

# Softstarters

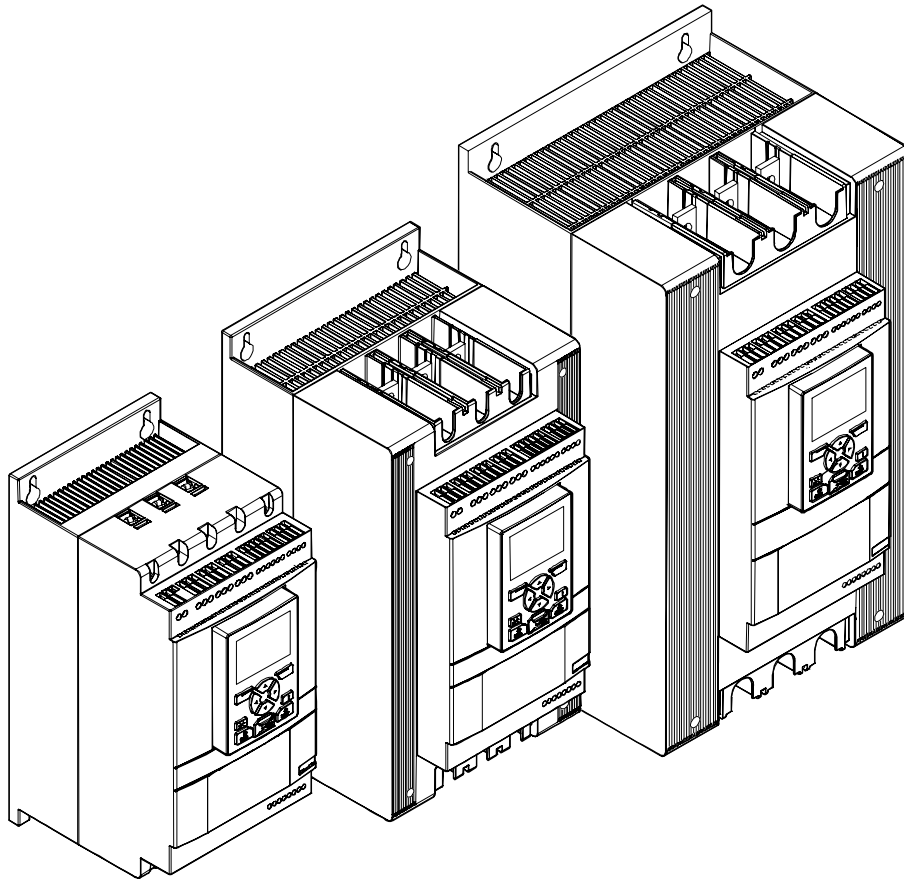
Type PSTX

Fieldbus communication, Fieldbus Plug

Modbus RTU

1SFC132092M0201

July 2014



The ABB logo, consisting of the letters 'ABB' in a bold, black, sans-serif font. The letter 'A' is stylized with a vertical line through its center.

# 1 Modbus RTU

The Modbus protocol is a fieldbus protocol that provides full control and status information of the softstarter, reading as well as writing of parameters. Through the fieldbus it is possible to start and stop the motor, read out currents and frequency, achieve information about protections, warnings, faults and much more. See chapter 8 in the Installation and commissioning manual, document 1SFC132081M0201, for available fieldbus related settings.

Before the Modbus RTU can be taken in operation following parameters must be set in the softstarter:  
Parameter *FB interface connector* set to *FbPlug*

- Parameter *Fieldbus control* set to *On*
- Parameter *Fieldbus address* set to an available Modbus slave id



## **Caution!**

*The motor may start unexpectedly if there is a start signal present when doing any of the actions listed below.*

- *Switching from one type of control to another (fieldbus control/hardwire control)*
- *Reset all Settings*

## 1.1 Digital input telegram

To PLC from the softstarter.

