

Softstarters

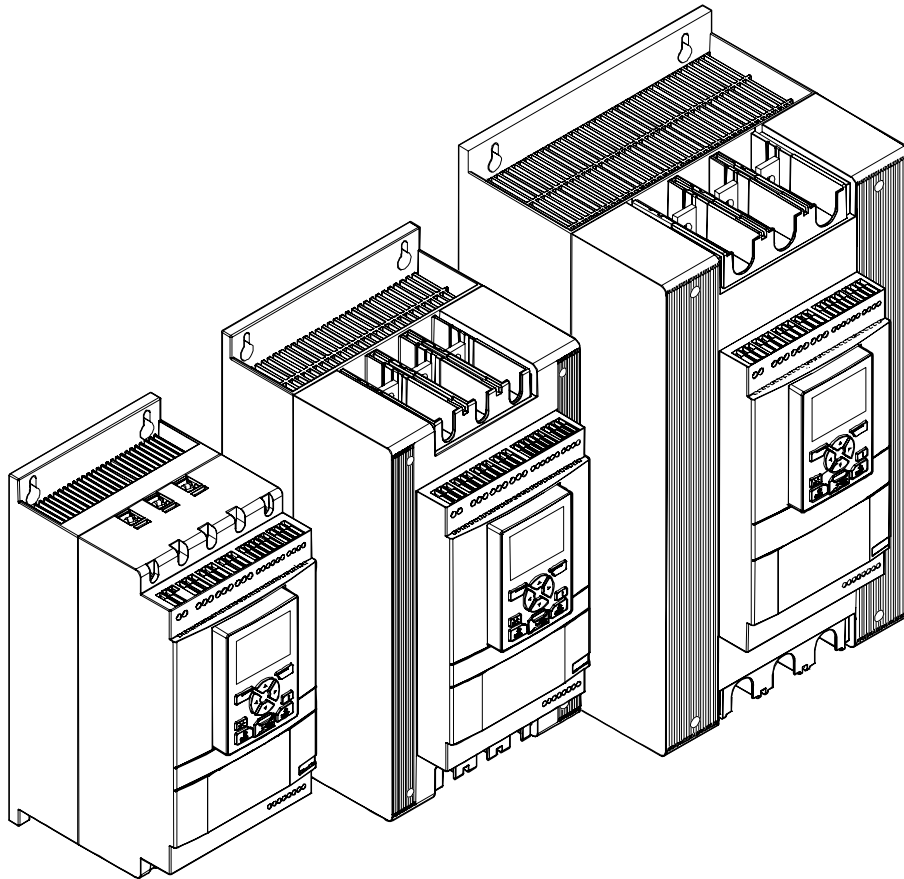
Type PSTX

Fieldbus communication, Anybus

Modbus TCP

1SFC132087M0201

July 2014



The ABB logo, consisting of the letters 'ABB' in a bold, black, sans-serif font. The letter 'A' is formed by two vertical bars and a horizontal bar, while the 'B's are solid blocks.

1 Modbus TCP

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 Anybus
- Parameter Fieldbus control set to On
- The parameters controlling the Anybus IP settings needs to be set to match existing network configuration:
 - Fieldbus IP address
 - Fieldbus IP gateway
 - Fieldbus IP net mask
 - Fieldbus IP DHCP client



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 |
|-------------------------|--------------------|---------------|-------------------------------|---|
| 0 | 0 | 0 | Auto Mode status ¹ | 0 = softstarter control from fieldbus not allowed |
| | | 1 | Event status | 0 = No active fault/warning/protection |
| | | 2 | Ready To Start | 0 = A start will probably cause a fault, 1 = A start will probably not cause a fault |
| | | 3 | FBT Response 0 | See Fieldbus Tasks |
| | | 4 | FBT Response 1 | See Fieldbus Tasks |
| | | 5 | FBT Toggle Bit | See Fieldbus Tasks |
| | | 6 | Programmable Digital Input 1 | Function of programmable digital input, see table 1.2 |
| | | 7 | Programmable Digital Input 2 | |
| | 1 | 8 (0) | Programmable Digital Input 3 | |
| | | 9 (1) | Programmable Digital Input 4 | |
| | | 10 (2) | Programmable Digital Input 5 | |
| | | 11 (3) | Programmable Digital Input 6 | |
| | | 12 (4) | Programmable Digital Input 7 | |
| | | 13 (5) | Programmable Digital Input 8 | |
| | | 14 (6) | Programmable Digital Input 9 | |
| | | 15 (7) | 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, see table 1.4. |
| 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 ¹ | Value = 1000 ⇒ 100A |
| Phase L2 current ¹ | Value = 1000 ⇒ 100A |
| Phase L3 current ¹ | 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 ¹ | 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 the 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 |
|-----------|--------------------|----|----|----|----|----|---|---|--------------------|---|---|---|---|---|---|---|
| 0 | Digital In, Byte 1 | | | | | | | | Digital In, Byte 0 | | | | | | | |
| 1 | Analog In, Word 0 | | | | | | | | | | | | | | | |
| 2 | Analog In, Word 1 | | | | | | | | | | | | | | | |
| 3 | Analog In, Word 2 | | | | | | | | | | | | | | | |
| 4 | Analog In, Word 3 | | | | | | | | | | | | | | | |
| 5 | Analog In, Word 4 | | | | | | | | | | | | | | | |
| 6 | Analog In, Word 5 | | | | | | | | | | | | | | | |
| 7 | Analog In, Word 6 | | | | | | | | | | | | | | | |
| 8 | Analog In, Word 7 | | | | | | | | | | | | | | | |
| 9 | Analog In, Word 8 | | | | | | | | | | | | | | | |
| 10 | Analog In, Word 9 | | | | | | | | | | | | | | | |
| 11 | 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 |
|----------|---------------------|----|----|----|----|----|---|---|---------------------|---|---|---|---|---|---|---|
| 0 | Digital Out, Byte 1 | | | | | | | | Digital Out, Byte 0 | | | | | | | |
| 1 | Digital Out, Byte 3 | | | | | | | | Digital Out, Byte 2 | | | | | | | |
| 2 | Analog Out, Word 0 | | | | | | | | | | | | | | | |
| 3 | Analog Out, Word 1 | | | | | | | | | | | | | | | |
| 4 | Analog Out, Word 2 | | | | | | | | | | | | | | | |

