.17*)	Drive has detected excessive output current unbalance in inverter unit of several parallel connected inverter modules. This can be caused by external fault (earth fault, motor, motor cabling, etc.) or internal fault (damaged inverter component). xx (2...12) refers to inverter module number.	Check that 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 BUS LIM (3211) 3.18 AW5 bit 9 (programmable Fault Function *30.23*)	Drive limits torque due to too high or too low intermediate circuit DC voltage.	Informative alarm Check Fault Function parameters.
EARTH FAULT (2330) 3.08 AW 1 bit 14 (programmable Fault Function *30.17*)	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check that there is no earth fault in motor or motor cables: - measure insulation resistances of motor and motor cable. If no earth fault can be detected, contact your local ABB representative.
ENCODER A<>B (7302) 3.09 AW 2 bit 4	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) 3.08 AW 1 bit 5	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 ENCODER MODULE* settings.

WARNING	CAUSE	WHAT TO DO
FAST STOP (FFF8)	Fast Stop Signal *10.10* activated.	Deactivate the Fast Stop signal.
FLWR1 LIM/FLT (FFFD)	Follower 1 has gone into a fault or has hit any of the limits. This message is displayed in the Master drive only	See Follower 1 drive for more detailed description of fault of limit.
FLWR2 LIM/FLT (FFFE)	Follower 2 has gone into a fault or has hit any of the limits. This message is displayed in the Master drive only	See Follower 2 drive for more detailed description of fault of limit.
FLWR3 LIM/FLT (FFB5)	Follower 3 has gone into a fault or has hit any of the limits. This message is displayed in the Master drive only	See Follower 3 drive for more detailed description of fault of limit.
FLWR4 LIM/FLT (FFB4)	Follower 4 has gone into a fault or has hit any of the limits. This message is displayed in the Master drive only	See Follower 4 drive for more detailed description of fault of limit.
HW RECONF RQ (FF38)	Inverter type (for example, 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.
HIGHEND LIMIT (FFF6)	High-end limit Signal *10.12* activated in the Up direction	Run the motor in the opposite direction and deactivate the High-end limit signal.
HOMING ACTIVE (FFB1)	Homing activation signal *10.21* activated in EXT 1 control	Homing sequence is activated. Start the drive and complete the homing sequence. After homing sequence is done deactivate the homing active signal.
HOMING DONE (FFB0)	Homing sequence is completed in EXT 1 control. The position is initialized to the value define in par *78.10.*	Homing sequence is completed. Deactivate the homing active signal and continue operation.
LOWEND LIMIT (FFF7)	Low-end limit Signal *10.13* activated in the down direction	Run the motor in the opposite direction and deactivate the Low-end limit signal.
ID DONE (FF32)	Drive has performed motor identification magnetisation and is ready for operation. This warning belongs to normal start-up procedure.	Continue drive operation.
ID MAGN (FF31)	Motor identification magnetisation is on. This warning belongs to normal start-up procedure.	Wait until drive indicates that motor identification is completed.
ID MAGN REQ (FF30)	Motor identification is required. This warning belongs to normal start-up procedure. The drive expects you to select how motor identification should be performed: With identification magnetisation or with ID Run.	Start identification magnetisation by pressing Start key, or select ID run and start (see 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.

WARNING	CAUSE	WHAT TO DO
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) 3.18 AW 5 bit 4	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) 3.18 AW 5 bit 8 (programmable Fault Function *30.23*)	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* LCU Q PW REF). Check Fault Function parameters.
INV DISABLED (3200) 3.18 AW 5 bit 6	Optional DC switch has opened while unit was stopped.	Close DC switch. Check AFSC-0x Fuse Switch Controller unit.
INV OVERTEMP (4290) 3.31 AW6 bit 0	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 CONFIG (FF8B) (programmable Fault Function *30.22*)	Input or output of optional I/O extension or fieldbus module has been selected as signal interface in application program but communication to appropriate I/O extension module has not been set accordingly.	Check Fault Function parameters. Check parameter group *98 OPTION MODULES*.
JOYSTICK CHECK (FFFA)	Hardware error in the configured joystick.	Check joystick connection.
LOAD SP UP LIM (FFB8) 3.32 CSW bit 5	The speed reference is limited in the forward direction according to the Load speed control function.	Check motor current settings and group 77 settings.

WARNING	CAUSE	WHAT TO DO
LOAD SP DW LIM (FFB9) 3.32 CSW bit 6	The speed reference is limited in the reverse direction according to the Load speed control function.	Check motor current settings and group 77 settings.
MACRO CHANGE (FF69)	Macro is restoring or user macro is being saved.	Wait until drive has finished task.
MASTERLIM/FLT (FFB2)	Master drive has gone into a fault or has hit any of the limits. This message is displayed in the Follower drives only	See Master drive for more detailed description of fault of limit.
MOT CUR LIM (2300) 3.18 AW 5 bit 10 (programmable Fault Function *30.23*)	Drive limits motor current according to current limit defined with parameter *20.03* MAXIMUM CURRENT.	Reduce load or increase ramp time. Increase parameter *20.03* MAXIMUM CURRENT value. Check Fault Function parameters.
MOTOR STALL (7121) 3.09 AW 2 bit 9 (programmable Fault Function *30.10*)	Motor is operating in stall region due to, for example, 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) 3.08 AW 1 bit 3 (programmable Fault Function *30.04*…*30.09*)	Motor temperature is too high (or appears to be too high) due to excessive load, insufficient motor power, inadequate cooling or incorrect start-up data.	Check motor ratings, load and cooling. Check start-up data. Check Fault Function parameters.
MOTOR 1 TEMP (4312) 3.16 AW 4 bit 1	Measured motor temperature has exceeded alarm limit set with parameter *35.02*.	Check value of alarm limit. Check that actual number of sensors corresponds to value set with parameter. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc.
MOTOR 2 TEMP (4313) 3.16 AW 4 bit 2	Measured motor temperature has exceeded alarm limit set with parameter *35.05*.	Check value of alarm limit. Check that actual number of sensors corresponds to value set with parameter. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc.

WARNING	CAUSE	WHAT TO DO
MOT POW LIM (FF86) 3.18 AW 5 bit 12 (programmable Fault Function *30.23*)	Drive limits motor power according to limits defined with parameters *20.11* and *20.12*.	Informative alarm Check parameter *20.11* P MOTORING LIM and *20.12* P GENERATING LIM settings. Check Fault Function parameters.
MOT TORQ LIM (FF85) 3.18 AW 5 bit 11 (programmable Fault Function *30.23*)	Drive limits motor torque according to calculated motor pull-out torque limit and minimum and maximum torque limits defined with parameters *20.13* and *20.14*.	Informative alarm Check parameter *20.13* MIN TORQ SEL and *20.14* MAX TORQ SEL settings. Check Fault Function parameters. If LIMIT WORD 1 bit 0 TORQ MOTOR LIM is 1, - check motor parameter settings (parameter group *99 START-UP DATA*) - ensure that ID run has been completed successfully.
PANEL LOSS (5300) 3.09 AW 2 bit 13 (programmable Fault Function *30.02*)	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.
->POWEROFF! (FF39)	Inverter type (for example, 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) 3.18 AW 5 bit 5	Excessive IGBT junction to case temperature. This can be caused by excessive load at low frequencies (for example, fast direction change with excessive load and inertia).	Increase ramp time. Reduce load.
REPLACE FAN (4280) 3.18 AW 5 bit 0	Running time of inverter cooling fan has exceeded its estimated life time.	Replace fan. Reset fan run time counter *01.44*.
SLOW DOWN UP (FFF4)	Slowdown signal *10.09* activated in the Up direction	Run the motor in the opposite direction and deactivate the Slowdown signal. Or let the drive run in the limited speed reference.
SLOW DOWN DOWN (FFF5)	Slowdown signal *10.09* activated in the down direction	Run the motor in the opposite direction and deactivate the Slowdown signal. Or let the drive run in the limited speed reference.
START INHIBI (FF7A) AW 1 bit 0	Optional start inhibit hardware logic is activated.	Check start inhibit circuit (AGPS board).

WARNING	CAUSE	WHAT TO DO
START HIGH (FFB3)	The Start command is active when the drive is powered ON. The Start command remains ON after a fault or fast stop has occurred and a reset is done.	Start command should be made OFF and then can be made ON for a start sequence.
START INTERL (FF8D)	No Start Interlock signal received.	Check the circuit connected to the Start Interlock input on the RMIO board.
SYNCRO SPEED (FF87) 3.18 AW 5 bit 1	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) 4.01 FAULTED INT INFO	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, for example, by unequal current sharing between parallel-connected inverters.	Check cooling fan. Replace fan. Check air filters.
THERMISTOR (4311) 3.08 AW 1 bit 2 (programmable Fault Function *30.04* … *30.05*)	Motor temperature is excessive. Motor thermal protection mode selection is THERMISTOR.	Check motor ratings and load. Check start-up data. Check thermistor connections to digital input DI6.
T MEAS ALM (FF91) 3.08 AW 1 bit 6	Motor temperature measurement is out of acceptable range.	Check connections of motor temperature measurement circuit. See chapter *Program features* for circuit diagram.
UNDERLOAD (FF6A) 3.09 AW 2 bit 1 (programmable Fault Function *30.13*)	Motor load is too low due to, For example, release mechanism in driven equipment.	Check for problem in driven equipment. Check Fault Function parameters.
ZERO POS WARN (FFFB)	Start command with incorrect Zero position input.	Check for Zero position DI.

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 application program version	Check panel type and drive application program version. Panel type is printed on panel cover. Application program version is stored in parameter *33.02*.
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.
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) 3.05 FW 1 bit 3	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) 3.05 FW 1 bit 3 and 4.01	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.
AI < MIN FUNC (8110) 3.06 FW 2 bit 10 (programmable Fault Function *30.01*)	Analogue control signal is below minimum allowed value due to incorrect signal level or failure in control wiring.	Check for proper analogue control signal levels. Check control wiring. Check Fault Function parameters.
AP [message]	Message generated by an EVENT block in the Adaptive Program.	Consult the documentation or author of the Adaptive Program.
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) 3.17 FW 5 bit 4	Brake chopper overload	Let chopper cool down. Check parameter settings of resistor overload protection function (see parameter group *27 BRAKE CHOPPER*). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
BC SHORT CIR (7113) 3.17 FW 5 bit 2	Short circuit in brake chopper IGBT(s)	Replace brake chopper. Ensure brake resistor is connected and not damaged.
BRAKE ACKN (FF74) 3.15 FW 4 bit 3	Unexpected state of brake acknowledge signal	See parameter group *42 BRAKE CONTROL*. Check connection of brake acknowledgement signal.
BRAKE SLIP FLT (FFF3) 3.33 CraneFW bit 3	The brake slipped and the motor speed exceeded the motor slip speed *42.11* for a period of slip fault delay *42.12* time.	Check brakes.
BR BROKEN (7110) 3.17 FW 5 bit 0	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.

FAULT	CAUSE	WHAT TO DO
BR OVERHEAT (7112) 3.17 FW 5 bit 3	Brake resistor overload	Let resistor cool down. Check parameter settings of resistor overload protection function (see parameter group *27 BRAKE CHOPPER*). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
BR WIRING (7111) 3.17 FW 5 bit 1	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.
COMM MODULE (7510) 3.06 FW 2 bit 12 (programmable Fault Function *30.18*, *30.19*)	Cyclical communication between drive and master is lost.	Check status of fieldbus communication. See chapter *Fieldbus control*, or appropriate fieldbus adapter manual. Check parameter settings: - group *51 COMM MODULE DATA* (for fieldbus adapter), 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) 3.06 FW 2 bit 7	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) 3.05 FW 1 bit 4 and 4.01 (programmable Fault Function *30.17*)	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.

FAULT	CAUSE	WHAT TO DO
DC OVERVOLT (3210) 3.05 FW 1 bit 2	Excessive intermediate circuit DC voltage. DC overvoltage trip limit is 1.3 · $U_{1max,}$ where U_{1max} is maximum value of mains voltage range. For 400 V units, U_{1max} is 415 V. For 500 V units, U_{1max} is 500 V. Actual voltage in intermediate circuit corresponding to mains voltage trip level is 728 V DC for 400 V units and 877 V DC for 500 V units.	Check that overvoltage controller is on (parameter *20.05*). Check mains for static or transient overvoltage. Check brake chopper and resistor (if used). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit frequency converter with brake chopper and brake resistor.
DC UNDERVOLT (3220) 3.06 FW 2 bit 2	Intermediate circuit DC voltage is not sufficient due to missing mains phase, blown fuse or rectifier bridge internal fault. DC undervoltage trip limit is 0.6 · U_{1min}, where U_{1min} is minimum value of mains voltage range. For 400 V and 500 V units, U_{1min} is 380 V. For 690 V units, U_{1min} is 525 V. Actual voltage in intermediate circuit corresponding to mains voltage trip level is 307 V DC for 400 V and 500 V units, and 425 V DC for 690 V units.	Check mains supply and fuses.
EARTH FAULT (2330) 3.05 FW 1 bit 4 (programmable Fault Function *30.17*)	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check that there is no earth fault in motor or motor cables: - measure insulation resistances of motor and motor cable. If no earth fault can be detected, contact your local ABB representative.
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) 3.06 FW 2 bit 5	Communication fault between pulse encoder and pulse encoder interface module and between module and drive	Check pulse encoder and its wiring, pulse encoder interface module and its wiring and parameter group *50 ENCODER MODULE* settings.
EXTERNAL FLT (9000) 3.06 FW 2 bit 8 (programmable Fault Function *30.03*)	Fault in external device. (This information is configured through one of programmable digital inputs.)	Check external devices for faults. Check parameter *30.03* EXTERNAL FAULT.
FAN OVERTEMP (FF83)	Excessive temperature of drive output filter fan. Supervision is in use in step-up drives.	Stop drive. Let it cool down. Check ambient temperature. Check fan rotates in correct direction and air flows freely.
FORCED TRIP (FF8F)	Generic Drive Communication Profile trip command	See appropriate communication module manual.

FAULT	CAUSE	WHAT TO DO
FLWR1 COM FLT (FFBA)	Follower 1 Communication error .	Check CH2 communication, communication settings.
FLWR2 COM FLT (FFBB)	Follower 2 Communication error .	Check CH2 communication, communication meetings.
FLWR3 COM FLT (FFBC)	Follower 3 Communication error .	Check CH2 communication, communication meetings.
FLWR4 COM FLT (FFBD)	Follower 4 Communication error .	Check CH2 communication, communication meetings.
GD DISABLED X	AGPS power supply of parallel connected R8i inverter module has been switched off during run. X (1...12) refers to inverter module number.	Check Safe Torque Off circuit. Replace AGPS board of R8i inverter module.
ID RUN FAIL (FF84)	Motor ID run is not completed successfully.	Check maximum speed (parameter *20.02*). It should be at least 80% of motor nominal speed (parameter *99.08*).
IN CHOKE TEMP (FF81) 3.17 FW 5 bit 5	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) 03.17 FW 5 bit 10	Number of inverter modules is not equal to original number of inverters.	Check status of inverters. See signal *03.34 APPL CONTROL WORD*. Check fibre optic cables between APBU and inverter modules. If Reduced run function is used, remove faulted inverter module from main circuit and write number of remaining inverter modules into parameter *95.03* INT CONFIG USER. Reset drive.
INV DISABLED 03.17 FW 5 bit 7 (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 LIMIT (FFBF) 3.33 CraneFW bit 5	The fault is generated when the drive has hit TORQUE INVERTER CURRENT LIMIT or IPP OVERTEMP ALM is active and a period of 200 ms has elapsed. The fault condition is only checked when the generating power is more than 10% of motor nominal power and the speed is greater than 5% of the maximum speed.	Check the Speed controller torque settings. Check torque, speed, power limit settings.

FAULT	CAUSE	WHAT TO DO
INV OVERTEMP (4290) 3.17 FW 5 bit 13	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) 3.06 FW 2 bit 6	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.
MOTOROVER SPD (FFF0) 3.33 CRANE FW bit 0	The speed exceeds the MOT OVERSPEED LEV (Par. *74.01*)	Check Torque and Current limit settings Check motor and motor cables Check pulse encoder connections if used
MOTOR PHASE (FF56) 3.06 FW 2 bit 15 (programmable Fault Function *30.16*)	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 TEMP (4310) 3.05 FW 1 bit 6 (programmable Fault Function *30.04* … *30.09*)	Motor temperature is too high (or appears to be too high) due to excessive load, insufficient motor power, inadequate cooling or incorrect start-up data.	Check motor ratings and load. Check start-up data. Check Fault Function parameters.

FAULT	CAUSE	WHAT TO DO
MOTOR 1 TEMP (4312) 3.15 FW 4 bit 1	Measured motor temperature has exceeded fault limit set with parameter *35.03*.	Check value of fault limit. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc.
MOTOR 2 TEMP (4313) 3.15 FW 4 bit 2	Measured motor temperature has exceeded fault limit set with parameter *35.06*.	Check value of fault limit. Let motor cool down. Ensure proper motor cooling: Check cooling fan, clean cooling surfaces, etc.
NO MOT DATA (FF52) 3.06 FW 2 bit 1	Motor data is not given or motor data does not match with inverter data.	Check motor data parameters *99.04* … *99.09*.
OVERCURR xx (2310) 3.05 FW 1 bit 1 and 4.01	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) 3.05 FW 1 bit 1	Output current exceeds trip limit.	Check motor load. Check acceleration time. Check motor and motor cable (including phasing). Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing).
OVERFREQ (7123) 3.05 FW 1 bit 9	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 (the Direct torque control mode active) or frequency limit (Scalar control active). Operating range limits are set with parameters *20.01* and *20.02* (DTC mode active) or *20.07* and *20.08* (Scalar control active).	Check minimum/maximum speed settings. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
OVER SWFREQ (FF55) 3.06 FW 2 bit 9	Switching frequency is too high.	Check motor parameter settings (parameter group *99 START-UP DATA*) Ensure that ID run has been completed successfully.