Word in input data area	Digital input byte	Bit	Data	Description
<b>0</b>	<b>0</b>	<b>0</b>	Auto Mode status <sup>1</sup>	0 = softstarter control from fieldbus not allowed
		<b>1</b>	Event status	0 = No active fault/warning/protection
		<b>2</b>	Ready To Start	0 = A start will probably cause a fault, 1 = A start will probably not cause a fault
		<b>3</b>	FBT Response 0	See Fieldbus Tasks
		<b>4</b>	FBT Response 1	See Fieldbus Tasks
		<b>5</b>	FBT Toggle Bit	See Fieldbus Tasks
		<b>6</b>	Programmable Digital Input 1	Function of programmable digital input, <a href="#">see table 1.2</a>
		<b>7</b>	Programmable Digital Input 2	
	<b>1</b>	<b>8 (0)</b>	Programmable Digital Input 3	
		<b>9 (1)</b>	Programmable Digital Input 4	
		<b>10 (2)</b>	Programmable Digital Input 5	
		<b>11 (3)</b>	Programmable Digital Input 6	
		<b>12 (4)</b>	Programmable Digital Input 7	
		<b>13 (5)</b>	Programmable Digital Input 8	
		<b>14 (6)</b>	Programmable Digital Input 9	
		<b>15 (7)</b>	Programmable Digital Input 10	

1) Auto mode reflects the control state of the Softstarter. This is affected by a combination of:

- The Auto mode input signal from the PLC (Digital output telegram).
- The state of the Local/Remote switch on the Fieldbus Plug Accessory.
- The state of the Local/Remote switch on the HMI.
- The parameter 'Fieldbus control'.
- The digital input 'Fieldbus disable'.

## 1.2 Programmable Digital Inputs

The functions of the programmable Digital inputs are controlled by the parameters *Fieldbus DI 1* through *Fieldbus DI 10*. The following functions are available for selection:

Function	Data
None	Value is set to 0.
Start feedback	Status of Start signal.
Stop feedback	Status of Stop signal.
Fault reset feedback	Status of Reset signal.
Slow speed reverse feedback	Status of Slow speed reverse signal.
Slow speed forward feedback	Status of Slow speed forward signal.
Start 1 feedback	Status of Start 1 signal.
Start 2 feedback	Status of Start 2 signal.
Start 3 feedback	Status of Start 3 signal.
Motor heating feedback	Status Motor heating signal.
User defined feedback	Status of User defined protection signal.
Stand still brake feedback	Status of Stand still brake signal.
Emergency mode feedback	Status of Emergency mode signal.
Start reverse feedback	Status of Start reverse signal.
Run status	1 = Indicates when the softstarter gives voltage to the motor.
TOR status	Top of Ramp. 1 = Indicates that motor runs on full voltage.
Line or Inside Delta Connection	0 = Line, 1 = Delta.
Phase sequence	0 = L1, L2, L3; 1 = L1, L3, L2.
Event group 0 status	0 = No active events present in group 0.
Event group 1 status	0 = No active events present in group 1.
Event group 2 status	0 = No active events present in group 2.
Event group 3 status	0 = No active events present in group 3.
Event group 4 status	0 = No active events present in group 4.
Event group 5 status	0 = No active events present in group 5.
Event group 6 status	0 = No active events present in group 6.
Sequence 1 Run status	Run status of sequence connected motor 1.
Sequence 2 Run status	Run status of sequence connected motor 2.
Sequence 3 Run status	Run status of sequence connected motor 3.
Sequence 1 TOR status	Top of Ramp status of sequence connected motor 1.
Sequence 2 TOR status	Top of Ramp status of sequence connected motor 2.
Sequence 3 TOR status	Top of Ramp status of sequence connected motor 3.
Run reverse status	1 = Indicates when the softstarter gives voltage to the motor after a reverse start.

### 1.3 Analog input telegram

To PLC from the softstarter.

All analog data is represented as 16-bit values.

