8

Modbus RTU control through the embedded fieldbus interface (EFB)
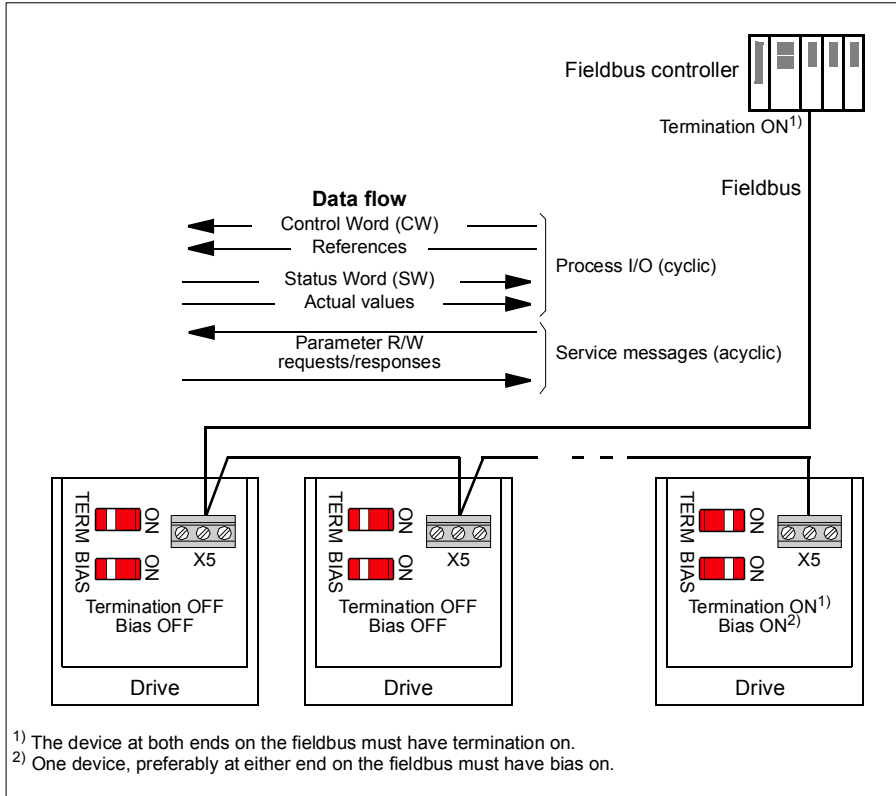
What this chapter contains

The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

System overview

The drive can be connected to an external control system through a communication link using either a fieldbus adapter or the embedded fieldbus interface.

The embedded fieldbus interface supports the Modbus RTU protocol. The drive control program can handle 10 Modbus registers in a 10-millisecond time level. For example, if the drive receives a request to read 20 registers, it will start its response within 22 ms of receiving the request – 20 ms for processing the request and 2 ms overhead for handling the bus. The actual response time depends on other factors as well, such as the baud rate (a parameter setting in the drive).

The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the embedded fieldbus interface and other available sources, for example, digital and analog inputs.

Data flow

1) The device at both ends on the fieldbus must have termination on.
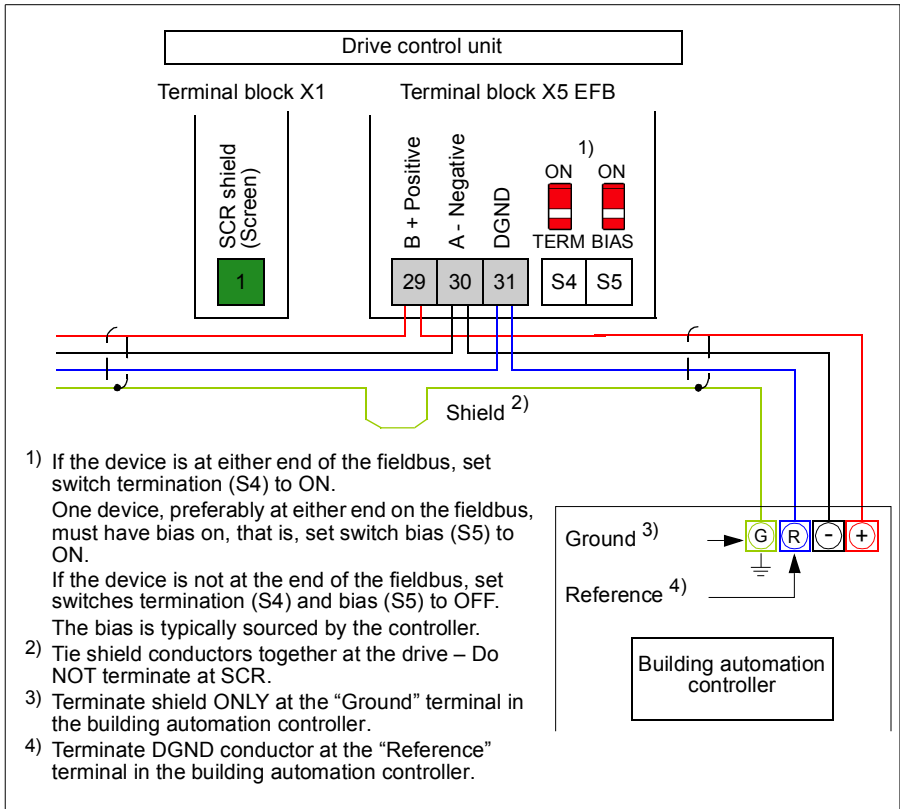2) One device, preferably at either end on the fieldbus must have bias on.

Connecting the drive to the fieldbus

Connect terminal block X5 on the control unit of the drive to the fieldbus. The connection diagram is shown below.

See also chapter *BACnet MS/TP control through the embedded fieldbus interface (EFB)*, section *Hardware installation* (page *244*).

Use preferably three conductors and a shield for the connection.