FAULT	CAUSE	WHAT TO DO
PANEL LOSS (5300) 3.06 FW 2 bit 13 (programmable Fault Function *30.02*)	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) 3.17 FW 5 bit 9	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) 3.17 FW 5 bit 9 and 4.01	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) 3.06 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. See parameter *16.09* CTRL BOARD SUPPLY. Check signal *03.19*. Contact ABB representative if any of faults in signal 3.19 are active.
PPCC LINK xx (5210) 3.06 FW 2 bit 11 and 4.01	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.) Check signal *03.19*. Contact ABB representative if any of faults in signal 3.19 are active.
PP OVERLOAD (5482) 3.17 FW 5 bit 6	Excessive IGBT junction to case temperature. This fault protects IGBT(s) and it can be activated by short circuit at output of long motor cables.	Check motor cables.
RUN DISABLED (FF54)	No Run enable signal received.	Check setting of parameter *16.01*. Switch on signal or check wiring of selected source.
SAFETYCLS FLT (FF7D) 3.33 CRANE FW bit 6	When an encoder is not used and the actual speed is below 1% of the max speed for more than 2 seconds with the Start command active, the drive trips on SAFETYCLS FLT.	Check references. Check motor model settings.

FAULT	CAUSE	WHAT TO DO
SPD MATCH FLT (FFF1) 3.33 CRANE FW bit 1	If speed error at set point is higher than SP DEV LEV (Par. *75.02*) or the actual speed change per second during acceleration/ deceleration is less than SPD CHG PER SEC (Par. *75.04*) for a time longer than SPD MATCH FLT TD (Par. *75.03*) the drive will trip for SPD MATCH FLT.	Check ramp times. Check Torque and Current limit settings.
SC INV xx y (2340) 3.05 FW 1 bit 0, 4.01 and 4.02	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) 3.05 FW 1 bit 0 and 4.02	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 the same connection interface selection.	Check connection interface selections in group *98 OPTION MODULES*.
START INHIBI (FF7A) 3.03 bit 8	Optional start inhibit hardware logic is activated.	Check start inhibit circuit (AGPS board).
SUPPLY PHASE (3130) 3.06 FW 2 bit 0	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.
SYNC FAULT (FFBE) 3.33 CRANE FW bit 4	Synchronisation error of Follower drive. The error in position of the Follower drive is greater than the allowed limits.	Check the Synchro error limits. Check encoder connections.
TEMP DIF xx y (4380) 3.17 FW 5 bit 8 and 4.01	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, for example, 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 *30.05*.

FAULT	CAUSE	WHAT TO DO
THERMISTOR (4311) 3.05 FW 1 bit 5 (programmable Fault Function *30.04* … *30.05*)	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 PROVE FLT (FFF2) 3.33 CRANE FW bit 2	If Torque proving is not successful, that means torque does not reach the test level within the time TORQ PROV FLT TD (Par. *76.02*), the drive will trip. (Normally only used if active load, for example, hoist drive, with pulse encoder feedback.	Check motor and motor cables. Check if setting of parameter 21.2 Control Magnetising time is to low.
UNDERLOAD (FF6A) 3.05 FW 1 bit 8 (programmable Fault Function *30.13* … *30.15*)	Motor load is too low due to, for example, release mechanism in driven equipment.	Check for problem in driven equipment. Check Fault Function parameters.
USER MACRO (FFA1) 3.07 SFW bit 1	No user macro saved or file is defective.	Create user macro.

Adaptive Programming examples for crane control

Chapter overview

This chapter includes examples of Adaptive Programming (AP) for Crane control program (+N697).

For more information on Adaptive Programming, see *Adaptive Programming using the function blocks* on page *110* and *Application Guide for Adaptive Program* (3AFE64527274 [English]). For information on DriveAP (a Windows-based tool for Adaptive Programming), see *DriveAP User's Manual* (3AFE64540998 [English]).

Note: If you use and/or change the AP blocks used in the Crane control program made by ABB, you are responsible for the software and the application.

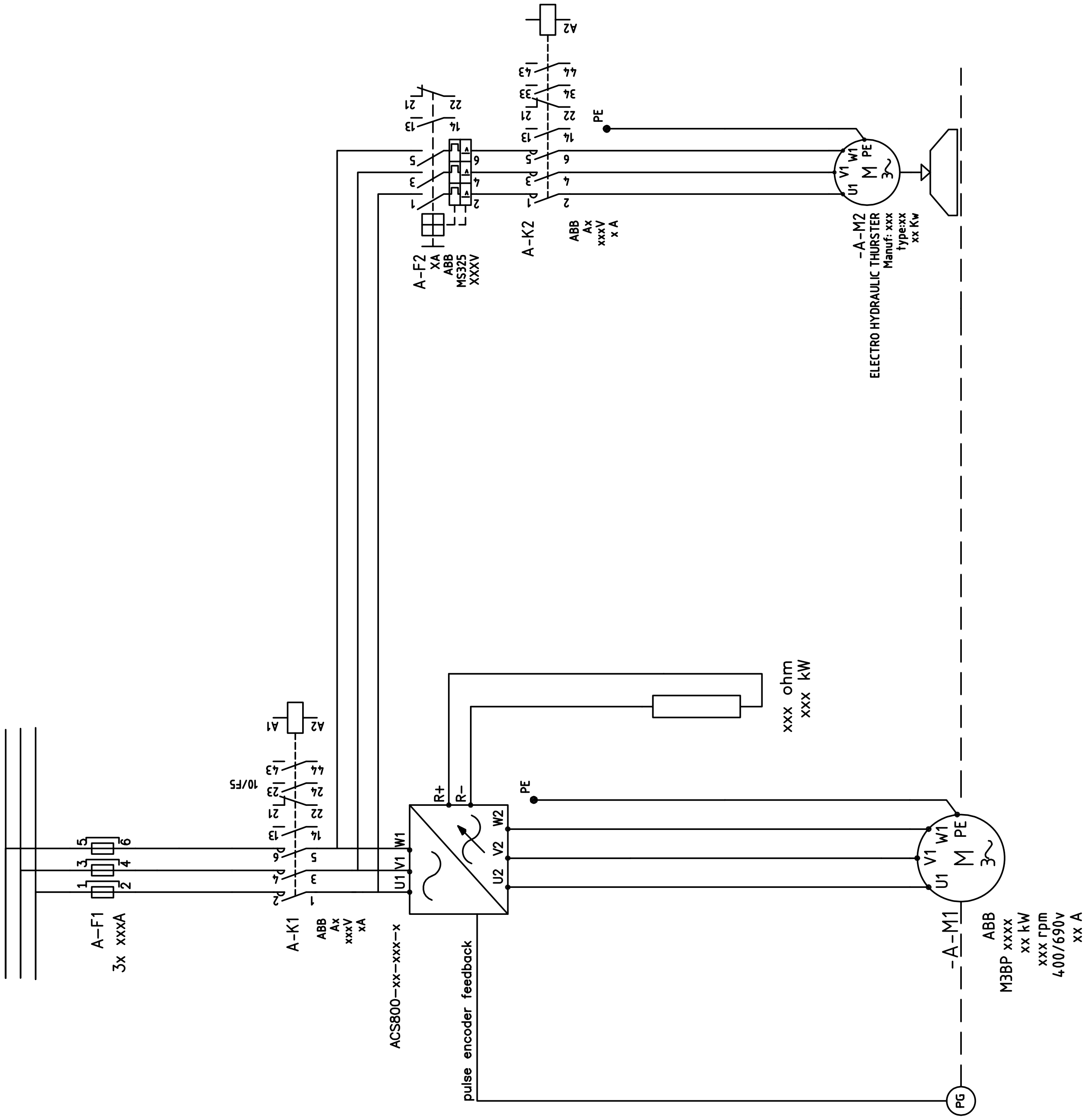
Main contactor control logic

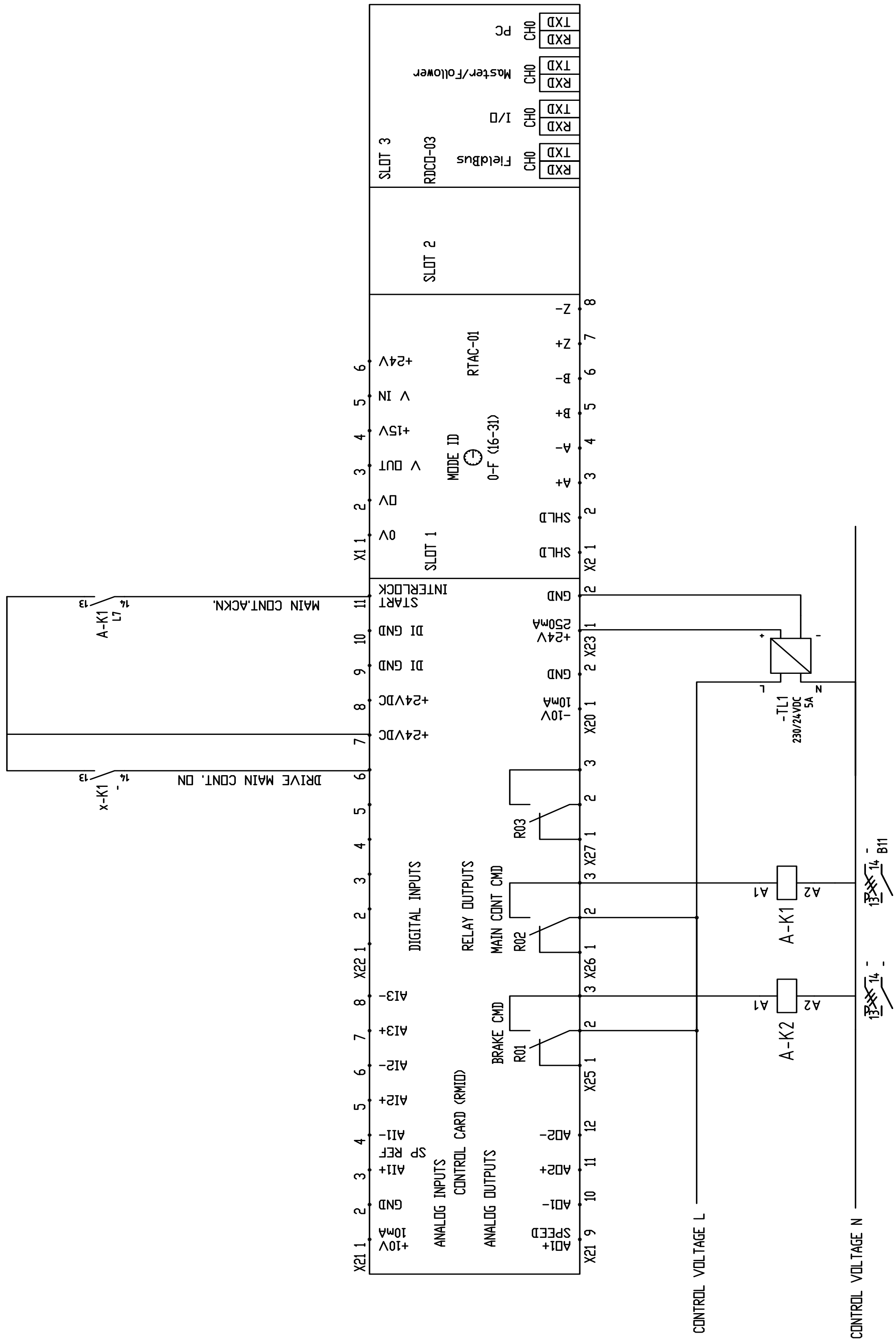
Using the Adaptive Programming (AP), you can create a main contactor control logic for the 3-phase power supply of the ACS800 drive. With the help of the main contactor control logic, the power supply of the drive is disabled when the crane is not used (the standby energy-efficiency mode).

For this, you must have the +24 V DC external auxiliary voltage supplied to the RMIO board (see *External 24 V supply of RMIO board* on page *117*). You can use a RMIO or RDIO relay output for controlling the main contactor, and you can close the main contactor with a command through a dedicated digital input of RMIO or RDIO.

For more information, see the *Application Guide for Adaptive Program* (3AFE64527274 [English]) and *DriveAP User's Manual* (3AFE64540998 [English]).

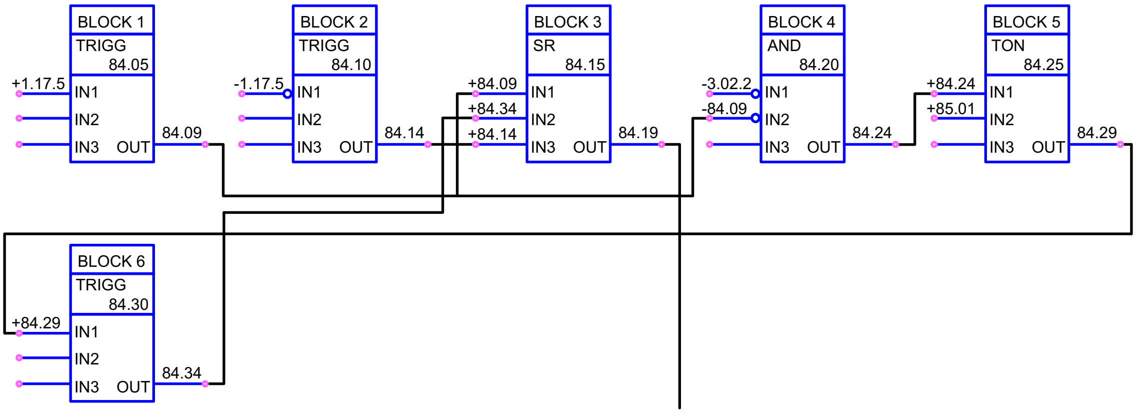
The following figures show the main circuit and control circuit diagrams for the main contactor control logic.





SLOT 3
RDCO-03
FieldBus
I/O
Master/Follower
PC
CH0
TXD
RXD
SLOT 2
SLOT 1
RTAC-01
MODE ID
0-F (16-31)
INTERLOCK
START
MAIN CONT.ACKN.
DRIVE MAIN CONT. ON
DIGITAL INPUTS
RELAY OUTPUTS
MAIN CONT CMD
BRAKE CMD
ANALOG INPUTS
CONTROL CARD (RMIO)
ANALOG OUTPUTS
SP REF
SPEED
A-K1
A-K2
-TL1
230/24VDC
5A
B11
CONTROL VOLTAGE L
CONTROL VOLTAGE N

Create an AP file for the automatic control of opening and closing the main contactor according to the following example.



In the AP file example:

- Parameter *84.06* defines the bit input used for the opening and closing command of the main contactor. Parameter *84.06* INPUT1 is configured to digital input DI6. When the DI6 bit value (actual signal *01.17* bit 5) changes from 0 to 1, the main contactor is closed. When the bit value changes from 1 to 0, the main contactor is opened.
- The main contactor must be closed before issuing the start command. Ensure this using the main contactor close request (DI6 0 ->1). You can also use the Power on acknowledge information to indicate that the main contactor is closed. In Crane control program +N697, the DIL input is, by default, used for Power ON acknowledge. For more information, see par. *97.18* PWRON STRTINT PTR and *Power ON acknowledge and internal fault reset* on page *90*.
- Parameter *85.01* defines the delay time in milliseconds for automatic opening of the main contactor after the drive has stopped running and the extended run time has elapsed. The default time is set to 10000 ms (= 10 s).
- The main contactor opening and closing command (relay output) (par. 84.19 bit 0) is, by default, linked to par. *14.02* RO PTR2 (bit value 1 = Main contactor closing command and bit value 0 = Main contactor opening command).

The main contactor opens automatically after:

- the stop command has been given (par. *10.01* or *10.02*) and the drive has stopped running,
- the possible extended run time has passed (par. *42.09*) and
- a user-configurable time delay has passed (parameter *85.01*, by default 10 s).

You can also open the main contactor manually without waiting for the delay time. You can do this with the lowering edge of digital input DI6 (1 -> 0).

Brake match

Brake match detects mechanical brake slips and downward movement of the load when Mechanical brake control is in use, the operator has given the stop command and the target is to close the brake. The slip detection is based on the motor encoder position signal, and the function works only if an encoder is used. You can use the function for an automatic restart of the crane or just for a warning (alarm) indication.

Working logic

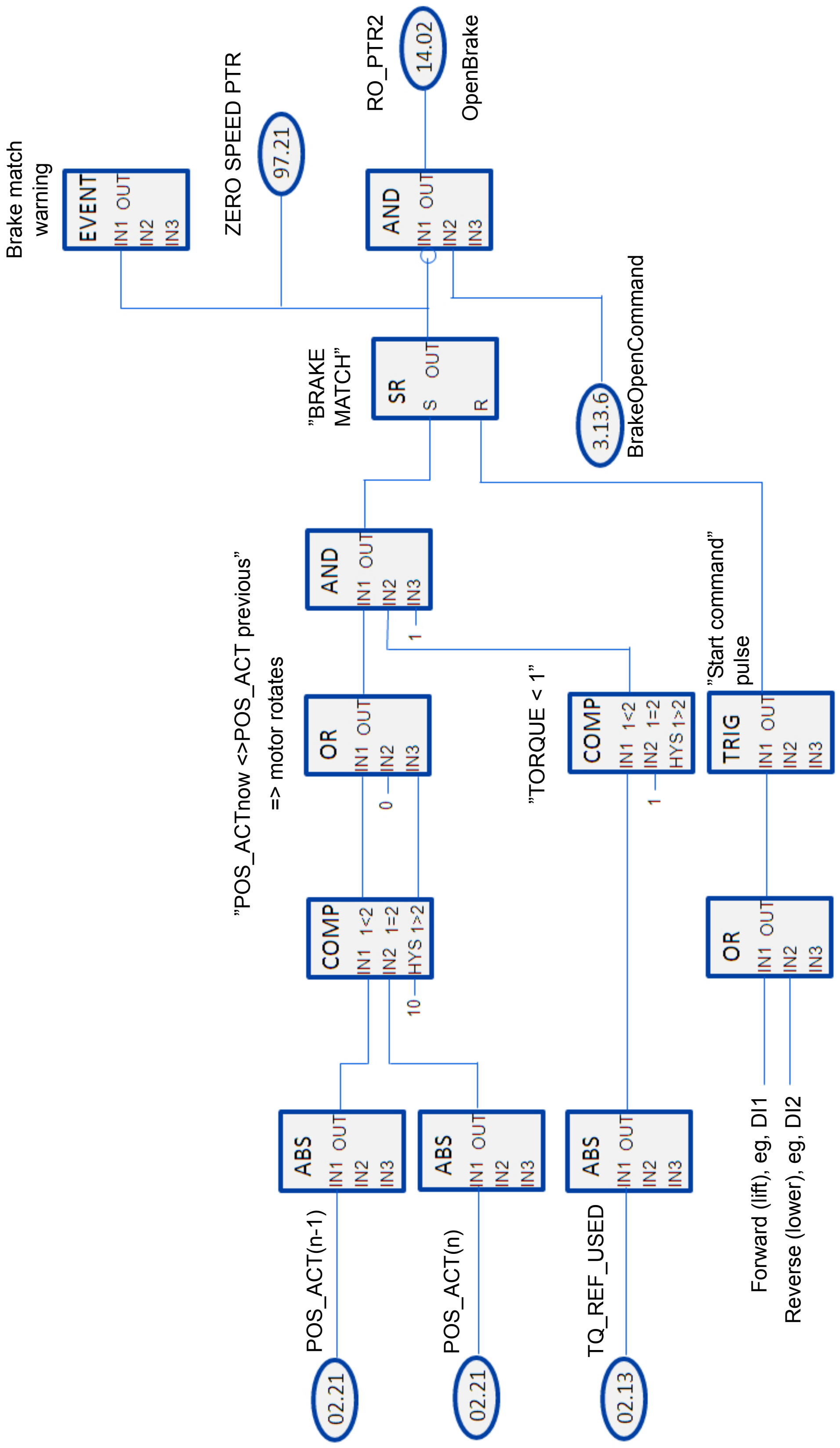
The logic checks whether the motor is rotating when the mechanical brake should be closed. The rotation is detected by comparing two successive position signal samples (*02.21* POS ACT PPU). Therefore, the system needs to be equipped with a pulse encoder. The logic works during the normal Stop command, extended run time, and also, when the drive is in the standby (spare unit) mode.