A protocol for Fieldbus tasks is used to read and write parameters. It is applicable for all Fieldbuses.

Word in input data area	Analog input word	Data	Representation
1	0	FBT Return Value	See Fieldbus Tasks
2	1	Programmable Analog Input 1	Function of programmable analog input, <a href="#">see table 1.4.</a>
3	2	Programmable Analog Input 2	
4	3	Programmable Analog Input 3	
5	4	Programmable Analog Input 4	
6	5	Programmable Analog Input 5	
7	6	Programmable Analog Input 6	
8	7	Programmable Analog Input 7	
9	8	Programmable Analog Input 8	
10	9	Programmable Analog Input 9	
11	10	Programmable Analog Input 10	

## 1.4 Programmable Analog Inputs

The functions of the programmable analog inputs are controlled by the parameters *Fieldbus AI 1* through *Fieldbus AI 10*. The following functions are available for selection:

Function	Representation
None	Value is set to 0
Phase L1 current <sup>1</sup>	Value = 1000 ⇒ 100A
Phase L2 current <sup>1</sup>	Value = 1000 ⇒ 100A
Phase L3 current <sup>1</sup>	Value = 1000 ⇒ 100A
Active power (HP)	Value = 1000 ⇒ 10hp
Active power	Value = 1000 ⇒ 10kW
Apparent power	Value = 1000 ⇒ 10VA
Mains voltage	Value = 1000 ⇒ 100V
Power factor	Value = 100 ⇒ 1 Example: 87 ⇒ 0.87
Motor voltage	Value = 100 ⇒ 100%
Active energy (resettable)	Value = 1000 ⇒ 10kW
EOL time to trip	Value = 100 ⇒ 100s Value = 65535 ⇒ No overload Value = 0 ⇒ Trip already occurred
Mains frequency	Value = 1000 ⇒ 100Hz
Max phase current <sup>1</sup>	Value = 1000 ⇒ 100A
Motor current	Value = 1000 ⇒ 100A
Motor run time (resettable)	Value = 100 ⇒ 1000h
Motor temperature	Value = 100 ⇒ 100°C
Motor temperature percent	Value = 100 ⇒ 100%
Number of starts (resettable)	Value = 1 ⇒ 100
Phase sequence	Value = 0 ⇒ L1->L2->L3 Value = 1 ⇒ L1->L3->L2 Value = 2 ⇒ No sequence detected
PT100 temperature	Value = n ⇒ n/10 – 50°C Example: 750 ⇒ 25°C
PTC resistance	Value = 100 ⇒ 100Ω
Reactive energy (resettable)	Value = 1000 ⇒ 10kVAr
Reactive power	Value = 1000 ⇒ 100VAr
Remaining time to start	Value = 100 ⇒ 100s
Thyristor temperature	Value = 100 ⇒ 100°C
Thyristor temperature percent	Value = 100 ⇒ 100%
EOL time to cool	Value = 100 ⇒ 100s
Top event code	Value = 1000 ⇒ 1000
Motor current in percent of IE.	Value = 100 ⇒ 100%
Thyristor run time (resettable)	Value = 1 ⇒ 10h
Motor connection	Value = 0 ⇒ auto Value = 1 ⇒ In-line Value = 2 ⇒ Inside delta – UI Value = 3 ⇒ Inside delta – IU Value = 4 ⇒ 2-phase L1 shorted Value = 5 ⇒ 2-phase L2 shorted Value = 6 ⇒ 2-phase L3 shorted

1) Phase current L1, L2 and L3 indicate the current through the softstarter, while the Max phase current is **always** the line current.

## 1.5 Digital output telegram

From PLC to softstarter.