1) If the device is at either end of the fieldbus, set switch termination (S4) to ON.
   One device, preferably at either end on the fieldbus, must have bias on, that is, set switch bias (S5) to ON.
   If the device is not at the end of the fieldbus, set switches termination (S4) and bias (S5) to OFF.
   The bias is typically sourced by the controller.
2) Tie shield conductors together at the drive – Do NOT terminate at SCR.
3) Terminate shield ONLY at the "Ground" terminal in the building automation controller.
4) Terminate DGND conductor at the "Reference" terminal in the building automation controller.

Setting up the embedded fieldbus interface

Set the drive up for the embedded fieldbus communication with the parameters shown in the table below. The **Setting for fieldbus control** column gives either the value to use or the default value. The **Function/Information column** gives a description of the parameter.

Parameter		Setting for fieldbus control	Function/Information
COMMUNICATION INITIALIZATION			
58.01	*Protocol enable*	*Modbus RTU*	Initializes embedded fieldbus communication.
EMBEDDED MODBUS CONFIGURATION			
58.03	*Node address*	1 (default)	Node address. There must be no two nodes with the same node address online.
58.04	*Baud rate*	*19.2 kbps* (default)	Defines the communication speed of the link. Use the same setting as in the master station.
58.05	*Parity*	*8 EVEN 1* (default)	Selects the parity and stop bit setting. Use the same setting as in the master station.
58.14	*Communication loss action*	*No* (default)	Defines the action taken when a communication loss is detected.
58.15	*Communication loss mode*	*Cw / Ref1 / Ref2* (default)	Enables/disables communication loss monitoring and defines the means for resetting the counter of the communication loss delay.
58.16	*Communication loss time*	30.0 s (default)	Defines the timeout limit for the communication monitoring.
58.17	*Transmit delay*	0 ms (default)	Defines a response delay for the drive.
58.25	*Control profile*	*ABB Drives* (default)	Selects the control profile used by the drive. See section *Basics of the embedded fieldbus interface* (page *219*).
58.26 *58.27*	*EFB ref1 type* *EFB ref2 type*	*Speed or frequency* (default for *58.26*), *Transparent*, *General*, *Speed*, *Frequency*	Defines the types of fieldbus references 1 and 2. The scaling for each reference type is defined by parameters *46.01*…*46.03*. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.
58.28 *58.29*	*EFB act1 type* *EFB act2 type*	*Speed or frequency* (default for *58.28*), *Transparent* (default for *58.29*), *General*, *Speed*, *Frequency*	Defines the types of actual values 1 and 2. The scaling for each actual value type is defined by parameters *46.01*…*46.03*. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.

Parameter	Setting for fieldbus control	Function/Information
58.31 *EFB act1* *58.32* *transparent source* *EFB act2 transparent source*	*Not selected*	Defines the source of actual values 1 and 2 when the *58.26 EFB ref1 type* (*58.27 EFB ref2 type*) is set to *Transparent*.
58.33 *Addressing mode*	*Mode 0* (default)	Defines the mapping between parameters and holding registers in the 400001…465536 (100…65535) Modbus register range.
58.34 *Word order*	*LO-HI* (default)	Defines the order of the data words in the Modbus message frame.
58.101 *Data I/O 1* … … *58.114* *Data I/O 14*	For example, the default settings (I/Os 1…6 contain the control word, the status word, two references and two actual values) *RO/DIO control word*, *AO1 data storage*, *AO2 data storage*, *Feedback data storage*, *Setpoint data storage*	Defines the address of the drive parameter which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus In/Out parameters. Select the parameters that you want to read or write through the Modbus I/O words. These settings write the incoming data into storage parameters *10.99 RO/DIO control word*, *13.91 AO1 data storage*, *13.92 AO2 data storage*, *40.91 Feedback data storage* or *40.92 Setpoint data storage*.
58.06 *Communication control*	*Refresh settings*	Validates the settings of the configuration parameters.

The new settings will take effect when the drive is powered up the next time, or when they are validated by parameter *58.06 Communication control* (*Refresh settings*).

Setting the drive control parameters

After the embedded fieldbus interface has been set up, check and adjust the drive control parameters listed in the table below. The **Setting for fieldbus control** column gives the value or values to use when the embedded fieldbus signal is the desired source or destination for that particular drive control signal. The **Function/Information** column gives a description of the parameter.

Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.

Parameter	Setting for fieldbus control	Function/Information
20.06 Ext2 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.

SPEED REFERENCE SELECTION		
22.11 Ext1 speed ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as speed reference 1.
22.18 Ext2 speed ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as speed reference 2.

FREQUENCY REFERENCE SELECTION		
28.11 Ext1 frequency ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as frequency reference 1.
28.15 Ext2 frequency ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as frequency reference 2.

OTHER SELECTIONS
EFB references can be selected as the source at virtually any signal selector parameter by selecting *Other*, then either *03.09 EFB reference 1* or *03.10 EFB reference 2*.

SYSTEM CONTROL INPUTS		
96.07 Parameter save manually	*Save* (reverts to *Done*)	Saves parameter value changes (including those made through fieldbus control) to permanent memory.

Basics of the embedded fieldbus interface

The cyclic communication between a fieldbus system and the drive consists of 16-bit data words or 32-bit data words (with a transparent control profile).

The diagram below illustrates the operation of the embedded fieldbus interface. The signals transferred in the cyclic communication are explained further below the diagram.