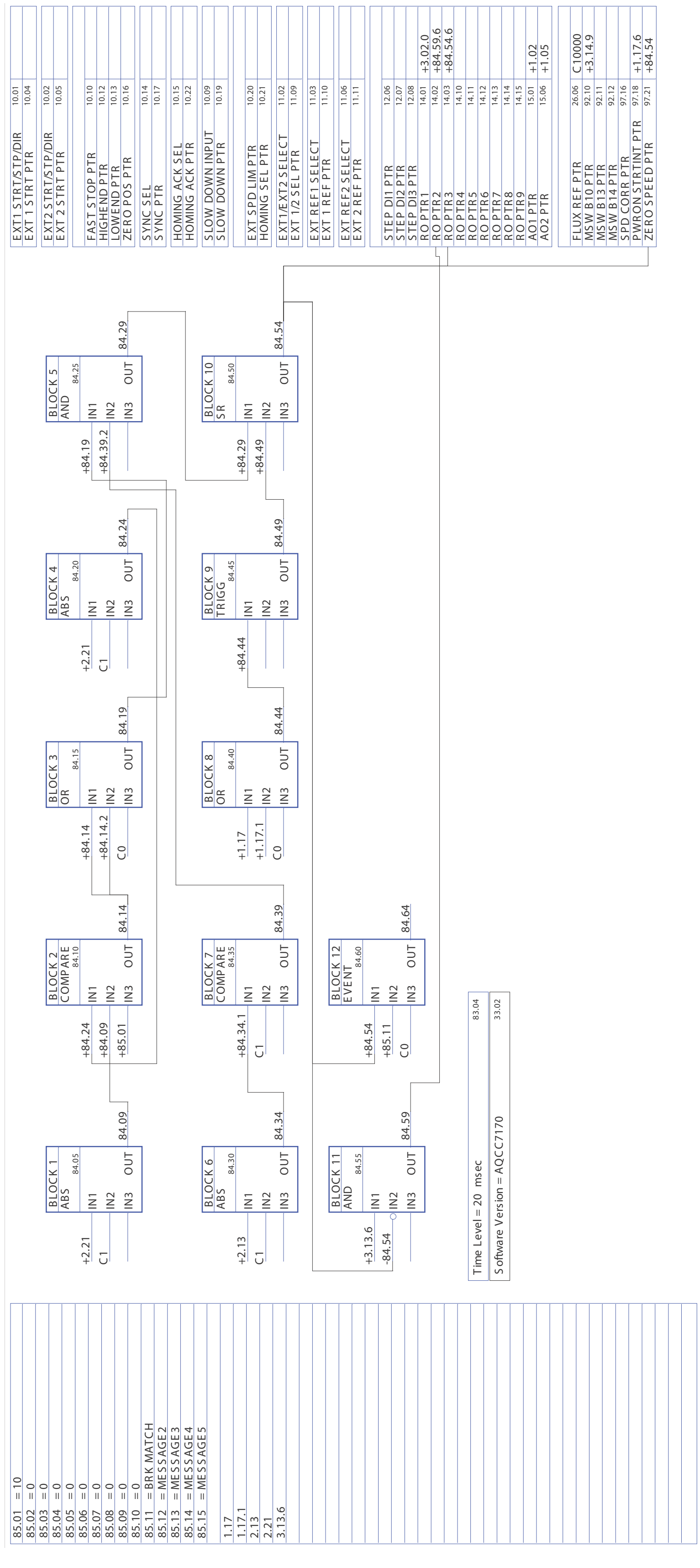
If the position differs between the two successive samples more than set with parameter *85.01* CONSTANT1, and the motor torque is less than the preset value, Brake match is activated. By means of pointer parameter *97.21* ZERO SPEED PTR, the drive will start with a zero speed reference, and a brake match warning is shown on the control panel and in the fault logger. You can reset the warning by giving a new start command: DI1 forward or DI2 reverse. While brake match is active, the mechanical brake open command is prevented.

For Brake match to work, you need to connect the output of AP block number 10 to hidden parameter *97.21* ZERO SPEED PTR. You can open group 97 by entering pass code 5600 into parameter *16.03* PASS CODE.

The following figures present an example AP file solution for Brake match.

Note: When creating the actual AP files, you must be pay attention to safety issues and carefully check the logic case by case.


Brake match
warning
EVENT
IN1 OUT
IN2
IN3
ZERO SPEED PTR
97.21
RO_PTR2
14.02
OpenBrake
AND
IN1 OUT
IN2
IN3
"BRAKE
MATCH"
SR
S OUT
R
3.13.6
BrakeOpenCommand
"POS_ACTnow <>POS_ACT previous"
=> motor rotates
AND
IN1 OUT
IN2
IN3
1
OR
IN1 OUT
IN2
IN3
0
COMP
IN1 1<2
IN2 1=2
HYS 1>2
10
"TORQUE < 1"
COMP
IN1 1<2
IN2 1=2
HYS 1>2
1
"Start command"
pulse
TRIG
IN1 OUT
IN2
IN3
OR
IN1 OUT
IN2
IN3
ABS
IN1 OUT
IN2
IN3
POS_ACT(n-1)
02.21
ABS
IN1 OUT
IN2
IN3
POS_ACT(n)
02.21
ABS
IN1 OUT
IN2
IN3
TQ_REF_USED
02.13
Forward (lift), eg, DI1
Reverse (lower), eg, DI2


EXT1 STRT/STP/DIR 10.01
EXT 1 STRT PTR 10.04
EXT2 STRT/STP/DIR 10.02
EXT 2 STRT PTR 10.05
FAST STOP PTR 10.10
HIGHEND PTR 10.12
LOWEND PTR 10.13
ZERO POS PTR 10.16
SYNC SEL 10.14
SYNC PTR 10.17
HOMING ACK SEL 10.15
HOMING ACK PTR 10.22
SLOW DOWN INPUT 10.09
SLOW DOWN PTR 10.19
EXT SPD LIM PTR 10.20
HOMING SEL PTR 10.21
EXT1/EXT2 SELECT 11.02
EXT 1/2 SEL PTR 11.09
EXT REF1 SELECT 11.03
EXT 1 REF PTR 11.10
EXT REF2 SELECT 11.06
EXT 2 REF PTR 11.11
STEP DI1 PTR 12.06
STEP DI2 PTR 12.07
STEP DI3 PTR 12.08
RO PTR1 14.01 +3.02.0
RO PTR2 14.02 +84.59.6
RO PTR3 14.03 +84.54.6
RO PTR4 14.10
RO PTR5 14.11
RO PTR6 14.12
RO PTR7 14.13
RO PTR8 14.14
RO PTR9 14.15
AO1 PTR 15.01 +1.02
AO2 PTR 15.06 +1.05
FLUX REF PTR 26.06 C10000
MSW B10 PTR 92.10 +3.14.9
MSW B13 PTR 92.11
MSW B14 PTR 92.12
SPD CORR PTR 97.16
PWRON STRTINT PTR 97.18 +1.17.6
ZERO SPEED PTR 97.21 +84.54
BLOCK 1 ABS 84.05 IN1 IN2 IN3 OUT +2.21 C1 84.09
BLOCK 2 COMPARE 84.10 IN1 IN2 IN3 OUT +84.24 +84.09 +85.01 84.14
BLOCK 3 OR 84.15 IN1 IN2 IN3 OUT +84.14 +84.14.2 C0 84.19
BLOCK 4 ABS 84.20 IN1 IN2 IN3 OUT +2.21 C1 84.24
BLOCK 5 AND 84.25 IN1 IN2 IN3 OUT +84.19 +84.39.2 84.29
BLOCK 6 ABS 84.30 IN1 IN2 IN3 OUT +2.13 C1 84.34
BLOCK 7 COMPARE 84.35 IN1 IN2 IN3 OUT +84.34.1 C1 84.39
BLOCK 8 OR 84.40 IN1 IN2 IN3 OUT +1.17 +1.17.1 C0 84.44
BLOCK 9 TRIGG 84.45 IN1 IN2 IN3 OUT +84.44 84.49
BLOCK 10 SR 84.50 IN1 IN2 IN3 OUT +84.29 +84.49 84.54
BLOCK 11 AND 84.55 IN1 IN2 IN3 OUT +3.13.6 -84.54 84.59
BLOCK 12 EVENT 84.60 IN1 IN2 IN3 OUT +84.54 +85.11 C0 84.64
Time Level = 20 msec 83.04
Software Version = AQCC7170 33.02
85.01 = 10
85.02 = 0
85.03 = 0
85.04 = 0
85.05 = 0
85.06 = 0
85.07 = 0
85.08 = 0
85.09 = 0
85.10 = 0
85.11 = BRK MATCH
85.12 = MESSAGE2
85.13 = MESSAGE3
85.14 = MESSAGE4
85.15 = MESSAGE5
1.17
1.17.1
2.13
2.21
3.13.6

Redundancy in Master/Follower crane control

In the Master/Follower crane control, redundancy is implemented using a spare drive unit that is ready to be used as a Master or a Follower. The spare unit usually replaces the faulty Master or one of the Followers.

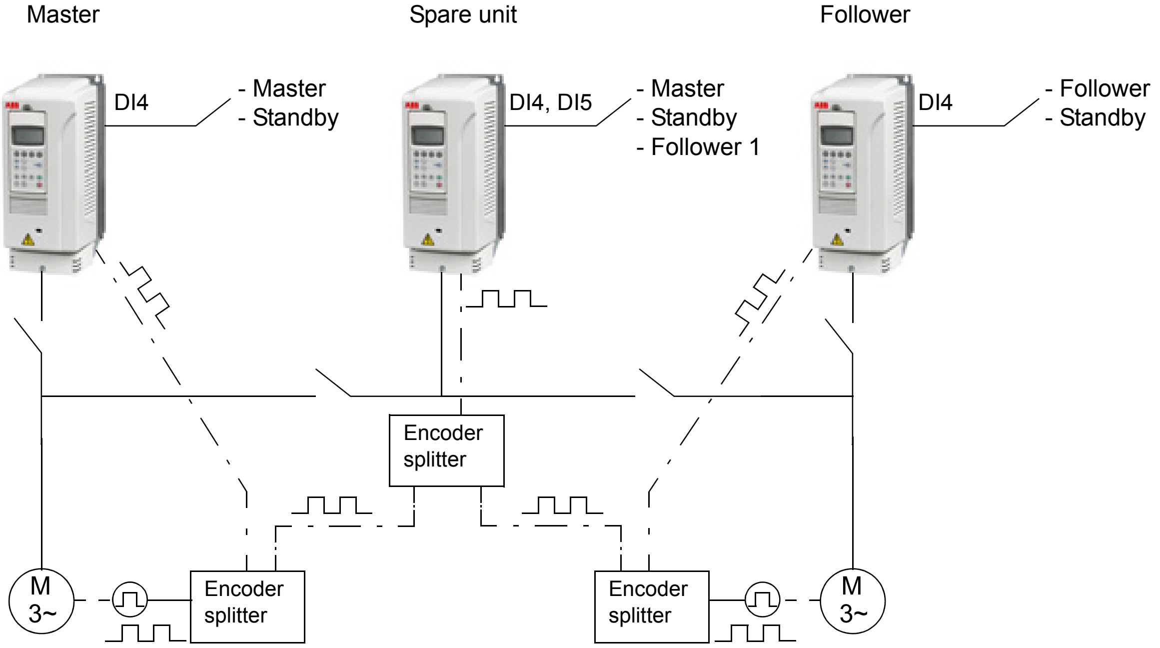
Adaptive Programming provides the ability to switch between the Master, Follower or standby (spare unit) mode. This means that the Master and Follower are no longer fixed, but can be changed when needed.

For more information, see the *Application Guide for Adaptive Program* (3AFE64527274 [English]) and *DriveAP User's Manual* (3AFE64540998 [English]).

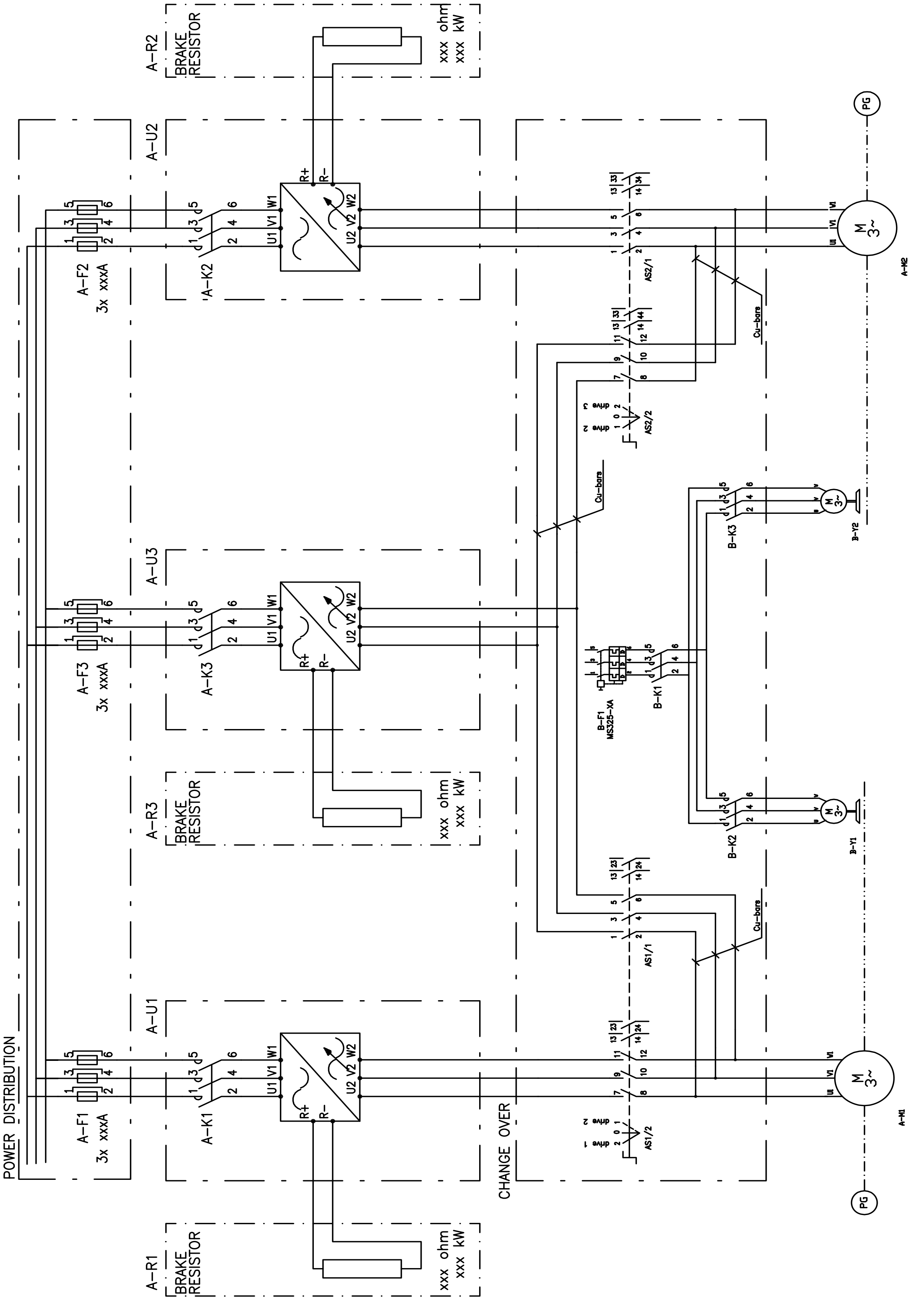
When you use a spare unit, the ACS800 motor output must be provided with an interlock power switch. The spare unit must be connected to the Master/Follower optical fibre ring network (communication channel 2). All RMIO control boards of the drives must be powered on with the external power supply (see *External 24 V supply of RMIO board* on page *117*).

The spare unit is normally in the standby mode.

The following figure shows a Master/Follower standby configuration with output contactors and encoder splitters.