Word in output data area	Digital output byte	Bit	Data	Description
0	0	0	Start	Commence a start when signal is set.
		1	Stop	Commence a stop when signal is negated.
		2	Fault reset	Reset signal for possible events.
		3	Auto mode	This must be set for controlling the motor.
		4	Slow speed reverse	Perform slow speed reverse when signal is set.
		5	Slow speed forward	Perform slow speed when signal is set.
		7	Start1	Start1 if sequence start.
		8 (0)	Start2	Start2 if sequence start.
		9 (1)	Start3	Start3 if sequence start.
		10 (2)	Motor heating	Perform motor heating when signal is set.
		11 (3)	Stand still brake	Perform stand still brake when signal is set.
		12 (4)	Start reverse	Commence a reverse start when signal is set.
		14 (6)	Emergency mode	Set to "1" to enable emergency mode.
		15 (7)	FBT Toggle Bit	See Fieldbus Tasks.
		1	2	16 (0)
17 (1)	Spare			
18 (2)	Spare			
19 (3)	Spare			
20 (4)	Spare			
21 (5)	Spare			
22 (6)	Spare			
23 (7)	Spare			
24 (0)	Spare			
25 (1)	Spare			
26 (2)	Spare			
27 (3)	Spare			
28 (4)	Spare			
29 (5)	Spare			
30 (6)	Spare			
31 (7)	Spare			

## 1.6 Analog output telegram

From PLC to the softstarter.

All analog data is represented as 16-bit values.

Word in output data area	Analog output word	Data	Representation
2	0	FBT Control Word	See Fieldbus Tasks
3	1	FBT Argument 2	See Fieldbus Tasks
4	2	FBT Argument 3	See Fieldbus Tasks

## 1.7 Input address map

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
<b>0</b>	Digital In, Byte 1								Digital In, Byte 0							
<b>1</b>	Analog In, Word 0															
<b>2</b>	Analog In, Word 1															
<b>3</b>	Analog In, Word 2															
<b>4</b>	Analog In, Word 3															
<b>5</b>	Analog In, Word 4															
<b>6</b>	Analog In, Word 5															
<b>7</b>	Analog In, Word 6															
<b>8</b>	Analog In, Word 7															
<b>9</b>	Analog In, Word 8															
<b>10</b>	Analog In, Word 9															
<b>11</b>	Analog In, Word 10															

## 1.8 Output address map

	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
<b>0</b>	Digital Out, Byte 1								Digital Out, Byte 0							
<b>1</b>	Digital Out, Byte 3								Digital Out, Byte 2							
<b>2</b>	Analog Out, Word 0															
<b>3</b>	Analog Out, Word 1															
<b>4</b>	Analog Out, Word 2															



## 2 Modbus RTU - A set-up example

### 2.1 Softstarter PST Modbus RTU communication

This document describes an application example between a Modbus RTU master (PLC CPU, PC, etc.) and the ABB softstarter PSTX equipped with an Anybus Modbus-RTU module. In this example the softstarter address is 47.

Please always use the actual softstarter manuals. In this particular example following documents has been used:

- Modbus RTU FBP Fieldbus Plug MRP21. FBP technical description 2CDC194001D0203.
- Softstarter PSTX Installation and commissioning manual, document 1SFC132081M0201.

### 2.2 Settings

1. **Set the softstarter address and field bus communication.**

Change the address of the softstarter to 47 (*Fieldbus Address*) and enable fieldbus control (*Fieldbus control* = On).

2. **Set the communication parameters.**

The communication parameters are:

1 Start bit, 8 Data bits, the Parity will be adapted to the master. The baud rate is mapped to the slave address; e.g. the baud rate to the slave 47 is 19200.