1. See also other parameters which can be controlled through fieldbus.
2. Data conversion if parameter *58.25 Control profile* is set to *ABB Drives*. See section *About the control profiles* (page *222*).
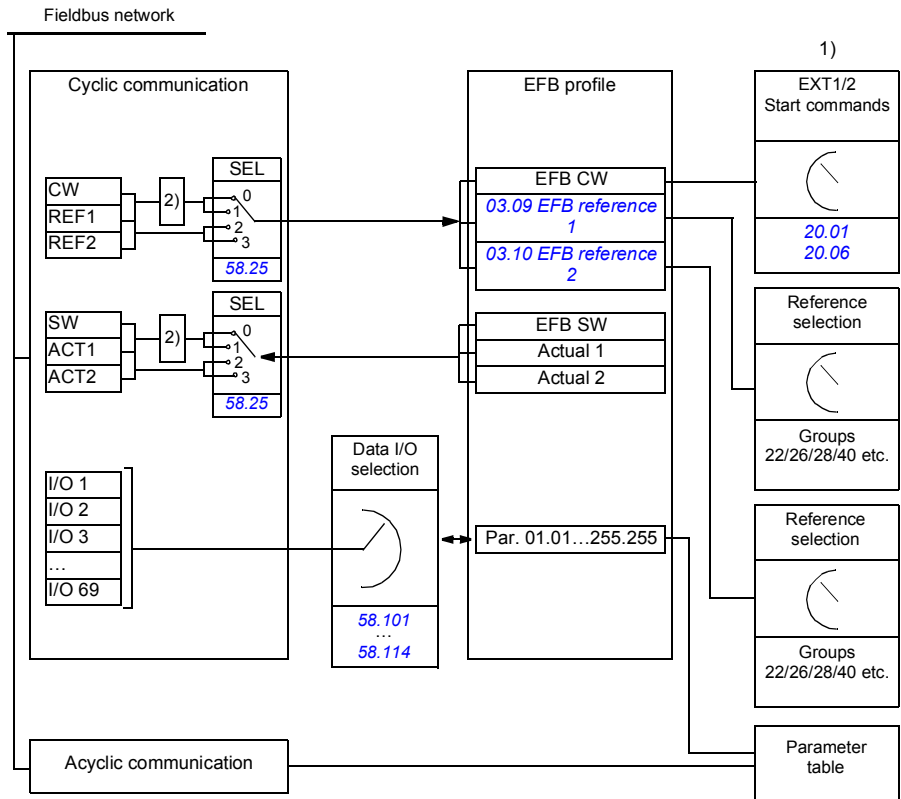
■   **Control word and Status word**

The Control Word (CW) is a 16-bit or 32-bit packed boolean word. It is the principal means of controlling the drive from a fieldbus system. The CW is sent by the fieldbus controller to the drive. With drive parameters, the user selects the EFB CW as the source of drive control commands (such as start/stop, emergency stop, selection between external control locations 1/2, or fault reset). The drive switches between its states according to the bit-coded instructions of the CW.

The fieldbus CW is either written to the drive as it is or the data is converted. See section *About the control profiles* (page *222*).

The fieldbus Status Word (SW) is a 16-bit or 32-bit packed boolean word. It contains status information from the drive to the fieldbus controller. The drive SW is either written to the fieldbus SW as it is or the data is converted. See section *About the control profiles* (page *222*).

■   **References**

EFB references 1 and 2 are 16-bit or 32-bit signed integers. The contents of each reference word can be used as the source of virtually any signal, such as the speed, frequency, torque or process reference. In embedded fieldbus communication, references 1 and 2 are displayed by *03.09 EFB reference 1* and *03.10 EFB reference 2* respectively. Whether the references are scaled or not depends on the settings of *58.26 EFB ref1 type* and *58.27 EFB ref2 type*. See section *About the control profiles* (page *222*).

■   **Actual values**

Fieldbus actual signals (ACT1 and ACT2) are 16-bit or 32-bit signed integers. They convey selected drive parameter values from the drive to the master. Whether the actual values are scaled or not depends on the settings of *58.28 EFB act1 type* and *58.29 EFB act2 type*. See section *About the control profiles* (page *222*).

■   **Data input/outputs**

Data input/outputs are 16-bit or 32-bit words containing selected drive parameter values. Parameters *58.101 Data I/O 1* … *58.114 Data I/O 14* define the addresses from which the master either reads data (input) or to which it writes data (output).

■   **Register addressing**

The address field of Modbus requests for accessing holding registers is 16 bits. This allows the Modbus protocol to support addressing of 65536 holding registers.

Historically, Modbus master devices used 5-digit decimal addresses from 40001 to 49999 to represent holding register addresses. The 5-digit decimal addressing limited to 9999 the number of holding registers that could be addressed.

Modern Modbus master devices typically provide a means to access the full range of 65536 Modbus holding registers. One of these methods is to use 6-digit decimal addresses from 400001 to 465536. This manual uses 6-digit decimal addressing to represent Modbus holding register addresses.

Modbus master devices that are limited to the 5-digit decimal addressing may still access registers 400001 to 409999 by using 5-digit decimal addresses 40001 to 49999. Registers 410000-465536 are inaccessible to these masters.

See parameter *58.33 Addressing mode*.

Note: Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

About the control profiles

A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- if packed boolean words are converted and how
- if signal values are scaled and how
- how drive register addresses are mapped for the fieldbus master.

You can configure the drive to receive and send messages according to one of the two profiles:

- *ABB Drives*
- *DCU Profile*.

For the ABB Drives profile, the embedded fieldbus interface of the drive converts the fieldbus data to and from the native data used in the drive. The DCU Profile involves no data conversion or scaling. The figure below illustrates the effect of the profile selection.