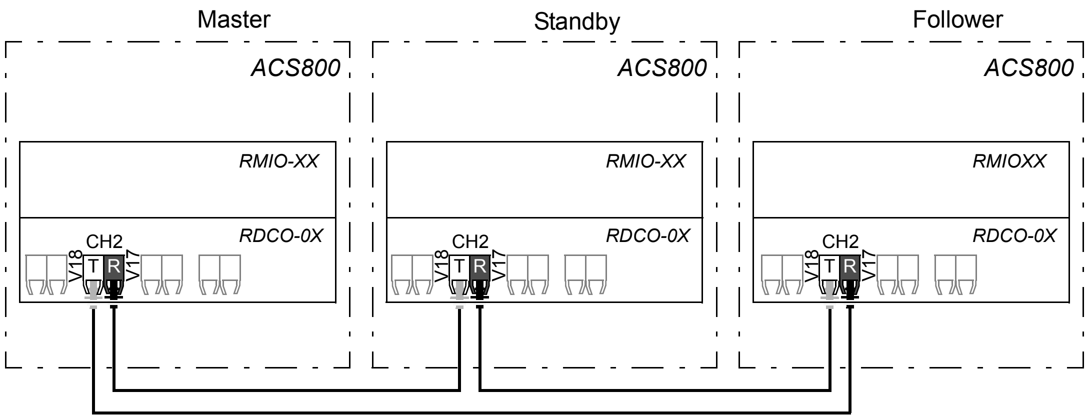
The following figure shows an example of a main circuit diagram with a Master, a Follower and a standby unit together with output interlock power switches.


POWER DISTRIBUTION
CHANGE OVER
A-F1
3x xxxA
A-F2
3x xxxA
A-F3
3x xxxA
A-K1
A-K2
A-K3
A-U1
A-U2
A-U3
A-R1
BRAKE RESISTOR
xxx ohm
xxx kW
A-R2
BRAKE RESISTOR
xxx ohm
xxx kW
A-R3
BRAKE RESISTOR
xxx ohm
xxx kW
U1 V1 W1
U2 V2 W2
R+
R-
AS1/1
AS1/2
AS2/1
AS2/2
Cu-bars
B-F1
MS325-XA
B-K1
B-K2
B-K3
B-Y1
B-Y2
A-M1
A-M2
M
3~
PG

The following figure describes the Master/Follower ring network (channel 2) on the RMIO boards.

Note: Only the ring topology is supported.

T = Transmitter; R = Receiver; RMIO = I/O and Control Board
Please note that channels CH0/CH2/CH3 are located on the optional RDCO-0x board.



Using the Adaptive Programming (AP) and the Write block, you can switch between the Master/Follower/standby link modes in the drives connected to the ring network (channel 2). Parameter *60.01* MASTER LINK MODE defines the role of the drive on the Master/Follower link. The mode is switched between MASTER, FOLLOWER1 and STANDBY via two available digital inputs.

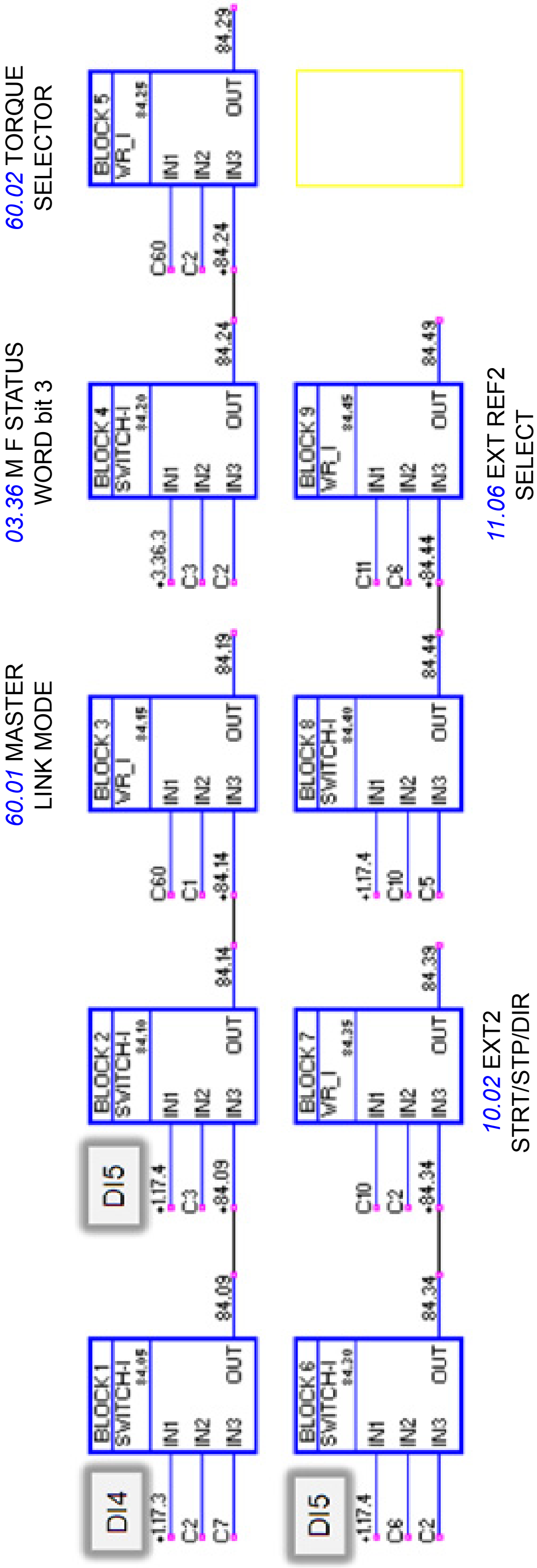
In the following example:

- Actual signal 01.17.3 = digital input DI4
- Actual signal 01.17.4 = digital input DI5

DI4	DI5	Master link mode (60.1)
0	0	Standby (value 7)
0	1	Follower 1 (value 3)
1	0	Master (value 2)
1	1	Follower 1 (value 7)

When the Master or Follower mode is switched, parameters *10.02* EXT2 STRT/STP/DIR and *11.06* EXT REF2 SELECT must be updated according to the correct sources.

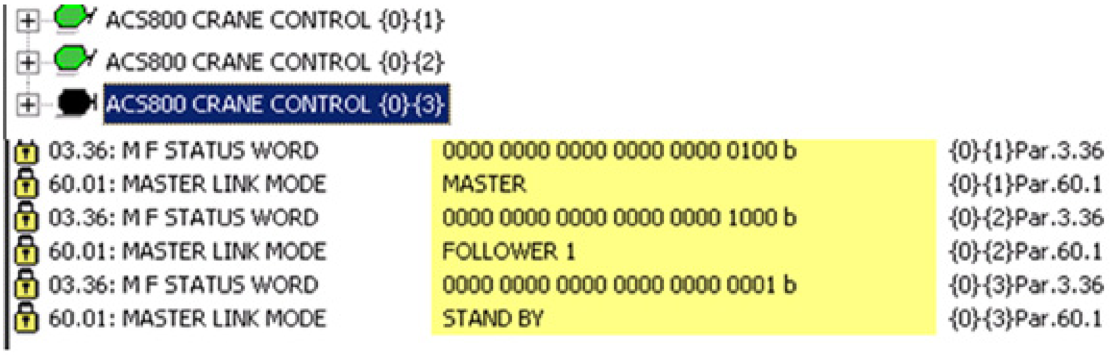
Parameter *03.36* M F STATUS WORD indicates the drive mode.


60.01 MASTER LINK MODE
03.36 M F STATUS WORD bit 3
60.02 TORQUE SELECTOR
10.02 EXT2 STRT/STP/DIR
11.06 EXT REF2 SELECT
DI4
DI5
DI5
BLOCK1 SWITCH-I
BLOCK 2 SWITCH-I
BLOCK 3 VR_I
BLOCK 4 SWITCH-I
BLOCK 5 VR_I
BLOCK 6 SWITCH-I
BLOCK 7 VR_I
BLOCK 8 SWITCH-I
BLOCK 9 VR_I
IN1
IN2
IN3
OUT

After switching the link mode, the RMIO +24 V DC must be switched OFF/ON before restarting the crane.

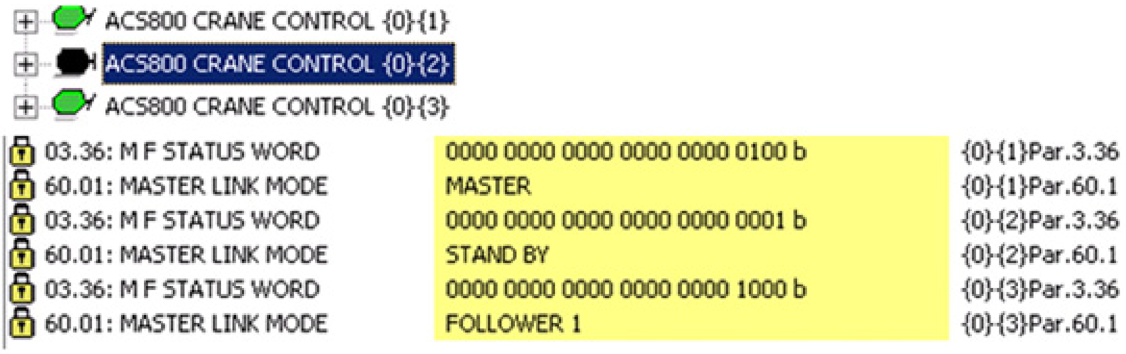
In the following example:

- Drive 01 {0}-{1} is the Master and it is running.
- Drive 02 {0}-{2} is a Follower and it is running.
- Drive 03 {0}-{3} is in the standby mode and ready.



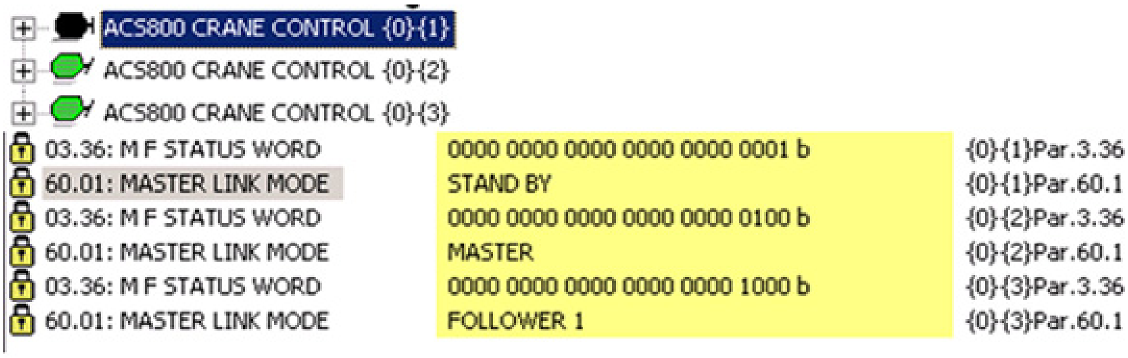
In the following example:

- Drive 01 {0}-{1} is the Master and it is running.
- Drive 02 {0}-{2} is in the standby mode and ready.
- Drive 03 {0}-{3} is a Follower and it is running.



In the following example:

- Drive 01 {0}-{1} in the standby mode and ready.
- Drive 02 {0}-{2} is the Master and it is running.
- Drive 03 {0}-{3} is a Follower and it is running.

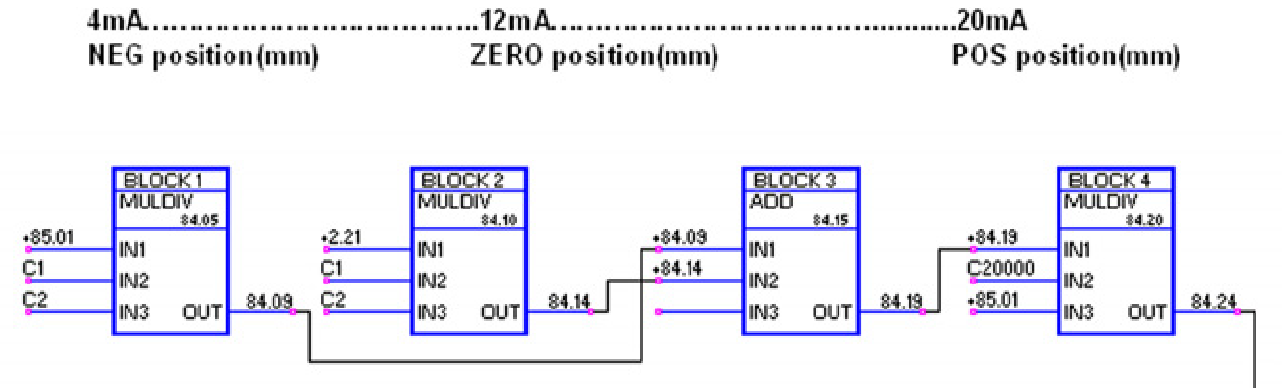


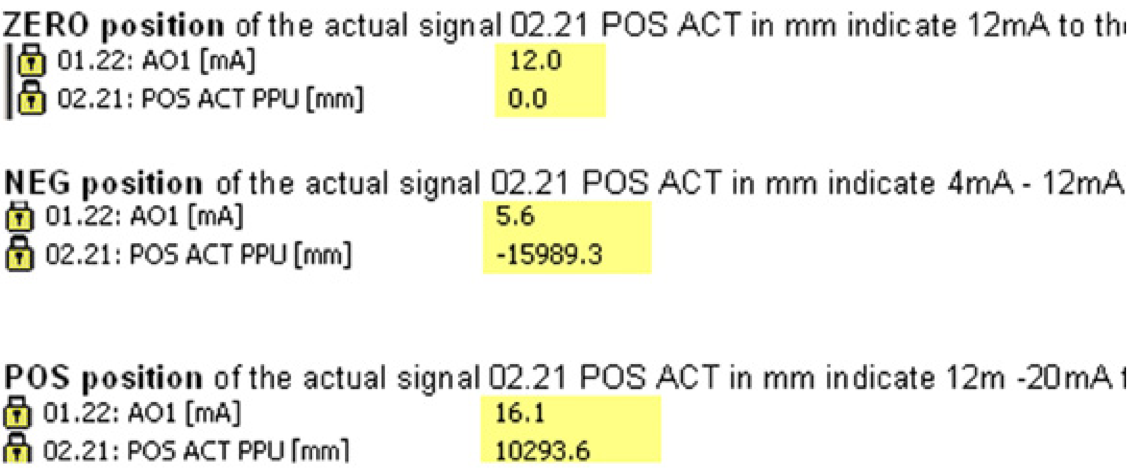
Scaling actual encoder position signal (mm) to analogue output as mA

The actual encoder position signal *02.21* POS ACT PPU (mm) can be scaled to 4 … 20 mA for analogue outputs and sent to other systems as an mA signal, for example, for supervision or protection purposes. For more information on the Position function, see section *Position* on page *91*.

Create an AP file for scaling the actual encoder position signal to an analogue output according to the following example. In the example:

- 4 mA is the negative position
- 12 mA is the zero position
- 20 mA is the positive position.





Slack rope torque detection

Using Adaptive Programming (AP), you can create a function for detecting slackness of the ropes on the drum. The slack rope detection is done by monitoring the actual motor torque and comparing it with a slack-rope-detection torque level. When the actual torque of the motor falls below the defined level and the slack rope detection delay has passed, the drive trips on "SLACK FLT".

The function starts to monitor the motor actual torque:

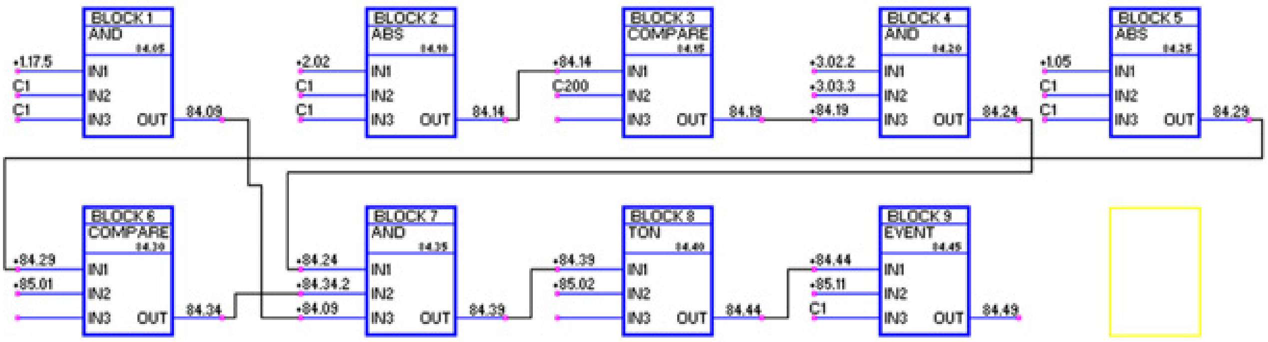
- after the drive has started running,
- the motor has magnetised and
- the speed reference ramp has exceeded 1% of the maximum/minimum speed limit.