Therefore the master and the slave will have the communication parameters:

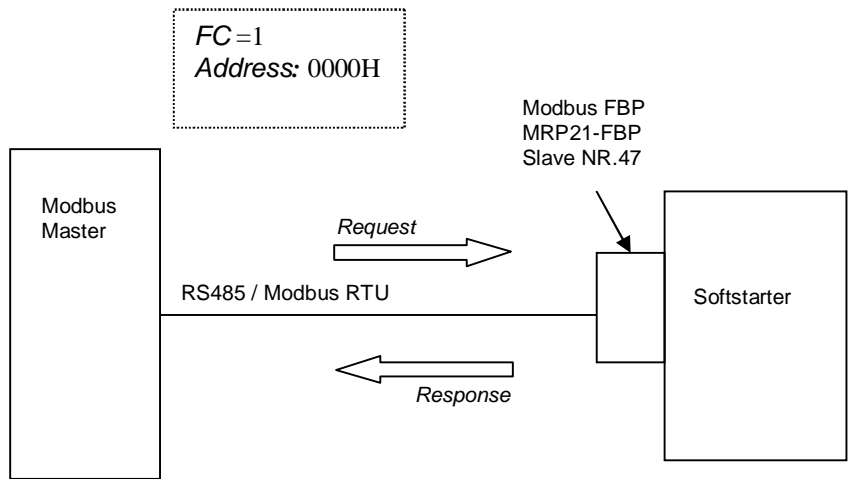
1 start bit, 1 stop bit, 8 data bit, even parity, 19200 baud.

3. **Select the FBP interface.**

The previous changes are taken in effect when the fieldbus interface is changed.

Change parameter *FB interface connector* to *FbPlug*.

### 2.3 Read binary input telegram



E.g: Read 16 bit starting at the address: 0000H

#### Request:

2F 01 00 00 00 10 3B 88

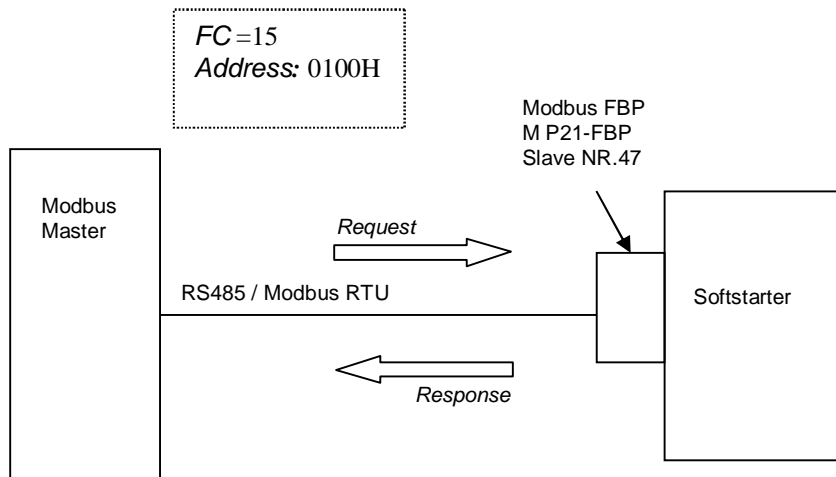
		}		}		}	
Slave 47	FC = 01	Address	16 bit	CRC			

#### Response:

2F 01 02 00 00 51 FA

		}			
Slave 47	FC = 01	2 Byte	CRC		

## 2.4 Write binary output telegram



E.g: Write 16 bit starting at the address: 0100H

### Request:

2F 0F 01 00 00 10 02 00 00 27 41

Slave 47  
FC = 15

Address      16 bit      2 Byte      CRC

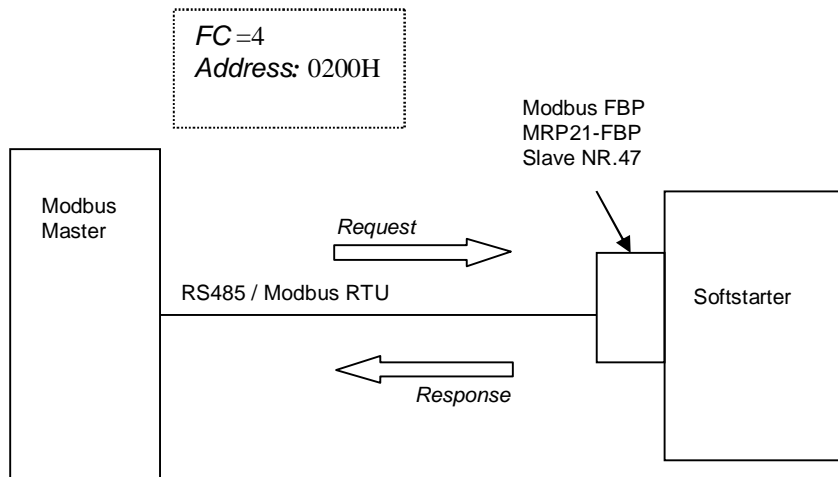
### Response:

2F 0F 01 00 00 10 53 B5

Slave 47  
FC = 15

Address      16 bit      CRC

## 2.5 Read analog input telegram



E.g: Read analog output words 2 & 3. Phase L1 current and Phase L2current with default settings.

### Request:

2F 04 02 01 00 02 27 FD

		}		}		}
Slave 47	FC = 04	Address	2 words	Output		

### Response:

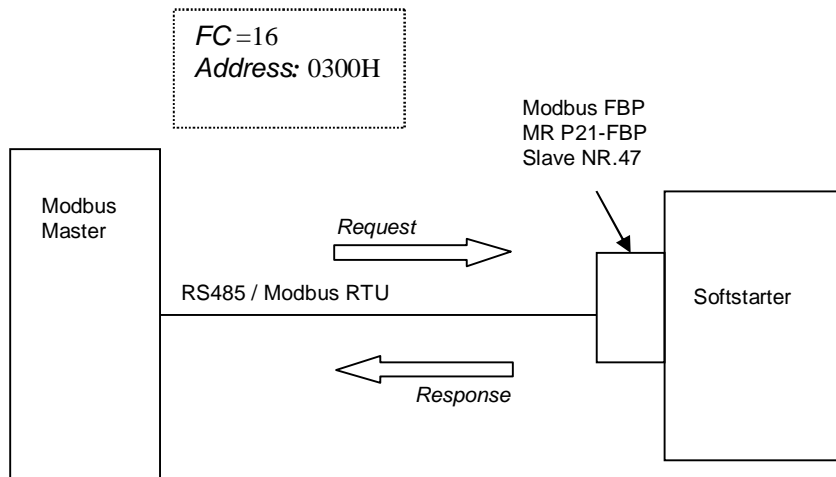
2F 04 04 00 00 00 00 35 86

		}		}		}	
Slave 47	FC = 04	4 Byte	W0	W1	CRC		

W0: Phase L1 current

W1: Phase L2 current

## 2.6 Write analog input telegram



E.g: Write analog output words 1 & 23. FBT Control Word and FBT Argument 2.

### Request:

2F 10 03 00 00 02 04 00 00 00 00 78 77

Slave 47  
FC = 16

Address      2 words      Address      W0      W1      CRC

W0: FBT Control Word  
W1: FBT Argument 2

### Response:

2F 10 03 00 00 02 47 C2

Slave 47  
FC = 16

Address      2 words      CRC

## 3 Fieldbus Tasks

By using Fieldbus Tasks it is possible to read and write parameters and set the real-time clock. Which task to execute is selected by filling in the *FBT Control Word*. There are three signals for arguments to the task:

- *FBT Argument 1* is packed together with the *Task ID* in the *FBT Control Word*.
- There are two additional 16-bit arguments in separate analog output signals, *FBT Argument 2* and *FBT Argument 3*.

To control when the task is executed, the digital output signal *FBT Toggle Bit* is changed. The softstarter will detect the change, execute the task, fill in the return values, and toggle the digital input signal *FBT Toggle Bit* as acknowledgement. Thus, the return values must be disregarded if the two toggle bits have different value.

### 3.1 FBT Control Word

The control word is a 16-bit analog output value sent from the PLC to the softstarter. It consists of a Task ID and an 11-bit argument packed together.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Task ID				Argument 1											

### 3.2 Task ID

The task identifier controls which function should be performed.