Control profile selection with parameter *58.25 Control profile* is:
- (0) *ABB Drives*
- (5) *DCU Profile*.
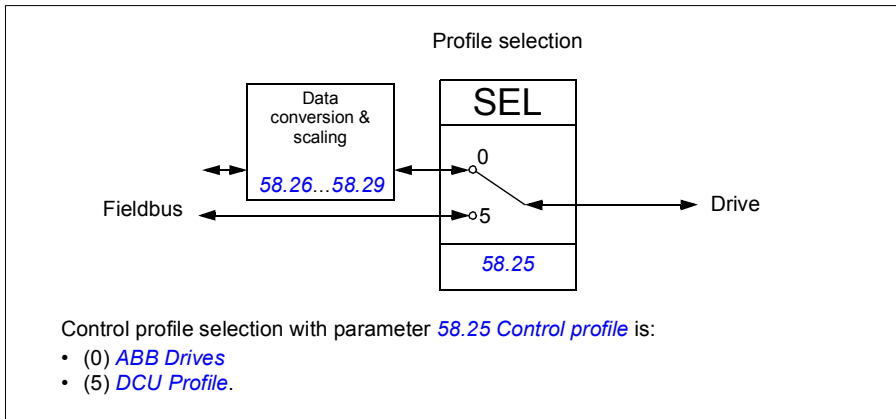
Control Word

■ Control Word for the ABB Drives profile

The table below shows the contents of the fieldbus Control Word for the ABB Drives control profile. The embedded fieldbus interface converts this word to the form in which it is used in the drive. The upper case boldface text refers to the states shown in *State transition diagram for the ABB Drives profile* on page *230*.

Bit	Name	Value	STATE/Description
0	OFF1_ CONTROL	1	Proceed to READY TO OPERATE.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2_ CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	OFF3_ CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. **Warning:** Ensure that the motor and driven machine can be stopped using this stop mode.
3	INHIBIT_ OPERATION	1	Proceed to **OPERATION ENABLED**. **Note:** Run permissive signal must be active; see the drive documentation. If the drive is set to receive the Run permissive signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	RAMP_OUT_ ZERO	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp Function Generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.

Bit	Name	Value	STATE/Description
8	Reserved		
9	Reserved		
10	REMOTE_CMD	1	Fieldbus control d.
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus control d. Reference and deceleration/acceleration ramp are locked.
11	EXT_CTRL_LOC	1	Select External Control Location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.
		0	Select External Control Location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.
12	USER_0		Writable control bits that can be combined with drive logic for application-specific functionality.
13	USER_1		
14	USER_2		
15	USER_3		

■ **Control Word for the DCU Profile**

The embedded fieldbus interface writes the fieldbus Control Word as is to the drive Control Word bits 0 to 15. Bits 16 to 32 of the drive Control Word are not in use.

Bit	Name	Value	State/Description
0	STOP	1	Stop according to the Stop Mode parameter or the stop mode request bits (bits 7…9).
		0	(no op)
1	START	1	Start the drive.
		0	(no op)
2	REVERSE	1	Reverse direction of motor rotation.
		0	Direction of motor rotation depends on the sign of reference: Positive reference: Forward Negative reference: Reverse.
3	Reserved		
4	RESET	0=>1	Fault reset if an active fault exists.
		0	(no op)
5	EXT2	1	Select External control location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.
		0	Select External control location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.

Bit	Name	Value	State/Description
6	RUN_DISABLE	1	Run disable. If the drive is set to receive the run enable signal from the fieldbus, this bit deactivates the signal.
		0	Run enable. If the drive is set to receive the run enable signal from the fieldbus, this bit activates the signal.
7	STOPMODE_RAMP	1	Normal ramp stop mode
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
8	STOPMODE_EMERGENCY_RAMP	1	Emergency ramp stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
9	STOPMODE_COAST	1	Coast stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
10	RAMP_PAIR _2	1	Select ramp set 2 (Acceleration time 2 / Deceleration time 2) when parameter *23.11 Ramp set selection* is set to *EFB DCU CW bit 10*.
		0	Select ramp set 1 (Acceleration time 1 / Deceleration time 1) when parameter *23.11 Ramp set selection* is set to *EFB DCU CW bit 10*.
11	RAMP_OUT_ZERO	1	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
		0	Normal operation.
12	RAMP_HOLD	1	Halt ramping (Ramp Function Generator output held).
		0	Normal operation.
13	RAMP_IN_ZERO	1	Force Ramp Function Generator input to zero.
		0	Normal operation.
14	REQ_LOCAL_LOCK	1	Drive does not switch to local control mode (see parameter *19.18 HAND/OFF disable source*).
		0	Drive can switch between local and external control modes.
15	TORQ_LIM_PAIR _2	1	Select torque limit set 2 (Minimum torque 2 / Maximum torque 2) when parameter *30.18 Torq lim sel* is set to *EFB*.
		0	Select torque limit set 1 (Minimum torque 1 / Maximum torque 1) when parameter *30.18 Torq lim sel* is set to *EFB*.
16	FB_LOCAL_CTL	1	Local mode for control from the fieldbus is requested. Steal control from the active source.
		0	(no op)
17	FB_LOCAL_REF	1	Local mode for reference from the fieldbus is requested. Steal reference from the active source.
		0	(no op)
18	Reserved for RUN_DISABLE_1		Not yet implemented.

Bit	Name	Value	State/Description
19	Reserved		
20	Reserved		
21	Reserved		
22	USER_0		Writable control bits that can be combined with drive logic for application-specific functionality.
23	USER_1		
24	USER_2		
25	USER_3		
26…31	Reserved		

Status Word

■ **Status Word for the ABB Drives profile**

The table below shows the fieldbus Status Word for the ABB Drives control profile.
The embedded fieldbus interface converts the drive Status Word into this form for the
fieldbus. The upper case boldface text refers to the states shown in *State transition
diagram for the ABB Drives profile* on page *230*.

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_STATUS	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	OFF_3_STATUS	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 (is within tolerance limits, for example, in speed control, speed error is 10% max. of nominal motor speed).
		0	Actual value differs from Reference (is outside tolerance limits).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	ABOVE_LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation. Set by drive parameters: *46.31 Above speed limit* and *46.32 Above frequency limit*. These parameters are indicated by bit 10 of *06.11 Main status word*.
		0	Actual frequency or speed within supervision limit.