Create an AP file for slack rope torque detection according to the following example. In the example:

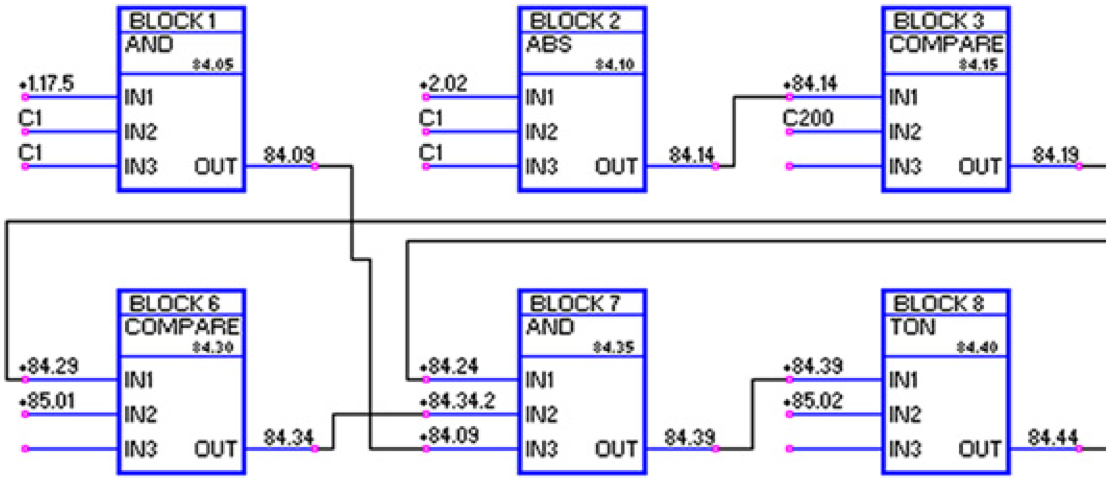
- Par. 84.06 defines the Slack-rope-detection bit input that is used to activate the Slack rope detection function. The Slack-rope-detection bit is, by default, set to digital input DI6 (Actual signal 01.17 bit 5).
- Parameter settings:

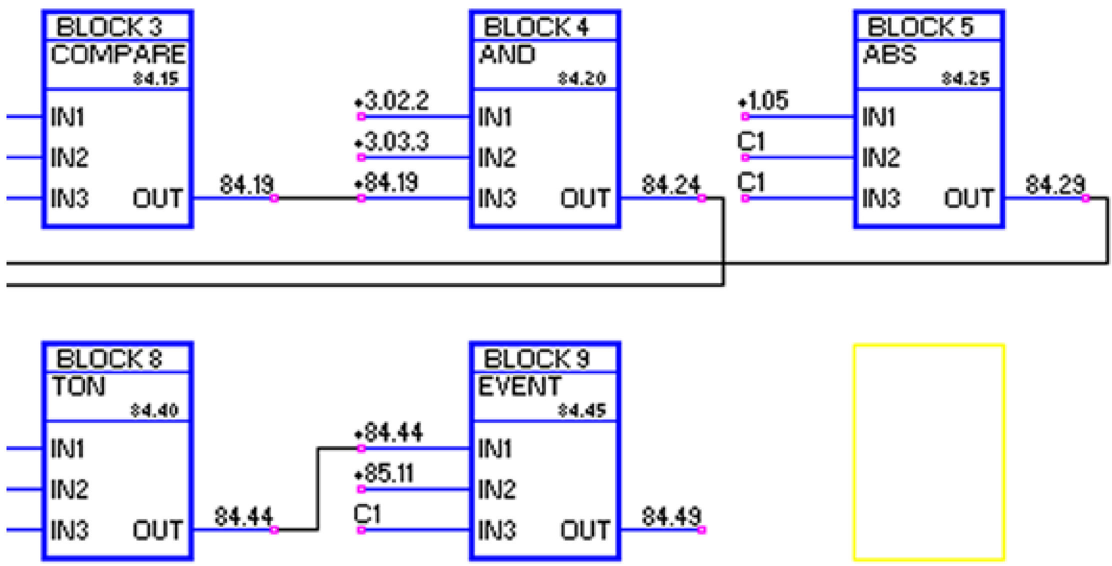
Bit value	Description
1	Slack rope detection function is enabled.
0	Slack rope detection function is disabled.

- User par. 85.01 defines the lack-rope-detection torque level as % of the motor nominal torque. When the actual motor torque is lower than the value defined in this parameter, a slack rope is detected. If this condition lasts for a period longer than the time defined in par 85.02 SLACK ROPE DETECTION DELAY, the drive trips on "SLACK FLT".
- User par. 85.01 has a scaling of 100. For example, if a torque level of 50% has to be set, the value entered in this parameter must be 5000. The default for Slack-rope-detection torque level is set to 50% (par. 85.01 = 50000).
- Par. 85.02 defines the delay time in milliseconds. The default for Slack-rope-detection delay is set to 2000 ms.



The following figures show the previous example enlarged.



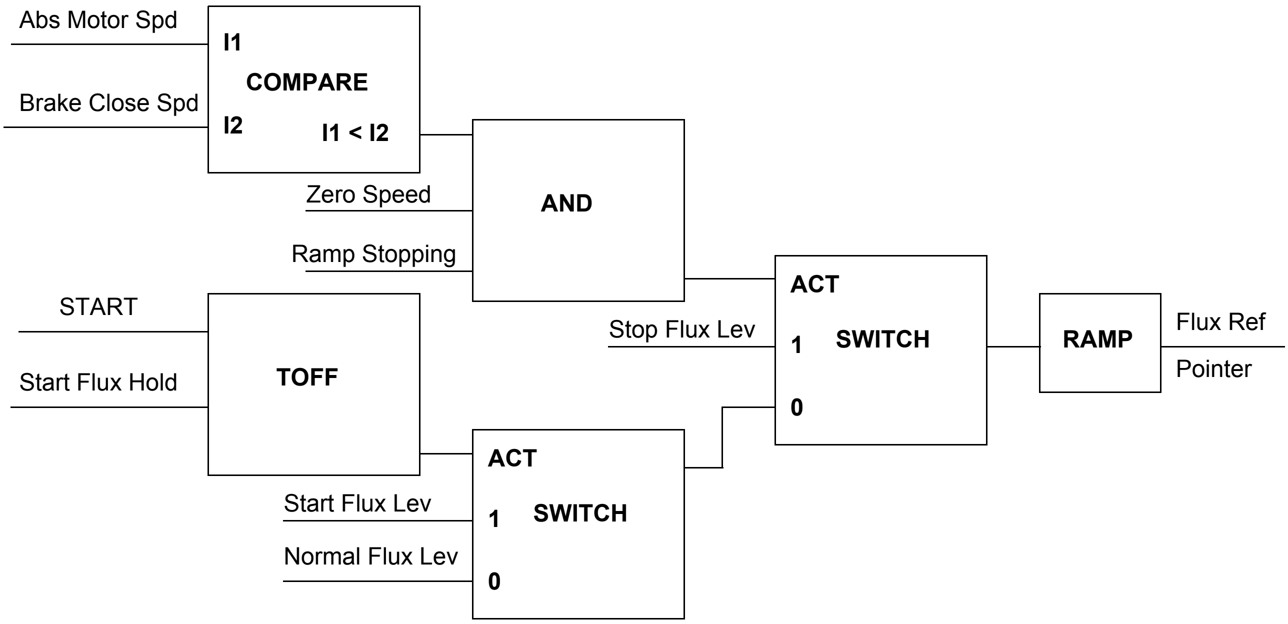


Conical rotor motors

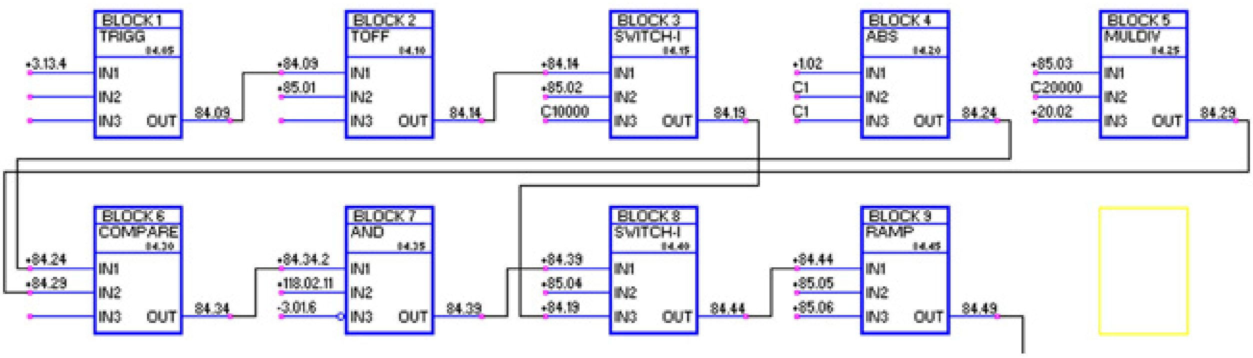
Using the Adaptive Programming (AP), you can create a file for handling brake control of conical rotor motors that do not have an external brake. With the help of Adaptive Programming, the conical rotor motors can be used together with the Crane control program.

For more information, see the *Application Guide for Adaptive Program* (3AFE64527274 [English]) and *DriveAP User's Manual* (3AFE64540998 [English]).

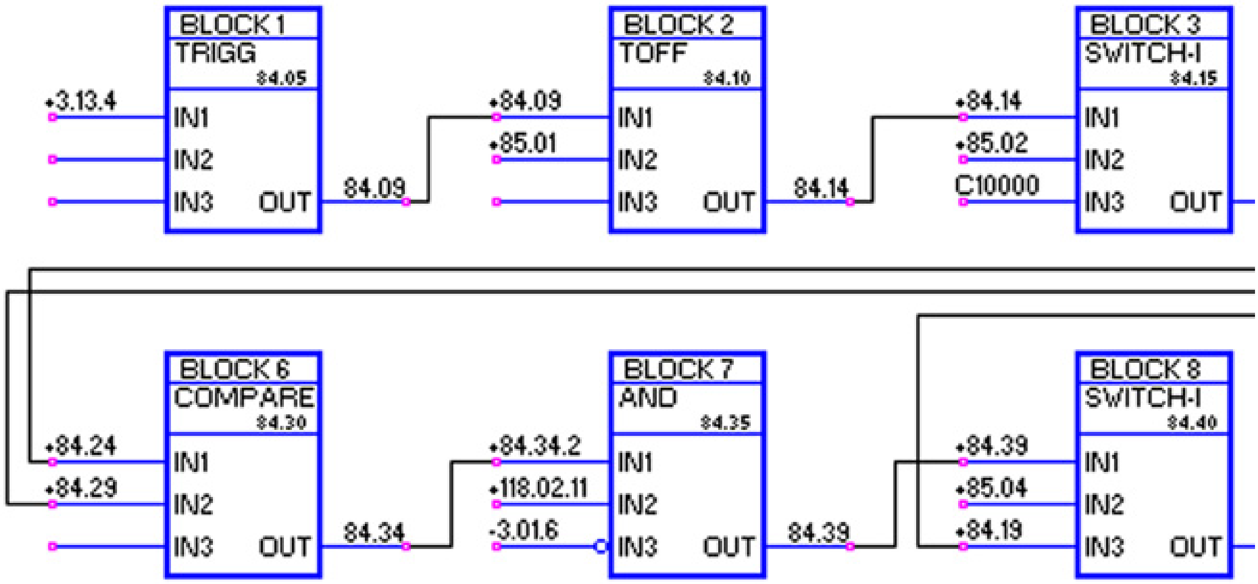
The brake control of conical rotor motors is done by using a high flux level during start and a lower flux level during stopping.

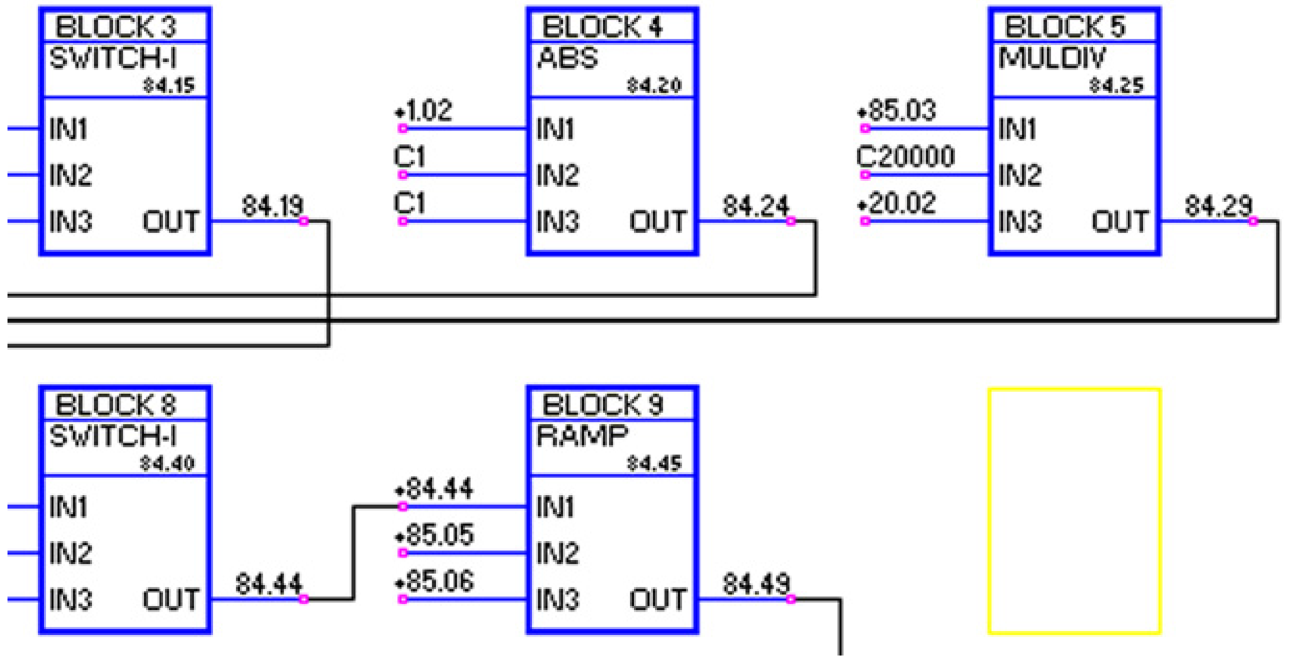


The figure on the following pages is an example of the conical rotor motor function using DriveAP for the crane control application.



The following figures show the previous example enlarged.





Analogue Extension Module

Chapter overview

The chapter describes the use of analogue extension module RAIO as the speed reference interface of an ACS800 drive equipped with the Crane control program.

Speed control through the analogue extension module

Two variants are described:

- Bipolar Input in Basic Speed Control
- Bipolar Input in Joystick Mode

Only the use of a bipolar input (± signal range) is covered here. The use of unipolar input corresponds to that of a standard unipolar input when:

- the settings described below are done, and
- the communication between the module and the drive is activated with parameter *98.06* AI/O EXT MODULE.

Basic checks

Ensure the drive is:

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

Ensure the extension module:

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

Settings of the analogue extension module and the drive

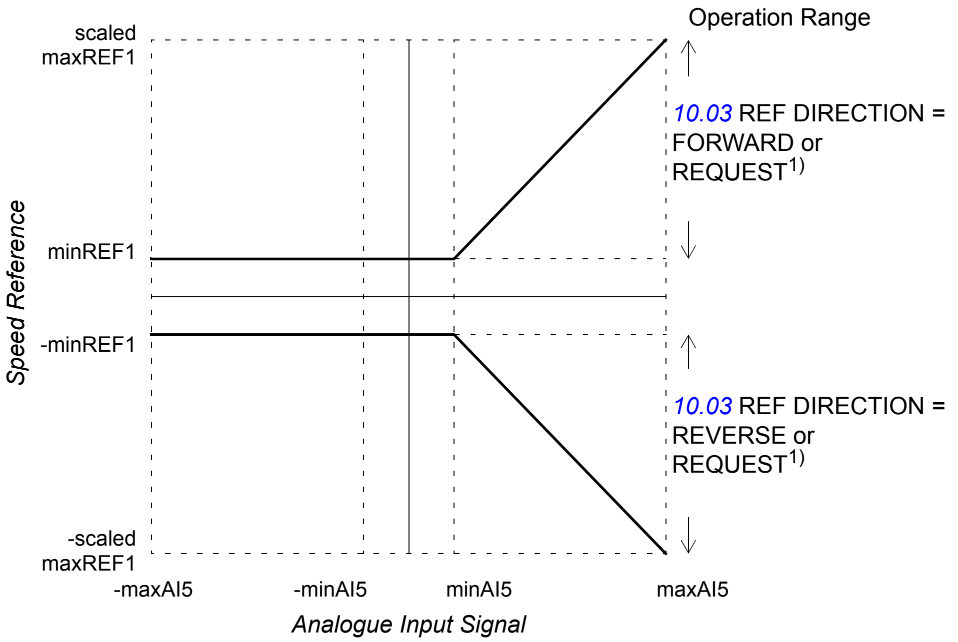
- Set the module node address to 5 (not required if installed to the option slot of the drive).
- Select the signal type for the module input AI1 (switch).
- Select the operation mode (unipolar/bipolar) of the module input (switch).
- Ensure the drive parameter settings correspond to the mode of the module inputs (parameter *98.13* AI/O EXT AI1 FUNC and *98.14* AI/O EXT AI2 FUNC).
- Set the drive parameters (see the appropriate section on the following pages).

Parameter settings: bipolar input in basic speed control

The table below lists the parameters that affect the handling of the speed reference received through the extension module bipolar input AI1 (AI5 of the drive).

Parameter	Setting
98.06 AI/O EXT MODULE	RAIO-SLOT1
98.13 AI/O EXT AI1 FUNC	BIPOLAR AI5
10.03 REF DIRECTION	FORWARD; REVERSE; REQUEST(1
11.02 EXT1/EXT2 SELECT	EXT1
11.03 EXT REF1 SELECT	AI5
11.04 EXT REF1 MINIMUM	minREF1
11.05 EXT REF1 MAXIMUM	maxREF1
13.16 MINIMUM AI5	minAI5
13.17 MAXIMUM AI5	maxAI5
13.18 SCALE AI5	100%
13.20 INVERT AI5	NO
30.01 AI<MIN FUNCTION	(2

The figure below presents the speed reference corresponding to bipolar input AI1 of the extension module.



minAI5	=	13.16 MINIMUM AI5
maxAI5	=	13.17 MAXIMUM AI5
scaled maxREF1	=	13.18 SCALE AI5 x 11.05 EXT REF1 MAXIMUM
minREF1	=	11.04 EXT REF1 MINIMUM

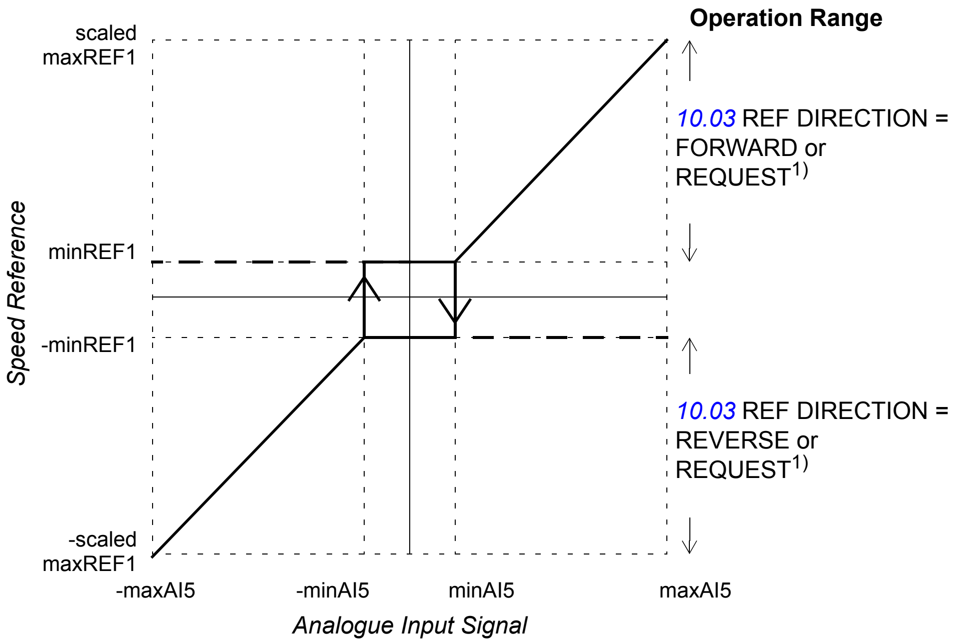
1) For the negative speed range, the drive must receive a Separate reverse command.
2) Set if supervision of living zero is used.