Task ID	Task	Response ID	
		Positive	Negative
0	No task	0	-
1	Request parameter value	1	2
2	Change parameter value	1	2
3	Set date and time	1	2

### 3.3 Response ID

The response ID is the softstarter response to a task. It tells whether a task was executed successfully. If there was an error, an additional error code is returned in the *FBT Return Value* analog input. The Response ID is transmitted as two digital input signals, *FBT Response 0* and *FBT Response 1*.

Response ID	FBT Response 1	FBT Response 0	Explanation
0	0	0	No response
1	0	1	Task executed
2	1	0	Task cannot be executed (with error number)
3	1	1	Reserved.

### 3.4 Error codes

The following error codes are sent when a task cannot be executed.

Error code	Explanation
0	Illegal parameter number
1	Parameter value cannot be changed
3	Lower or upper limit violated
4	Invalid argument
5	No error

### 3.5 Request parameter value

This task reads the current value of specified parameter. See chapter 3.8 for parameter number and value scaling.

#### 3.5.1 Arguments

- FBT Argument 1: parameter number.

#### 3.5.2 Return Value

- Response ID 1 and parameter value in FBT Return Value on success.
- Response ID 2 and error number in FBT Return Value on failure.

### 3.6 Change parameter value

This task writes a specified value to a parameter. See chapter 3.8 for parameter number and value scaling.

#### 3.6.1 Arguments

- FBT Argument 1: parameter number.
- FBT Argument 2: parameter value

#### 3.6.2 Return Value

- Response ID 1 on success.
- Response ID 2 and error number in FBT Return Value on failure.

### 3.7 Set date and time

This task updates the real-time clock on the softstarter. The date and time fields have the following limits:

- Year: 0-63 (2000-2063)
- Month: 1-12
- Day: 1-31
- Hour:0-23
- Minute:0-59
- Second:0-59
- 

#### 3.7.1 Arguments

- FBT Argument 2: year, month, day and least significant bit of seconds

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
s0	year						month				day				

- FBT Argument 3: hour, minute, seconds, bit 1-5

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
hour					minute						seconds, bit 1-5				

#### 3.7.2 Return Value

- Response ID 1 on success.
- Response ID 2 and error number in FBT Return Value on failure. In case the supplied time didn't differ from the set time, error code 5 (no error) is used.

### 3.8 Parameter numbers and values

To access parameters from the fieldbus a unique parameter number is needed, this can be found in document 1SFC132081M0201, chapter 7.20, Complete parameter list, Table 5.

Since the parameter values need to be represented as integers on the fieldbus while, the parameter values with greater precision need to be scaled. In document 1SFC132081M0201, Chapter 7.20 Complete parameter list, Table 5, there is a column specifying the number of decimals for each parameter.

- Parameter values that are read from the fieldbus needs to be divided by  $10^{\text{number of decimals}}$ .
- Parameters values that are written from the fieldbus needs to be multiplied by  $10^{\text{number of decimals}}$ .

**For example:**

The parameter Kick start time has parameter number 24 and 2 decimals. To read this parameter:

1. Set FBT Task ID to 1.
2. Set FBT Argument 1 to 24.
3. Toggle FBT Toggle Bit output and wait for the FBT Toggle Bit input to update.
4. Response ID 1 should now contain value 1, indicating success.
5. FBT Return Value contains the value 50 (this is an example and depends on the actual set value).
6. The return value should be interpreted as  $50/10^2 = 0.5\text{s}$ .

**To change the *Kick start time* parameter to 1s:**

1. Set FBT Task ID to 2.
2. Set FBT Argument 1 to 24.
3. Set FBT Argument 2 to  $1 \cdot 10^2 = 100$ .
4. Toggle FBT Toggle Bit output and wait for the FBT Toggle Bit input to update.
5. Response ID 1 should now contain value 1, indicating success.



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