Bit	Name	Value	STATE/Description
11	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
12	USER_1		
13	USER_2		
14	USER_3		
15	Reserved		

■ **Status Word for the DCU Profile**

The embedded fieldbus interface writes the drive Status Word bits 0 to 15 to the fieldbus Status Word as is. Bits 16 to 32 of the drive Status Word are not in use.
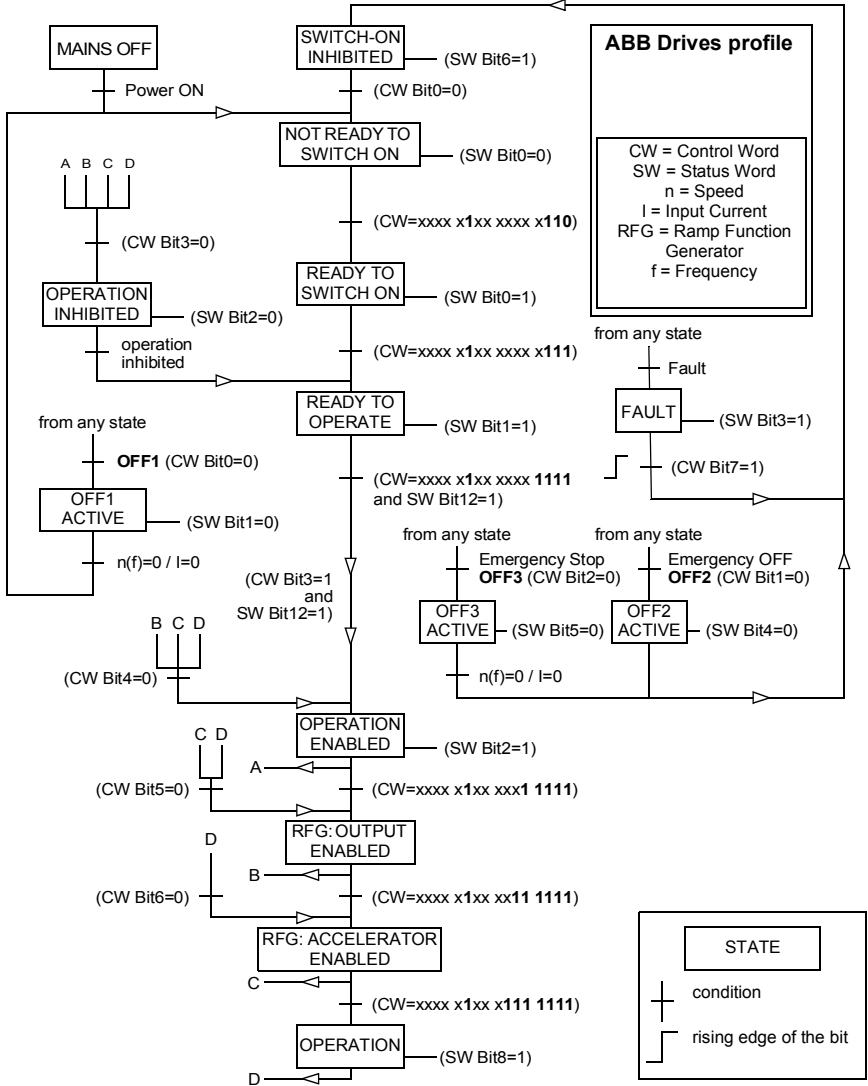
Bit	Name	Value	State/Description
0	READY	1	Drive is ready to receive the start command.
		0	Drive is not ready.
1	ENABLED	1	Run permissive and all start interlocks are active.
		0	Run permissive and all start interlocks are not active.
2	STARTED	1	Drive has received start command.
		0	Drive has not received start command.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	ZERO_SPEED	1	Drive is at zero speed.
		0	Drive is not at zero speed.
5	ACCELERATING	1	Drive speed is increasing.
		0	Drive speed is not increasing.
6	DECELERATING	1	Drive speed is decreasing.
		0	Drive speed is not decreasing.
7	AT_SETPOINT	1	Drive is at setpoint.
		0	Drive is not at setpoint.
8	LIMIT	1	Drive operation is limited.
		0	Drive operation is not limited.
9	SUPERVISION	1	Actual value (speed, frequency or torque) is above a limit. Limit is set with parameters 46.31…46.
		0	Actual value (speed, frequency or torque) is within limits.
10	REVERSE_REF	1	Drive reference is in the reverse direction.
		0	Drive reference is in the forward direction
11	REVERSE_ACT	1	Drive is running in the reverse direction
		0	Drive is running in the forward direction
12	PANEL_LOCAL	1	Panel/keypad (or PC tool) is in local control mode.
		0	Panel/keypad (or PC tool) is not in local control mode.

Bit	Name	Value	State/Description
13	FIELDBUS_LOCAL	1	Fieldbus is in local control mode.
		0	Fieldbus is not in local control mode.
14	EXT2_ACT	1	External control location EXT2 is active.
		0	External control location EXT1 is active.
15	FAULT	1	Drive is faulted.
		0	Drive is not faulted.
16	ALARM	1	Warning/Alarm is active.
		0	No warning/alarm.
17	Reserved		
18	DIRLOCK	1	Direction lock is ON. (Direction change is locked out.)
		0	Direction lock is OFF.
19	LOCALLOCK	1	Local mode lock is ON. (Local mode is locked out.)
		0	Local mode lock is OFF.
20	Reserved		
21	Reserved		
22	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
23	USER_1		
24	USER_2		
25	USER_3		
26	REQ_CTL	1	Control has been granted to this channel.
		0	Control has not been granted to this channel.
27	REQ_REF1	1	Reference 1 has been requested in this channel.
		0	Reference 1 has not been requested in this channel.
28	REQ_REF2	1	Reference 2 has been requested in this channel.
		0	Reference 2 has not been requested in this channel.
29…31	Reserved		

State transition diagrams

■ **State transition diagram for the ABB Drives profile**

The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile and the drive is configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections *Control Word for the ABB Drives profile* on page *223* and *Status Word for the ABB Drives profile* on page *227*.