Parameter settings: bipolar input in joystick mode

The table below lists the parameters that affect the handling of the speed and direction reference received through the extension module bipolar input AI1 (AI5 of the drive).

Parameter	Setting
98.06 AI/O EXT MODULE	RAIO-SLOT1
98.13 AI/O EXT AI1 FUNC	BIPOLAR AI5
10.03 REF DIRECTION	FORWARD; REVERSE; REQUEST(1
11.02 EXT1/EXT2 SELECT	EXT1
11.03 EXT REF1 SELECT	AI5/JOYST
11.04 EXT REF1 MINIMUM	minREF1
11.05 EXT REF1 MAXIMUM	maxREF1
13.16 MINIMUM AI5	minAI5
13.17 MAXIMUM AI5	maxAI5
13.18 SCALE AI5	100%
13.20 INVERT AI5	NO
30.01 AI<MIN FUNCTION	(2

The figure below presents the speed reference corresponding to bipolar input AI1 of the extension module in joystick mode.



minAI5	=	13.16 MINIMUM AI5
maxAI5	=	13.17 MAXIMUM AI5
scaled maxREF1	=	13.18 SCALE AI5 x 11.05 EXT REF1 MAXIMUM
minREF1	=	11.04 EXT REF1 MINIMUM

1) Enables the use of both positive and negative speed range.
2) Set if supervision of living zero is used.

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	Profibus equivalent for drive parameters communicating through the **NPBA-12** Profibus Adapter.
FbEq	Fieldbus equivalent: The scaling between the value shown on the panel and the integer used in serial communication.
Absolute Maximum Frequency	Value of *20.08*, or *20.07* if the absolute value of the minimum limit is greater than the maximum limit.
Absolute Maximum Speed	Value of parameter *20.02*, or *20.01* if the absolute value of the minimum limit is higher than the maximum limit.
W	Write access is not allowed when the motor is running.

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:

- See column PB in the tables below.

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						
01.02	SPEED	SPEED	-20000 = -100% 20000 = 100% of motor absolute max. speed	rpm		2	
01.03	FREQUENCY	FREQ	-100 = -1 Hz 100 = 1 Hz	Hz		3	
01.04	CURRENT	CURRENT	10 = 1 A	A		4	
01.05	TORQUE	TORQUE	-10000 = -100% 10000 = 100% of motor nominal torque	%		5	
01.06	POWER	POWER	-1000 = -100% 1000 = 100% of motor nominal power	%		6	
01.07	DC BUS VOLTAGE V	DC BUS V	1 = 1 V	V		7	
01.08	MAINS VOLTAGE	MAINS V	1 = 1 V	V		8	
01.09	OUTPUT VOLTAGE	OUT VOLT	1 = 1 V	V		9	
01.10	ACS800 TEMP	ACS TEMP	1 = 1°C	°C		10	
01.11	EXTERNAL REF 1	EXT REF1	1 = 1 rpm	rpm		11	
01.12	EXTERNAL REF 2	EXT REF2	0 = 0% 10000 = 100% 1)	%		12	
01.13	CTRL LOCATION	CTRL LOC	(1,2) LOCAL; (3) EXT1; (4) EXT2		LOCAL; EXT1; EXT2	13	
01.14	OP HOUR COUNTER	OP HOUR	1 = 1 h	h		14	
01.15	KILOWATT HOURS	KW HOURS	1 = 100 kWh	kWh		15	
01.17	DIL DI6-1 STATUS	DIL DI6-1	1 = 1			17	
01.18	AI1 [V]	AI1 [V]	1 = 0.001 V	V		18	
01.19	AI2 [mA]	AI2 [mA]	1 = 0.001 mA	mA		19	
01.20	AI3 [mA]	AI3 [mA]	1 = 0.001 mA	mA		20	
01.21	RO3-1 STATUS	RO3-1	1 = 1			21	
01.22	AO1 [mA]	AO1 [mA]	1 =0.001 mA	mA		22	
01.23	AO2 [mA]	AO2 [mA]	1 = 0.001 mA	mA		23	
01.27	APPLICATION MACRO	MACRO	1 … 5		According to parameter 99.02	27	
01.28	EXT AO1 [mA]	EXT AO1	1 = 0.001 mA	mA		28	
01.29	EXT AO2 [mA]	EXT AO2	1 = 0.001 mA	mA		29	
01.30	PP 1 TEMP	PP 1 TEM	1 = 1°C	°C		30	
01.31	PP 2 TEMP	PP 2 TEM	1 = 1°C	°C		31	
01.32	PP 3 TEMP	PP 3 TEM	1 = 1°C	°C		32	
01.33	PP 4 TEMP	PP 4 TEM	1 = 1°C	°C		33	
01.35	MOTOR 1 TEMP	M1 TEMP	1 = 1°C	°C		35	
01.36	MOTOR 2 TEMP	M2 TEMP	1 = 1°C	°C		36	
01.37	MOTOR TEMP EST	MOTOR TE	1 = 1°C	°C		37	
01.38	AI5 [mA]	AI5 [mA]	1 = 0.001 mA	mA		38	
01.39	AI6 [mA]	AI6 [mA]	1 = 0.001 mA	mA		39	
01.40	DI15-7 STATUS	DI15-7	1 = 1			40	
01.41	EXT RO STATUS	EXT RO	1 = 1			41	
01.42	PROCESS SPEED REL	P SPEED	1 = 1	%		42	
01.43	CRANE OPT TIME	CR OPTTIME	1 = 10 h	h		43	
01.44	FAN ON-TIME	FAN TIME	10 h = 1	h		44	
01.45	CTRL BOARD TEMP	CTRL B T	1 = 1	°C		45	
01.46	OEM SIGNAL	OEM PAR				46	
02	ACTUAL SIGNALS						
02.01	SPEED REF 2	S REF 2	0 = 0% 20000 = 100% of motor absolute max. speed	rpm		51	
02.02	SPEED REF 3	S REF 3		rpm		52	

Index	Name	Short name	FbEq	Unit	Range	PB	
02.09	TORQUE REF 2	T REF 2	0 = 0% 10000 = 100% of motor nominal torque	%		59	
02.10	TORQUE REF 3	T REF 3		%		60	
02.13	TORQ USED REF	T USED R		%		63	
02.14	FLUX REF	FLUX REF	0 = 0% 10000 = 100%	%		64	
02.17	SPEED ESTIMATED	SPEED ES	0 = 0% 20000 = 100% of motor absolute max. speed	rpm		67	
02.18	SPEED MEASURED	SPEED ME		rpm		68	
02.19	MOTOR ACCELERATIO	MOT AC	1 = 1 rpm/s.	rpm/s		69	
02.21	POS ACT PPU	POS ACT PPU	1=1mm			71	
02.22	SHAFT POS	SHAFT POS	1=1			72	
02.23	SYNC POS ERROR	SYNC ER	1=1 mm			73	
02.24	SYNC POS ERROR 1	SYNC ER1	1=1 mm			74	
02.25	SYNC POS ERROR 2	SYNC ER2	1=1 mm			75	
02.26	SYNC POS ERROR 3	SYNC ER3	1=1 mm			-	
02.27	SYNC POS ERROR 4	SYNC ER4	1=1 mm			-	
02.28	BRAKE OPT COUNTS	BRK CNTS	1=1			-	
03	ACTUAL SIGNALS		2)				
03.01	MAIN CTRL WORD	MAIN CW			0...65535 (Decimal)	76	
03.02	MAIN STATUS WORD	MAIN SW			0...65535 (Decimal)	77	
03.03	AUX STATUS WORD	AUX SW			0...65535 (Decimal)	78	
03.04	LIMIT WORD 1	LIMIT W1			0...65535 (Decimal)	79	
03.05	FAULT WORD 1	FAULT W1			0...65535 (Decimal)	80	
03.06	FAULT WORD 2	FAULT W2			0...65535 (Decimal)	81	
03.07	SYSTEM FAULT	SYS FLT			0...65535 (Decimal)	82	
03.08	ALARM WORD 1	ALARM W1			0...65535 (Decimal)	83	
03.09	ALARM WORD 2	ALARM W2			0...65535 (Decimal)	84	
03.11	FOLLOWER MCW	FOLL MCW			0...65535 (Decimal)	86	
03.13	AUX STATUS WORD 3	AUX SW3			0...65535 (Decimal)	88	
03.14	AUX STATUS WORD 4	AUX SW4			0...65535 (Decimal)	89	
03.15	FAULT WORD 4	FAULT W4			0...65535 (Decimal)	90	
03.16	ALARM WORD 4	ALARM W4			0...65535 (Decimal)	91	
03.17	FAULT WORD 5	FAULT W5			0...65535 (Decimal)	92	
03.18	ALARM WORD 5	ALARM W5			0...65535 (Decimal)	93	
03.19	INT INIT FAULT	INT INIT			0...65535 (Decimal)	94	
03.20	LATEST FAULT	LAST FLT			0...65535 (Decimal)	95	
03.21	2.LATEST FAULT	2.FAULT			0...65535 (Decimal)	96	

Index	Name	Short name	FbEq	Unit	Range	PB	
03.22	3.LATEST FAULT	3.FAULT			0...65535 (Decimal)	97	
03.23	4.LATEST FAULT	4.FAULT			0...65535 (Decimal)	98	
03.24	5.LATEST FAULT	5.FAULT			0...65535 (Decimal)	99	
03.25	LATEST WARNING	LAST WRN			0...65535 (Decimal)	100	
03.26	2.LATEST WARNING	2.WARN			0...65535 (Decimal)	-	
03.27	3.LATEST WARNING	3.WARN			0...65535 (Decimal)	-	
03.28	4.LATEST WARNING	4.WARN			0...65535 (Decimal)	-	
03.29	5.LATEST WARNING	5.WARN			0...65535 (Decimal)	-	
03.30	LIMIT WORD INV	LIMIT WO			0...65535 (Decimal)	-	
03.31	ALARM WORD 6	ALARM W6			0...65535 (Decimal)	-	
03.32	CRANE STATUS WORD	CRANE SW			0...65535 (Decimal)	-	
03.33	CRANE FAULT WORD	CRANE FW			0...65535 (Decimal)	-	
03.34	APPL CONTROL WORD	APPL CW			0...65535 (Decimal)	-	
03.35	SPEED CORR BUF	SPD CORR			0...65535 (Decimal)	-	
03.36	M F STATUS WORD	M F SW			0...65535 (Decimal)	-	
03.37	FLW CMD WITH POS	FCW POS			0...65535 (Decimal)	-	
03.38	POSITION REM	POS R			0...65535 (Decimal)	-	
04	ACTUAL SIGNALS						
04.01	FAULTED INT INFO	FLTD INT			0...65535 (Decimal)	-	
04.02	INT SC INFO	INT SC			0...65535 (Decimal)	-	
09	ACTUAL SIGNALS						
09.01	AI1 SCALED	AI1 SCAL	20000 = 10 V		0…20000	-	
09.02	AI2 SCALED	AI2 SCAL	20000 = 20 mA		0…20000	-	
09.03	AI3 SCALED	AI3 SCAL	20000 = 20 mA		0…20000	-	
09.04	AI5 SCALED	AI5 SCAL	20000 = 20 mA		0…20000	-	
09.05	AI6 SCALED	AI6 SCAL	20000 = 20 mA		0…20000	-	
09.06	DS MCW	DS MCW	0...65535 (Decimal)		0...65535 (Decimal)	-	
09.07	MASTER REF1	M REF1	-32768…32767		-32768…32767	-	
09.08	MASTER REF2	M REF2	-32768…32767		-32768…32767	-	
09.09	AUX DS VAL1	AUX DSV1	-32768…32767		-32768…32767	-	
09.10	AUX DS VAL2	AUX DSV2	-32768…32767		-32768…32767	-	
09.11	AUX DS VAL3	AUX DSV3	-32768…32767		-32768…32767	-	
09.12	AUX DS VAL4	AUX DSV4	-32768…32767		-32768…32767	-	
09.13	AUX DS VAL5	AUX DSV5	-32768…32767		-32768…32767	-	
09.14	AUX DS VAL6	AUX DSV6	-32768…32767		-32768…32767	-	
09.15	LCU ACT SIGNAL1	LCU ACT1	1 = 1		-	-	
09.16	LCU ACT SIGNAL2	LCU ACT2	1 = 1		-	-	

1) Percent of motor max. speed / nominal torque / max. process reference (depending on the ACS800 macro selected).

2) The contents of these data words are detailed in chapter *Fieldbus control*. For the contents of Actual Signal 03.11, see the *Master/Follower Application Guide* [3AFE64590430 (English)].

Parameters

Index	Name/Selection	User	Default	PB
10	START/STOP/DIR			
10.01	EXT1 STRT/STP/DIR		DI1 F, DI2 R	101
10.02	EXT2 STRT/STP/DIR		NOT SEL	102
10.03	REF DIRECTION		REQUEST	103
10.04	EXT 1 STRT PTR		0	104
10.05	EXT 2 STRT PTR		0	105
10.07	NET CONTROL		0	107
10.08	NET REFERENCE		0	108
10.09	SLOW DOWN INPUT		NOT SEL	109
10.10	FAST STOP PTR		0	110
10.12	HIGHEND PTR		0	112
10.13	LOWEND PTR		0	113
10.14	SYNC SEL		NOT SEL	114
10.15	HOMING ACK SEL		NOT SEL	115
10.16	ZERO POS PTR		0	116
10.17	SYNC PTR		0	117
10.19	SLOW DOWN PTR		0	119
10.20	EXT SPD LIM PTR		0	120
10.21	HOMING SEL PTR		0	121
10.22	HOMING ACK PTR		0	122
11	REFERENCE SELECT			
11.01	KEYPAD REF SEL		REF1 (rpm)	126
11.02	EXT1/EXT2 SELECT		EXT1	127
11.03	EXT REF1 SELECT		AI1/JOYST	128
11.04	EXT REF 1 MINIMUM		0 rpm	129
11.05	EXT REF 1 MAXIMUM		1500 rpm	130
11.06	EXT REF2 SELECT		Keypad	131
11.07	EXT REF 2 MINIMUM		0%	132
11.08	EXT REF 2 MAXIMUM		100%	133
11.09	EXT 1/2 SEL PTR		0	134
11.10	EXT 1 REF PTR		0	135
11.11	EXT 2 REF PTR		0	136
11.12	SLOW DOWN REF		0%	137
11.13	JOYSTICK WARN TD		2 s	138
11.14	HOMING REF		0 rpm	139
12	STEP REFERENCING			
12.01	STEP REF SEL		NOT SEL	151
12.02	STEP REF 1		0 rpm	152
12.03	STEP REF 2		0 rpm	153
12.04	STEP REF 3		0 rpm	154
12.05	STEP REF 4		0 rpm	155
12.06	STEP DI1 PTR		0	156
12.07	STEP DI2 PTR		0	157
12.08	STEP DI3 PTR		0	158
13	ANALOGUE INPUTS			
13.01	MINIMUM AI1		0 V	176
13.02	MAXIMUM AI1		10 V	177
13.03	SCALE AI1		100%	178
13.04	FILTER AI1		0.10 s	179
13.05	INVERT AI1		NO	180
13.06	MINIMUM AI2		0 mA	181
13.07	MAXIMUM AI2		20 mA	182
13.08	SCALE AI2		100%	183
13.09	FILTER AI2		0.10 s	184
13.10	INVERT AI2		NO	185
13.11	MINIMUM AI3		0 mA	186

Index	Name/Selection	User	Default	PB
13.12	MAXIMUM AI3		20 mA	187
13.13	SCALE AI3		100%	188
13.14	FILTER AI3		0.10 s	189
13.15	INVERT AI3		NO	190
13.16	MINIMUM AI5		0 mA	191
13.17	MAXIMUM AI5		20 mA	192
13.18	SCALE AI5		100%	193
13.19	FILTER AI5		0.10 s	194
13.20	INVERT AI5		NO	195
13.21	MINIMUM AI6		0 mA	196
13.22	MAXIMUM AI6		20 mA	197
13.23	SCALE AI6		100%	198
13.24	FILTER AI6		0.10 s	199
13.25	INVERT AI6		NO	200
14	RELAY OUTPUTS			
14.01	RO PTR1		+003.013.06	201
14.02	RO PTR2		+003.002.02	202
14.03	RO PTR3		-.003.002.03	203
14.10	RO PTR4		0	210
14.11	RO PTR5		0	211
14.12	RO PTR6		0	212
14.13	RO PTR7		0	213
14.14	RO PTR8		0	214
14.15	RO PTR9		0	215
15	ANALOGUE OUTPUTS			
15.01	AO1 PTR		+.001.002.00	226
15.02	INVERT AO1		NO	227
15.03	MINIMUM AO1		0 mA	228
15.04	FILTER AO1		0.10 s	229
15.05	SCALE AO1		100%	230
15.06	AO2 PTR		+.001.005.00	231
15.07	INVERT AO2		NO	232
15.08	MINIMUM AO2		0 mA	233
15.09	FILTER AO2		2.00 s	234
15.10	SCALE AO2		100%	235
16	SYST CTRL INPUTS			
16.01	RUN ENABLE		YES	251
16.02	PARAMETER LOCK		OPEN	252
16.03	PASS CODE		0	253
16.04	FAULT RESET SEL		NOT SEL	254
16.05	USER MACRO IO CHG		NOT SEL	255
16.06	LOCAL LOCK		OFF	256
16.07	PARAMETER SAVE		DONE	257
16.08	RUN ENA PTR		0	258
16.09	CTRL BOARD SUPPLY		INTERNAL 24V	259
16.11	FAULT RESET PTR		0	261
16.12	POWER ON RESET TD		10 s	262
16.13	USER MACRO PTR		0	263
16.14	FAN KWH CNT RESET		NOT SEL	
20	LIMITS			
20.01	MINIMUM SPEED		(calculated)	351
20.02	MAXIMUM SPEED		(calculated)	352
20.03	MAXIMUM CURRENT		type-specific	353
20.04	TORQ MAX LIM1		300%	354
20.05	OVERVOLTAGE CTRL		OFF	355
20.06	UNDERVOLTAGE CTRL		ON	356
20.07	MINIMUM FREQ		- 50 Hz	357
20.08	MAXIMUM FREQ		50 Hz	358