MAINS OFF	SWITCH-ON INHIBITED —— (SW Bit6=1)		**ABB Drives profile**
+ Power ON	+ (CW Bit0=0)		
	NOT READY TO SWITCH ON —— (SW Bit0=0)		CW = Control Word
A B C D			SW = Status Word
	+ (CW=xxxx x1xx xxxx **x110**)		n = Speed
+ (CW Bit3=0)			I = Input Current
	READY TO SWITCH ON —— (SW Bit0=1)		RFG = Ramp Function Generator
OPERATION INHIBITED —— (SW Bit2=0)			f = Frequency
operation inhibited	+ (CW=xxxx x1xx xxxx **x111**)		
	READY TO OPERATE —— (SW Bit1=1)		from any state
from any state			+ Fault
+ **OFF1** (CW Bit0=0)	+ (CW=xxxx x1xx xxxx **1111** and SW Bit12=1)		FAULT —— (SW Bit3=1)
OFF1 ACTIVE —— (SW Bit1=0)			⌐ + (CW Bit7=1)
+ n(f)=0 / I=0	(CW Bit3=1 and SW Bit12=1)	from any state	from any state
		Emergency Stop **OFF3** (CW Bit2=0)	Emergency OFF **OFF2** (CW Bit1=0)
B C D		OFF3 ACTIVE —— (SW Bit5=0)	OFF2 ACTIVE —— (SW Bit4=0)
(CW Bit4=0) +		+ n(f)=0 / I=0	
	OPERATION ENABLED —— (SW Bit2=1)		
C D	A ◁		
(CW Bit5=0) +	+ (CW=xxxx x1xx xxx**1 1111**)		
	RFG: OUTPUT ENABLED		
D	B ◁		
(CW Bit6=0) +	+ (CW=xxxx x1xx xx**11 1111**)		
	RFG: ACCELERATOR ENABLED		STATE
	C ◁		
	+ (CW=xxxx x1xx x**111 1111**)		+ condition
	OPERATION —— (SW Bit8=1)		⌐ rising edge of the bit
	D ◁		

The start and stop sequences are given below.

Control word:

Start:

- 476h –> NOT READY TO SWITCH ON
- If MSW bit 0 = 1 then
    - 477h –> READY TO SWITCH ON (Stopped)
    - 47Fh –> OPERATION (Running)

Stop:

- 477h = Stop according to *21.03 Stop mode*
- 47Eh = OFF1 ramp stop (Note: uninterruptable ramp stop)

Fault reset:

- Rising edge of MCW bit 7

Start after STO:

- If *31.22 STO indication run/stop* is not Fault/ Fault, check that *06.18 Start inhibit status word*, bit 7 STO = 0 before giving a start command.

References

■ **References for the ABB Drives profile and DCU Profile**

The ABB Drives profile supports the use of two references, EFB reference 1 and EFB reference 2. The references are 16-bit words each containing a sign bit and a 15-bit integer. A negative reference is formed by calculating the two's complement from the corresponding positive reference.

The references are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type* (see page *516*).
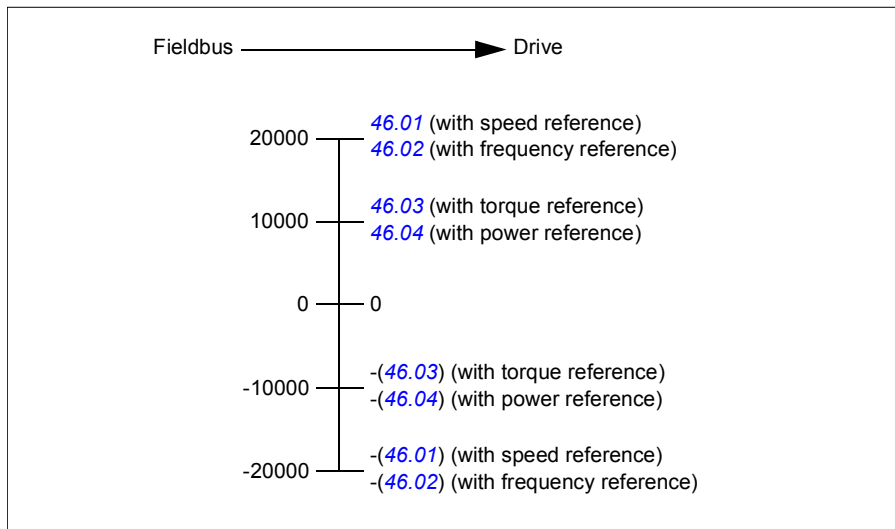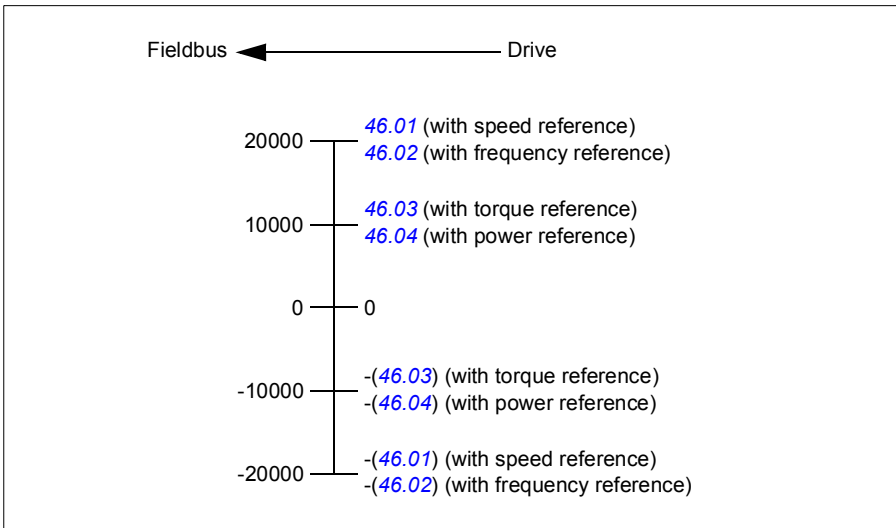

The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

Actual values

■ **Actual values for the ABB Drives profile and DCU Profile**

The ABB Drives profile supports the use of two fieldbus actual values, ACT1 and ACT2. The actual values are 16-bit words each containing a sign bit and a 15-bit integer. A negative value is formed by calculating the two's complement from the corresponding positive value.

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *58.28 EFB act1 type* and *58.29 EFB act2 type* (see page *516*).

Fieldbus ◄─────────────── Drive
20000 ─┬─ *46.01* (with speed reference)
46.02 (with frequency reference)
10000 ─┼─ *46.03* (with torque reference)
46.04 (with power reference)
0 ─┼─ 0
-10000 ─┼─ -(*46.03*) (with torque reference)
-(*46.04*) (with power reference)
-20000 ─┴─ -(*46.01*) (with speed reference)
-(*46.02*) (with frequency reference)

Modbus holding register addresses

■ Modbus holding register addresses for the ABB Drives profile and DCU Profile

The table below shows the default Modbus holding register addresses for the drive data with the ABB Drives profile. This profile provides a converted 16-bit access to the drive data.

Note: Only the 16 least significant bits of the drive's 32-bit Control and Status Words can be accessed.

Note: Bits 16 through 32 of the DCU Control/Status word are not in use if 16-bit control/status word is used with the DCU Profile.

Register address	Register data (16-bit words)
400001	Default: Control word (*CW 16bit*). See sections *Control Word for the ABB Drives profile* (page *223*) and *Control Word for the DCU Profile* (page *224*). The selection can be changed using parameter *58.101 Data I/O 1*.
400002	Default: Reference 1 (*Ref1 16bit*). The selection can be changed using parameter *58.102 Data I/O 2*.
400003	Default: Reference 2 (*Ref2 16bit*). The selection can be changed using parameter *58.102 Data I/O 2*.
400004	Default: Status Word (*SW 16bit*). See sections *Status Word for the ABB Drives profile* (page *227*) and *Status Word for the DCU Profile* (page *228*). The selection can be changed using parameter *58.102 Data I/O 2*.
400005	Default: Actual value 1 (*Act1 16bit*). The selection can be changed using parameter *58.105 Data I/O 5*.
400006	Actual value 2 (*Act2 16bit*). The selection can be changed using parameter *58.106 Data I/O 6*.
400007…400014	Data in/out 7…14. Selected by parameters *58.107 Data I/O 7*…*58.114 Data I/O 14*.
400015…400089	Unused
400090…400100	Error code access. See section *Error code registers (holding registers 400090…400100)* (page *242*).
400101…465536	Parameter read/write. Parameters are mapped to register addresses according to parameter *58.33 Addressing mode*.

Modbus function codes

The table below shows the Modbus function codes supported by the embedded fieldbus interface.

Code	Function name	Description
01h	Read Coils	Reads the 0/1 status of coils (0X references).
02h	Read Discrete Inputs	Reads the 0/1 status of discrete inputs (1X references).
03h	Read Holding Registers	Reads the binary contents of holding registers (4X references).
05h	Write Single Coil	Forces a single coil (0X reference) to 0 or 1.
06h	Write Single Register	Writes a single holding register (4X reference).
08h	Diagnostics	Provides a series of tests for checking the communication, or for checking various internal error conditions. Supported subcodes: • 00h Return Query Data: Echo/loopback test. • 01h Restart Comm Option: Restarts and initializes the EFB, clears communications event counters. • 04h Force Listen Only Mode • 0Ah Clear Counters and Diagnostic Register • 0Bh Return Bus Message Count • 0Ch Return Bus Comm. Error Count • 0Dh Return Bus Exception Error Count • 0Eh Return Slave Message Count • 0Fh Return Slave No Response Count • 10h Return Slave NAK (negative acknowledge) Count • 11h Return Slave Busy Count • 12h Return Bus Character Overrun Count • 14h Clear Overrun Counter and Flag
0Bh	Get Comm Event Counter	Returns a status word and an event count.
0Fh	Write Multiple Coils	Forces a sequence of coils (0X references) to 0 or 1.
10h	Write Multiple Registers	Writes the contents of a contiguous block of holding registers (4X references).
16h	Mask Write Register	Modifies the contents of a 4X register using a combination of an AND mask, an OR mask, and the register's current contents.
17h	Read/Write Multiple Registers	Writes the contents of a contiguous block of 4X registers, then reads the contents of another group of registers (the same or different than those written) in a server device.

Code	Function name	Description
2Bh / 0Eh	Encapsulated Interface Transport	Supported subcodes: • 0Eh Read Device Identification: Allows reading the identification and other information. Supported ID codes (access type): • 00h: Request to get the basic device identification (stream access) • 04h: Request to get one specific identification object (individual access) Supported Object IDs: • 00h: Vendor Name ("ABB") • 01h: Product Code (for example, "AHVKx") • 02h: Major Minor Revision (combination of contents of parameters *07.05 Firmware version* and *58.02 Protocol ID*). • 03h: Vendor URL ("www.abb.com") • 04h: Product name: ("ACH580").

Exception codes

The table below shows the Modbus exception codes supported by the embedded fieldbus interface.

Code	Name	Description
01h	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server.
02h	ILLEGAL ADDRESS	The data address received in the query is not an allowable address for the server.
03h	ILLEGAL VALUE	The requested quantity of registers is larger than the device can handle. This error does not mean that a value written to the device is outside of the valid range.
04h	DEVICE FAILURE	An unrecoverable error occurred while the server was attempting to perform the requested action. See section *Error code registers (holding registers 400090…400100)* on page *242*.

Coils (0xxxx reference set)

Coils are 1-bit read/write values. Control Word bits are exposed with this data type. The table below summarizes the Modbus coils (0xxxx reference set). Note that the references are 1-based index which match the address transmitted on the wire.