Index	Name/Selection	User	Default	PB
20.11	P MOTORING LIM		300%	361
20.12	P GENERATING LIM		-300%	362
20.13	MIN TORQ SEL		NEG MAX TORQ	363
20.14	MAX TORQ SEL		MAX LIM1	364
20.15	TORQ MIN LIM1		0.0%	365
20.16	TORQ MIN LIM2		0.0%	366
20.17	TORQ MAX LIM2		300.0%	367
20.18	TORQ MIN PTR		0	368
20.19	TORQ MAX PTR		0	369
20.20	MIN AI SCALE		0%	370
20.21	MAX AI SCALE		300%	371
20.22	MAX EXT SPD LIM		1500 rpm	372
20.23	MIN EXT SPD LIM		-1500 rpm	373
21	START/STOP			
21.01	START FUNCTION	<read-protected>	CNST DC MAGN	376
21.02	CONST MAGN TIME		500.0 ms	377
21.03	STOP FUNCTION		RAMP	378
21.04	DC HOLD		NO	379
21.05	DC HOLD SPEED		5 rpm	380
21.06	DC HOLD CURR		30%	381
21.07	RUN ENABLE FUNC		COAST STOP	382
21.08	SCALAR FLY START		NO	383
21.09	START INTRL FUNC		OFF2 STOP	384
21.10	ZERO SPEED DELAY		0.5 s	385
22	ACCEL/DECEL			
22.01	ACC/DEC SEL		ACC/DEC DIR	401
22.02	ACCEL TIME 1		3.00 s	402
22.03	DECEL TIME 1		3.00 s	403
22.04	ACCEL TIME 2		3.00 s	404
22.05	DECEL TIME 2		3.00 s	405
22.06	ACC/DEC RAMP SHPE		0.00 s	406
22.07	EM STOP RAMP TIME		3.00 s	407
22.08	ACC PTR		0	408
22.09	DEC PTR		0	409
22.10	FST STP DCCL TIME		3.00 s	410
23	SPEED CTRL			
23.01	GAIN		10	426
23.02	INTEGRATION TIME		2.50 s	427
23.03	DERIVATION TIME		0.0 ms	428
23.04	ACC COMPENSATION		0.00 s	429
23.05	SLIP GAIN		100.0%	430
23.06	AUTOTUNE RUN		NO	431
23.07	SP ACT FILT TIME		3.9 ms	432
24	TORQUE CTRL			
24.01	TORQ RAMP UP			451
24.02	TORQ RAMP DOWN			452
26	MOTOR CONTROL			
26.01	FLUX OPTIMIZATION		NO	501
26.02	FLUX BRAKING		YES	502
26.03	IR-COMPENSATION		0%	503
26.04	IR STEP-UP FREQ		0	504
26.05	HEX FIELD WEAKEN		NO	505
26.06	FLUX REF PTR		C.10000	506
26.07	FS METHOD		ON	507
27	BRAKE CHOPPER			
27.01	BRAKE CHOPPER CTL		OFF	526
27.02	BR OVERLOAD FUNC		NO	527
27.03	BR RESISTANCE		100.00 ohm	528

Index	Name/Selection	User	Default	PB
27.04	BR THERM T CONST		0 s	529
27.05	MAX CONT BR POWER		0 kW	530
27.06	BC CTRL MODE		COMMON DC	531
30	FAULT FUNCTIONS			
30.01	AI<MIN FUNCTION		FAULT	601
30.02	PANEL LOSS		FAULT	602
30.03	EXTERNAL FAULT		NOT SEL	603
30.04	MOTOR THERM PROT		NO	604
30.05	MOT THERM P MODE		DTC/USER MODE	605
30.06	MOTOR THERM TIME		(calculated)	606
30.07	MOTOR LOAD CURVE		100.0%	607
30.08	ZERO SPEED LOAD		74.0%	608
30.09	BREAK POINT		45.0 Hz	609
30.10	STALL FUNCTION		FAULT	610
30.11	STALL FREQ HI		20.0 Hz	611
30.12	STALL TIME		20.00 s	612
30.13	UNDERLOAD FUNC		NO	613
30.14	UNDERLOAD TIME		600.0 s	614
30.15	UNDERLOAD CURVE		1	615
30.16	MOTOR PHASE LOSS		NO	616
30.17	EARTH FAULT		FAULT	617
30.18	COMM FLT FUNC		FAULT	618
30.19	MAIN REF DS T-OUT		3.00 s	619
30.21	AUX DS T-OUT		3.0 s	621
30.22	IO CONFIG FUNC		WARNING	622
30.23	LIMIT WARNING		0	623
30.24	EXT FAULT PTR		0	624
33	INFORMATION			
33.01	SOFTWARE VERSION		(Version)	676
33.02	APPL SW VERSION		(Version)	677
33.03	TEST DATE		(Date)	678
34	PROCESS VARIABLE			
34.04	MOTOR SP FILT TIM		100 ms	704
34.05	TORQ ACT FILT TIM		100 ms	705
35	MOT TEMP MEAS			
35.01	MOT 1 TEMP AI1 SEL		NOT IN USE	726
35.02	MOT 1 TEMP ALM L		110	727
35.03	MOT 1 TEMP FLT L		130	728
35.04	MOT 2 TEMP AI2 SEL		NOT IN USE	729
35.05	MOT 2 TEMP ALM L		110	730
35.06	MOT 2 TEMP FLT L		130	731
35.07	MOT MOD COMPENSAT		YES	732
42	BRAKE CONTROL			
42.01	BRAKE CTRL		ON	-
42.02	BRAKE ACKNOWLEDGE		OFF	-
42.03	BRAKE OPEN DELAY		1 s	-
42.04	BRAKE CLOSE DELAY		2 s	-
42.05	ABS BRAKE CLS SPD		30 rpm	-
42.06	BRAKE FAULT FUNC		FAULT	-
42.07	STRT TORQ REF SEL		PAR 42.08	-
42.08	START TORQ REF		50%	-
42.09	EXTEND RUN T		60 s	-
42.10	LOW REF BRK HOLD		0.0 s	-
42.11	MOTOR SLIP SPD		10 rpm	-
42.12	SLIP FAULT DELAY		0.5 s	-
42.13	BRK LONG FLT DLY		10 s	-
42.14	SAFETY CLOSE CMD		ENABLE	-
42.15	BRAKE ACKN PTR		0	-

Index	Name/Selection	User	Default	PB
42.16	BRK REOPEN DLY		0 s	-
50	ENCODER MODULE			
50.01	PULSE NR		1024	1001
50.02	SPEED MEAS MODE		A --- B ---	1002
50.03	ENCODER FAULT		FAULT	1003
50.04	ENCODER DELAY		1000	1004
50.05	ENCODER DDCS CH		CH 1	1005
50.06	SPEED FB SEL		ENCODER	1006
50.07	ENC CABLE CHECK		DISABLED	1007
51	COMM MOD DATA			1026 ...
52	STANDARD MODBUS			
52.01	STATION NUMBER		1	1051
52.02	BAUDRATE		9600	1052
52.03	PARITY		ODD	1053
60	MASTER/FOLLOWER			
60.01	MASTER LINK MODE		NOT IN USE	1195
60.02	TORQUE SELECTOR		not visible	1196
60.03	WINDOW SEL ON		not visible	1167
60.04	WINDOW WIDTH POS		not visible	1198
60.05	WINDOW WIDTH NEG		not visible	1199
60.06	DROOP RATE		0	1200
60.07	MASTER SIGNAL 2		202	1201
60.08	MASTER SIGNAL 3		213	1202
60.09	LOAD SHARE		100	1203
60.10	NO OF SLAVES		1	1204
60.11	SLAVE MODE		SPEED	1205
70	DDCS CONTROL			
70.01	CHANNEL 0 ADDR		1	1375
70.02	CHANNEL 3 ADDR		1	1376
70.03	CH1 BAUDRATE		4 Mbit/s	1377
70.04	CH0 DDCS HW CONN		RING	1378
70.05	CH2 HW CONNECTION		RING	1379
74	SPEED MONITOR			
74.01	MOT OVERSPEED LEV		110 %	1447
75	SPEED MATCHING			
75.01	SPEED MATCH SEL		TRUE	1465
75.02	SP DEV LEV		10 %	1466
75.03	SPD MATCH FLT TD		1 s	1467
75.04	SPD CHG PER SEC		5 s	1468
76	TORQUE PROVING			
76.01	TORQ PROV SEL		TRUE	1483
76.02	TORQ PROV FLT TD		1.0 s	1484
77	LOAD SPEED CTRL			
77.01	LOAD SPD CTRL SEL		NOT SEL	
77.02	LOAD SPD CTRL PTR		0	
77.03	HOLD RAMP		0.2 s	
77.04	CURRENT X1 FWD		0 A	
77.05	REF Y1 FWD		0 rpm	
77.06	CURRENT X2 FWD		0 A	
77.07	REF Y2 FWD		0 rpm	
77.08	CURRENT X3 FWD		0 A	
77.09	REF Y3 FWD		0 rpm	
77.10	CURRENT X4 FWD		0 A	
77.11	REF Y4 FWD		0 rpm	
77.12	CURRENT X1 REV		0 A	
77.13	REF Y1 REV		0 rpm	
77.14	CURRENT X2 REV		0 A	

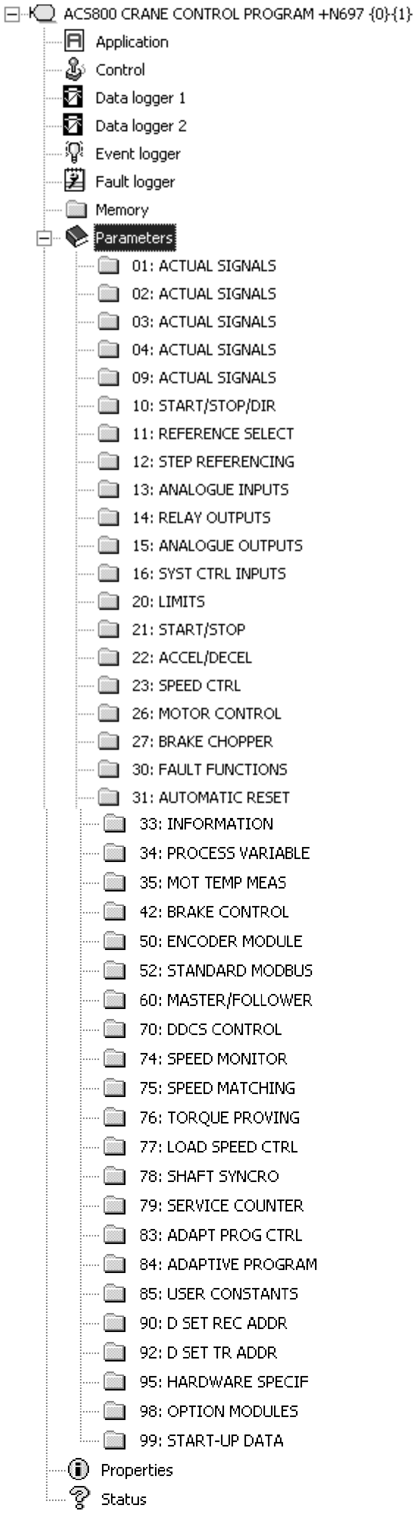
Index	Name/Selection	User	Default	PB
77.15	REF Y2 REV		0 rpm	
77.16	CURRENT X3 REV		0 A	
77.17	REF Y3 REV		0 rpm	
77.18	CURRENT X4 REV		0 A	
77.19	REF Y4 REV		0 rpm	
77.20	BASE SPEED		1500 rpm	
78	SHAFT SYNCRO			
78.01	SYNCRO CONTROL		OFF	1519
78.02	SYNCRO GAIN		1.0	1520
78.03	SHAFT SCALE		1.0	1521
78.04	POS SCALE		1.0 P/mm	1522
78.05	POS CORR MAX LIM		10.00 mm	1523
78.06	POS CORR MIN LIM		-10.00 mm	1524
78.07	SYNC ERR FLT DLY		2 s	1525
78.08	SYNC CORR SCALE		1 rpm	1526
78.09	SYNC ERR LIM		10.0 mm	1527
78.10	HOME POSITION		0 mm	1528
78.12	SYNC CORR MODE		OFFSET	1530
78.13	POS HYSTERISIS		5 mm	1531
79	SERVICE COUNTER			
79.01	BRAKE CTR RESET		NO	1537
79.02	RESET OPT TIME		NO	1538
83	ADAPT PROG CTRL			
83.01	ADAPT PROG CMD		EDIT	1609
83.02	EDIT COMMAND		NO	1610
83.03	EDIT BLOCK		0	1611
83.04	TIMELEVEL SEL		100 ms	1612
83.05	PASSCODE		0	1613
84	ADAPTIVE PROGRAM			
84.01	STATUS		8h	1628
84.02	FAULTED PAR		+.000.000.00	1629
84.05	BLOCK1		NO	1630
84.06	INPUT1		0	1631
84.07	INPUT2		0	1632
84.08	INPUT3		0	1633
84.09	OUTPUT		0	1634
…	…			… 1644
84.79	OUTPUT		0	-
85	USER CONSTANTS			
85.01	CONSTANT1		0	1645
85.02	CONSTANT2		0	1646
85.03	CONSTANT3		0	1647
85.04	CONSTANT4		0	1648
85.05	CONSTANT5		0	1649
85.06	CONSTANT6		0	1650
85.07	CONSTANT7		0	1651
85.08	CONSTANT8		0	1652
85.09	CONSTANT9		0	1653
85.10	CONSTANT10		0	1654
85.11	STRING1		MESSAGE1	1655
85.12	STRING2		MESSAGE2	1656
85.13	STRING3		MESSAGE3	1657
85.14	STRING4		MESSAGE4	1658
85.15	STRING5		MESSAGE5	1659
90	D SET REC ADDR			
90.01	AUX DS REF3		0	1735
90.02	AUX DS REF4		0	1736

Index	Name/Selection	User	Default	PB
90.03	AUX DS REF5		0	1737
90.04	AUX DS REF6		0	1738
90.05	AUX DS REF7		0	1739
90.06	AUX DS REF8		0	1740
90.07	START DS REC		1	1741
92	D SET TR ADDR			
92.01	MAIN DS STATUS WORD		302	1771
92.02	MAIN DS ACT1		102	1772
92.03	MAIN DS ACT2		105	1773
92.04	AUX1 DS ACT3		0	1774
92.05	AUX1 DS ACT4		0	1775
92.06	AUX1 DS ACT5		0	1776
92.07	AUX2 DS ACT6		0	1777
92.08	AUX2 DS ACT7		0	1778
92.09	AUX2 DS ACT8		0	1779
92.10	MSW B10 PTR		+.003.014.09	1780
92.11	MSW B13 PTR		0	1781
92.12	MSW B14 PTR		0	1782
92.13	START DS TRA		2	1783
95	HARDWARE SPECIF			
95.01	FAN SPD CTRL MODE	CONTROLLED		1825
95.02	FUSE SWITCH CTRL	Inverter type dependent		1826
95.03	INT CONFIG USER		0	1827
95.04	EX/SIN REQUEST		NO	1828
95.05	ENA INC SW FREQ		0	1829
95.06	LCU Q PW REF		0	1830
95.07	LCU DC REF		0	1831
95.08	LCU PAR1 SEL		106	1832
95.09	LCU PAR2 SEL		110	1833
95.10	TEMP INV AMBIENT		40°C	1834
96	EXTERNAL AO			
96.01	EXT AO1 PTR		SPEED	1843
96.02	INVERT EXT AO1		NO	1844
96.03	MINIMUM EXT AO1		0 mA	1845
96.04	FILTER EXT AO1		0.01 s	1846
96.05	SCALE EXT AO1		100%	1847
96.06	EXT AO2 PTR		CURRENT	1848
96.07	INVERT EXT AO2		NO	1849
96.08	MINIMUM EXT AO2		0 mA	1850
96.09	FILTER EXT AO2		2.00 s	1851
96.10	SCALE EXT AO2		100%	1852
96.11	EXT AO1 PTR		0	1853
96.12	EXT AO2 PTR		0	1854
97	MOTOR MODEL			
97.12	EM STOP DIO		NO	
97.16	SPD CORR PTR		+.000.000.00	
97.17	APL LIM WRN MASK		0000 0011 1111 1000 b (binary mode)	
97.18	PWRON STRTINT PTR		+.001.017.06	
97.19	SYNC ERR BLK LVL		0 mm	
97.20	PWR ACK START DLY		0.00 s	
97.21	ZERO SPEED PTR		+.000.000.00	
98	OPTION MODULES			
98.01	ENCODER MODULE		NO	1901
98.02	COMM. MODULE LINK		NO	1902
98.03	DI/O EXT MODULE 1		NO	1903
98.04	DI/O EXT MODULE 2		NO	1904
98.05	DI/O EXT MODULE 3		NO	1905