Reference	ABB Drives profile	DCU Profile
000001	OFF1_CONTROL	STOP
000002	OFF2_CONTROL	START
000003	OFF3_CONTROL	Reserved
000004	INHIBIT_OPERATION	Reserved
000005	RAMP_OUT_ZERO	RESET
000006	RAMP_HOLD	EXT2
000007	RAMP_IN_ZERO	RUN_DISABLE
000008	RESET	STOPMODE_RAMP
000009	Not for ACH580/ACQ580	STOPMODE_EMERGENCY_RAMP
000010	Not for ACH580/ACQ580	STOPMODE_COAST
000011	REMOTE_CMD	Reserved
000012	EXT_CTRL_LOC	RAMP_OUT_ZERO
000013	USER_0	RAMP_HOLD
000014	USER_1	RAMP_IN_ZERO
000015	USER_2	Reserved
000016	USER_3	Reserved
000017	Reserved	FB_LOCAL_CTL
000018	Reserved	FB_LOCAL_REF
000019	Reserved	Reserved
000020	Reserved	Reserved
000021	Reserved	Reserved
000022	Reserved	Reserved
000023	Reserved	USER_0
000024	Reserved	USER_1
000025	Reserved	USER_2
000026	Reserved	USER_3
000027	Reserved	Reserved
000028	Reserved	Reserved
000029	Reserved	Reserved
000030	Reserved	Reserved
000031	Reserved	Reserved
000032	Reserved	Reserved

Reference	ABB Drives profile	DCU Profile
000033	Control for relay output RO1 (parameter *10.99 RO/DIO control word*, bit 0)	Control for relay output RO1 (parameter *10.99 RO/DIO control word*, bit 0)
000034	Control for relay output RO2 (parameter *10.99 RO/DIO control word*, bit 1)	Control for relay output RO2 (parameter *10.99 RO/DIO control word*, bit 1)
000035	Control for relay output RO3 (parameter *10.99 RO/DIO control word*, bit 2)	Control for relay output RO3 (parameter *10.99 RO/DIO control word*, bit 2)
000036	Control for relay output RO4 (parameter *10.99 RO/DIO control word*, bit 3)	Control for relay output RO4 (parameter *10.99 RO/DIO control word*, bit 3)
000037	Control for relay output RO5 (parameter *10.99 RO/DIO control word*, bit 4)	Control for relay output RO5 (parameter *10.99 RO/DIO control word*, bit 4)

Discrete inputs (1xxxx reference set)

Discrete inputs are 1-bit read-only values. Status Word bits are exposed with this data type. The table below summarizes the Modbus discrete inputs (1xxxx reference set). Note that the references are 1-based index which match the address transmitted on the wire.

Reference	ABB Drives profile	DCU Profile
100001	RDY_ON	READY
100002	RDY_RUN	D
100003	RDY_REF	Reserved
100004	TRIPPED	RUNNING
100005	OFF_2_STATUS	ZERO_SPEED
100006	OFF_3_STATUS	Reserved
100007	SWC_ON_INHIB	Reserved
100008	ALARM	AT_SETPOINT
100009	AT_SETPOINT	LIMIT
100010	REMOTE	SUPERVISION
100011	ABOVE_LIMIT	Reserved
100012	USER_0	Reserved
100013	USER_1	PANEL_LOCAL
100014	USER_2	FIELDBUS_LOCAL
100015	USER_3	EXT2_ACT
100016	Reserved	FAULT
100017	Reserved	ALARM
100018	Reserved	Reserved
100019	Reserved	Reserved
100020	Reserved	Reserved
100021	Reserved	Reserved
100022	Reserved	Reserved
100023	Reserved	USER_0
100024	Reserved	USER_1
100025	Reserved	USER_2
100026	Reserved	USER_3
100027	Reserved	REQ_CTL
100028	Reserved	Reserved
100029	Reserved	Reserved
100030	Reserved	Reserved
100031	Reserved	Reserved
100032	Reserved	Reserved

Reference	ABB Drives profile	DCU Profile
100033	Delayed status of digital input DI1 (parameter *10.02 DI delayed status*, bit 0)	Delayed status of digital input DI1 (parameter *10.02 DI delayed status*, bit 0)
100034	Delayed status of digital input DI2 (parameter *10.02 DI delayed status*, bit 1)	Delayed status of digital input DI2 (parameter *10.02 DI delayed status*, bit 1)
100035	Delayed status of digital input DI3 (parameter *10.02 DI delayed status*, bit 2)	Delayed status of digital input DI3 (parameter *10.02 DI delayed status*, bit 2)
100036	Delayed status of digital input DI4 (parameter *10.02 DI delayed status*, bit 3)	Delayed status of digital input DI4 (parameter *10.02 DI delayed status*, bit 3)
100037	Delayed status of digital input DI5 (parameter *10.02 DI delayed status*, bit 4)	Delayed status of digital input DI5 (parameter *10.02 DI delayed status*, bit 4)
100038	Delayed status of digital input DI6 (parameter *10.02 DI delayed status*, bit 5)	Delayed status of digital input DI6 (parameter *10.02 DI delayed status*, bit 5)

Error code registers (holding registers 400090…400100)

These registers contain information about the last query. The error register is cleared when a query has finished successfully.

Reference	Name	Description
400090	Reset Error Registers	1 = Reset internal error registers (91…95). 0 = Do nothing.
400091	Error Function Code	Function code of the failed query.
400092	Error Code	Set when exception code 04h is generated (see table above). • 00h No error • 02h Low/High limit exceeded • 03h Faulty Index: Unavailable index of an array parameter • 05h Incorrect Data Type: Value does not match the data type of the parameter • 65h General Error: Undefined error when handling query
400093	Failed Register	The last register (discrete input, coil, input register or holding register) that failed to be read or written.
400094	Last Register Written Successfully	The last register (discrete input, coil, input register or holding register) that was written successfully.
400095	Last Register Read Successfully	The last register (discrete input, coil, input register or holding register) that was read successfully.