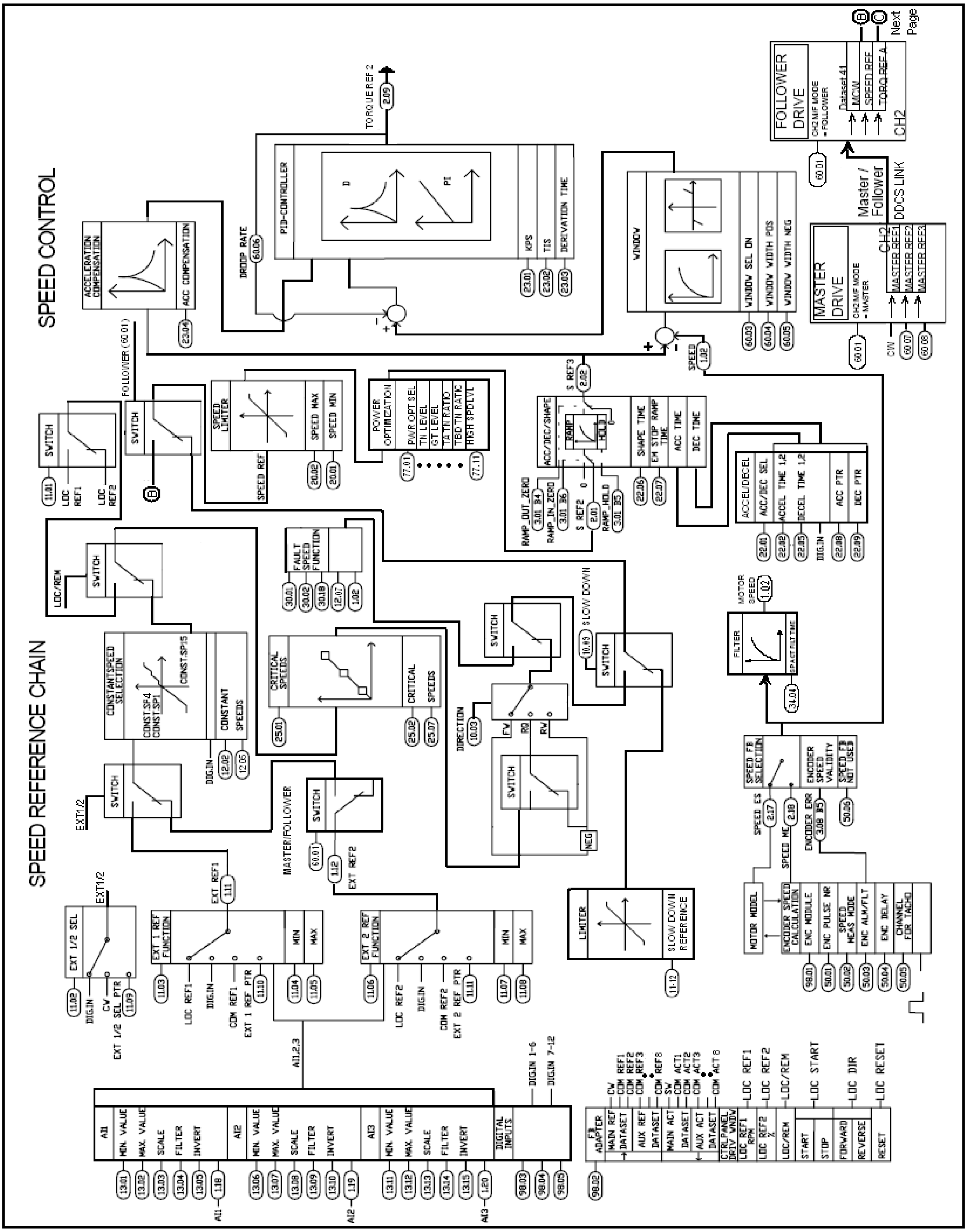
Index	Name/Selection	User	Default	PB
98.06	AI/O EXT MODULE		NO	1906
98.07	COMM PROFILE		ABB DRIVES	1907
98.12	AI/O MOTOR TEMP		NO	1912
98.13	AI/O EXT AI1 FUNC		UNIPOLAR AI5	1913
98.14	AI/O EXT AI2 FUNC		UNIPOLAR AI6	1914
98.16	SIN FILT SUPERV		NO	1915
99	START-UP DATA			
99.01	LANGUAGE		ENGLISH	1926
99.02	APPLICATION MACRO		CRANE	1927
99.03	APPLIC RESTORE		NO	1928
99.04	MOTOR CTRL MODE		DTC	1929
99.05	MOTOR NOM VOLTAGE		0 V	1930
99.06	MOTOR NOM CURRENT		0.0 A	1931
99.07	MOTOR NOM FREQ		50.0 Hz	1932
99.08	MOTOR NOM SPEED		2900 rpm	1933
99.09	MOTOR NOM POWER		0.0 kW	1934
99.10	MOTOR ID RUN MODE		ID MAGN	1935
99.11	DEVICE NAME		ACS800 CRANE CONTROL	1936
99.12	OEM SIGNAL		ACS800 CRANE CONTROL	1937

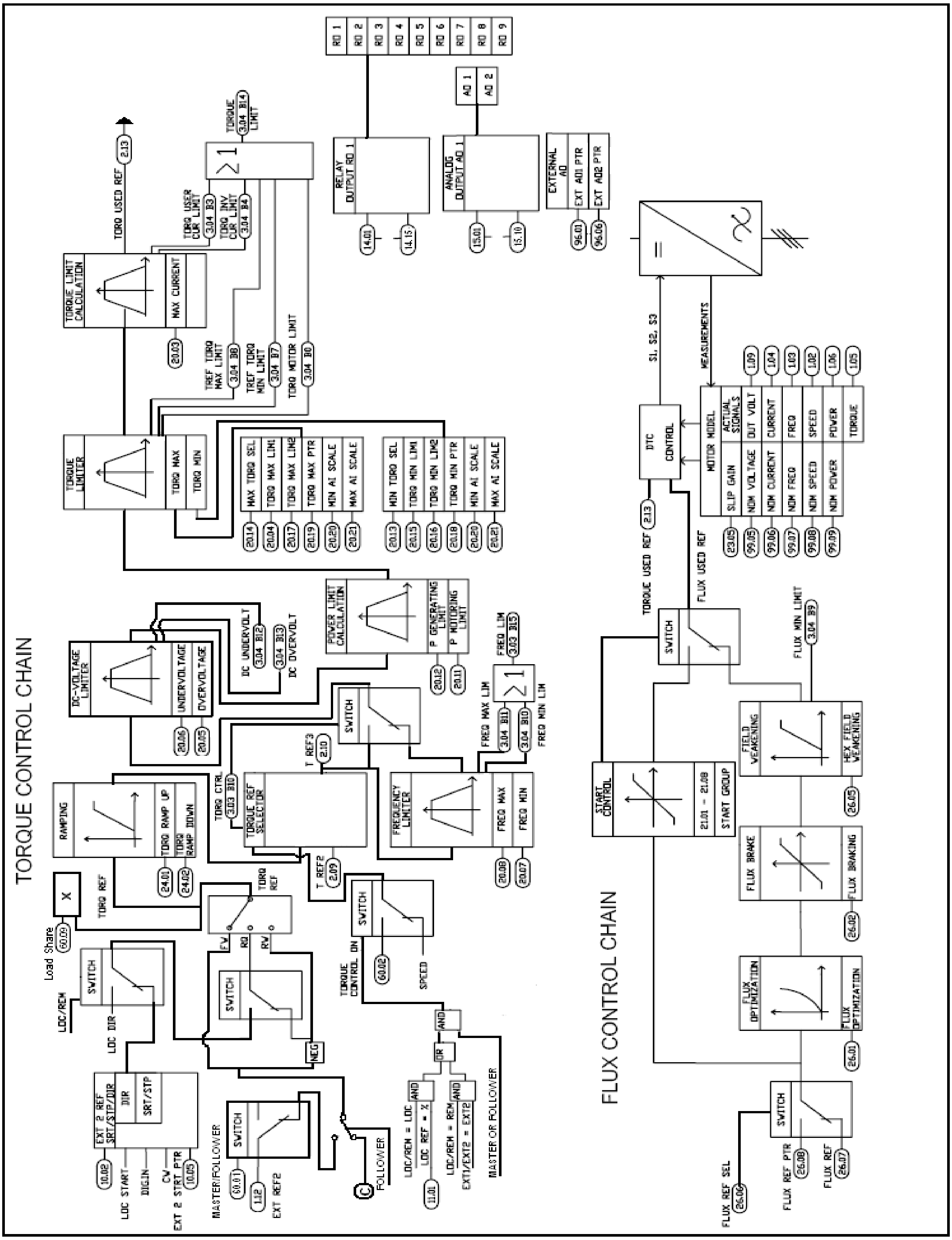
DriveWindow

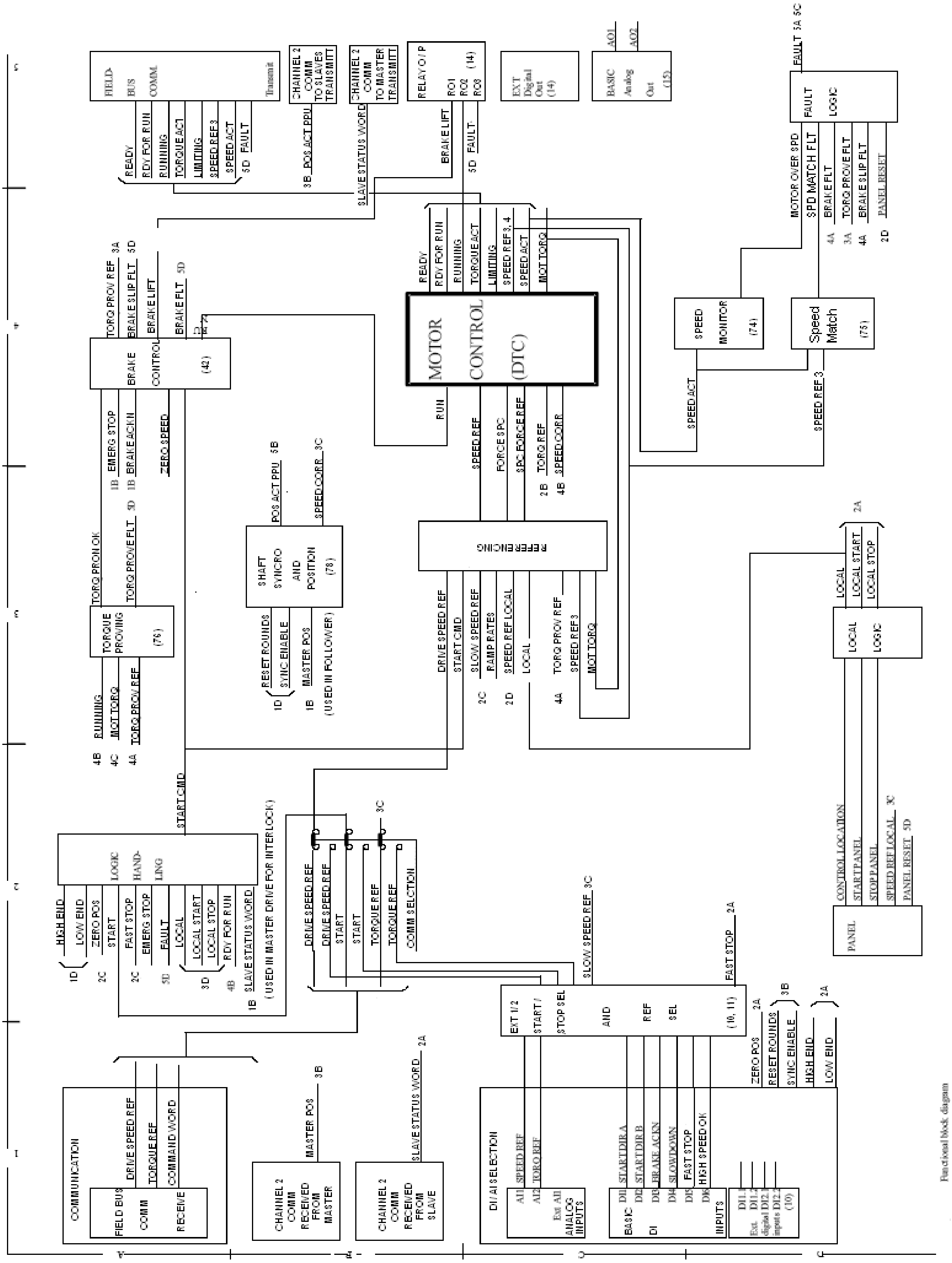
DriveWindow connected to the ACS800 RMIO/RDCO board and channel CH3.



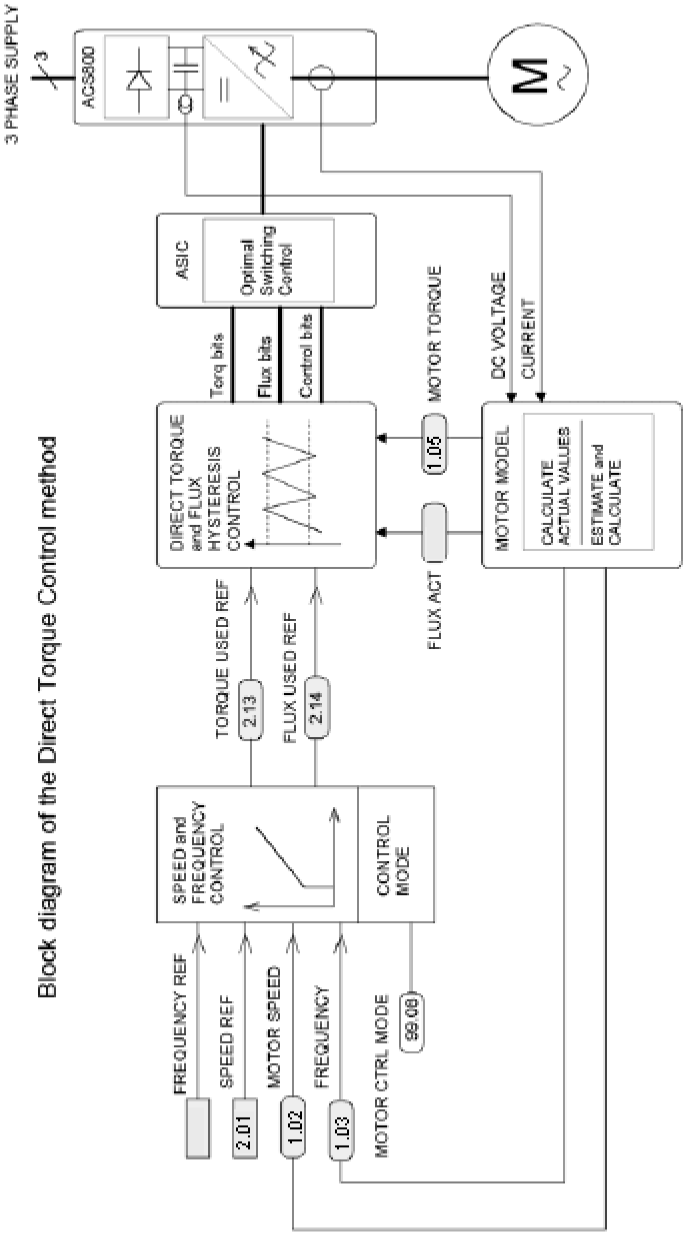
Control block diagrams




TORQUE CONTROL CHAIN
FLUX CONTROL CHAIN
EXT 2 REF SRT/STP/DIR
DIR
SRT/STP
LOC START
DIGIN
CV
EXT 2 STRT PTR
MASTER/FOLLOWER
EXT REF2
FOLLOWER
MASTER OR FOLLOWER
LOC/REM = LOC
LOC REF = X
LOC/REM = REM
EXT1/EXT2 = EXT2
AND
OR
NEG
SWITCH
LOC/REM
LOC DIR
Load Share
X
TORQ REF
RAMPING
TORQ RAMP UP
TORQ RAMP DOWN
FV
RQ
RV
TORQUE CONTROL ON
SPEED
T REF2
T REF3
TORQUE REF SELECTOR
TORQ CTRL
FREQUENCY LIMITER
FREQ MAX
FREQ MIN
FREQ MAX LIM
FREQ MIN LIM
FREQ LIM
DC-VOLTAGE LIMITER
UNDERVOLTAGE
OVERVOLTAGE
DC UNDERVOLT
DC OVERVOLT
POWER LIMIT CALCULATION
P GENERATING LIMIT
P MOTORING LIMIT
TORQUE LIMITER
TORQ MAX
TORQ MIN
MAX TORQ SEL
TORQ MAX LIM1
TORQ MAX LIM2
TORQ MAX PTR
MIN AI SCALE
MAX AI SCALE
MIN TORQ SEL
TORQ MIN LIM1
TORQ MIN LIM2
TORQ MIN PTR
TREF TORQ MAX LIMIT
TREF TORQ MIN LIMIT
TORQ MOTOR LIMIT
TORQUE LIMIT CALCULATION
MAX CURRENT
TORQ USER CUR LIMIT
TORQ INV CUR LIMIT
TORQUE LIMIT
TORQ USED REF
RELAY OUTPUT RO 1
RO 1
RO 2
RO 3
RO 4
RO 5
RO 6
RO 7
RO 8
RO 9
ANALOG OUTPUT AO 1
AO 1
AO 2
EXTERNAL AO
EXT AO1 PTR
EXT AO2 PTR
S1, S2, S3
MEASUREMENTS
DTC CONTROL
TORQUE USED REF
FLUX USED REF
MOTOR MODEL
SLIP GAIN
NOM VOLTAGE
NOM CURRENT
NOM FREQ
NOM SPEED
NOM POWER
ACTUAL SIGNALS
OUT VOLT
CURRENT
FREQ
SPEED
POWER
TORQUE
START CONTROL
21.01 - 21.09
START GROUP
FIELD WEAKENING
MIN FIELD WEAKENING
FLUX MIN LIMIT
FLUX BRAKE
FLUX BRAKING
FLUX OPTIMIZATION
FLUX REF SEL
FLUX REF PTR
FLUX REF


MOTOR CONTROL (DTC)
REFERENCING
COMMUNICATION
FIELD BUS COMM RECEIVE
CHANNEL 2 COMM RECEIVED FROM MASTER
CHANNEL 2 COMM RECEIVED FROM SLAVE
DI / AI SELECTION
EXT I/2 START / STOP SEL AND REF SEL (10, 11)
LOGIC HAND-LING
TORQUE PROVING (76)
BRAKE CONTROL (42)
SHAFT SYNCRO AND POSITION (78)
LOCAL LOGIC
PANEL
SPEED MONITOR (74)
Speed Match (75)
FAULT LOGIC
FIELD-BUS COMM. Transmit
CHANNEL 2 COMM TO SLAVES TRANSMITT
CHANNEL 2 COMM TO MASTER TRANSMITT
RELAY O / P
Functional block diagram

Block diagram of the Direct Torque Control method



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