2 Modbus TCP - A set-up example

2.1 Softstarter PST Modbus TCP communication

This document describes an application example between a Modbus TCP master (PLC CPU, PC, etc.) and the ABB softstarter PSTX using the built-in Modbus TCP interface.

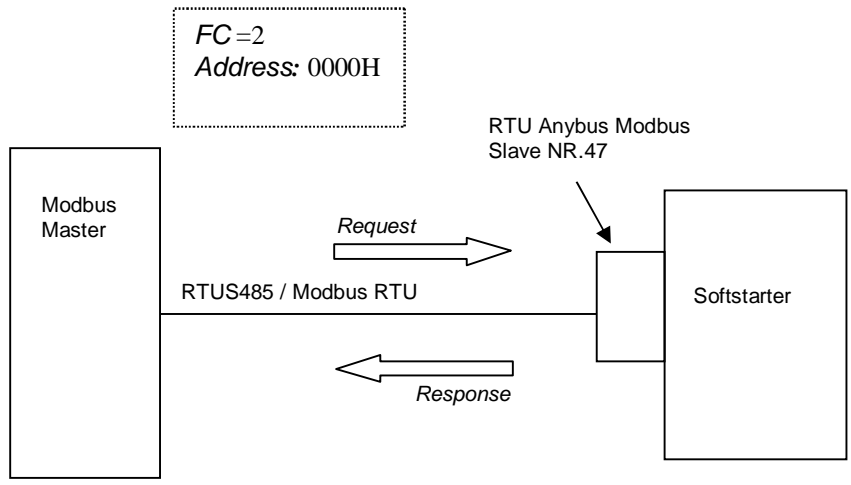
Please always use the actual softstarter manuals. In this particular example following documents has been used:

- 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.**
Change the communication parameters baud rate, parity, stop bits to match the Modbus network settings.
3. **Select the FBP interface.**
The previous changes are taken in effect when the fieldbus interface is changed. Change parameter *Com3 function* to *Modbus RTU Slave* and change parameter *FB interface connector* to *Modbus RTU*.

2.3 Read binary input telegram



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

Request:

2F 02 00 00 00 10 7F 88

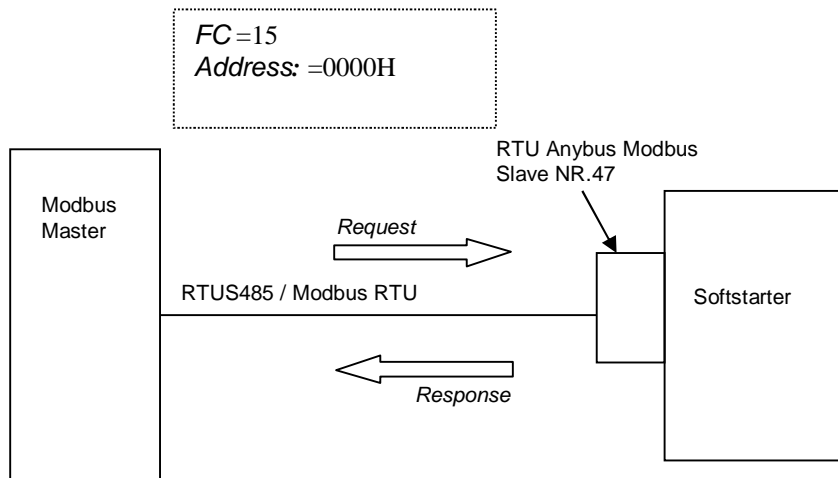
Slave 47
5FC = 02
Address
16 bit
CRC

Response:

2F 02 02 00 00 51 BE

Slave 47
5FC = 02
2 Byte
Byte 0
Byte 1
CRC

2.4 Write binary output telegram



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

Request:

2F 0F 00 00 00 10 02 00 00 37 88

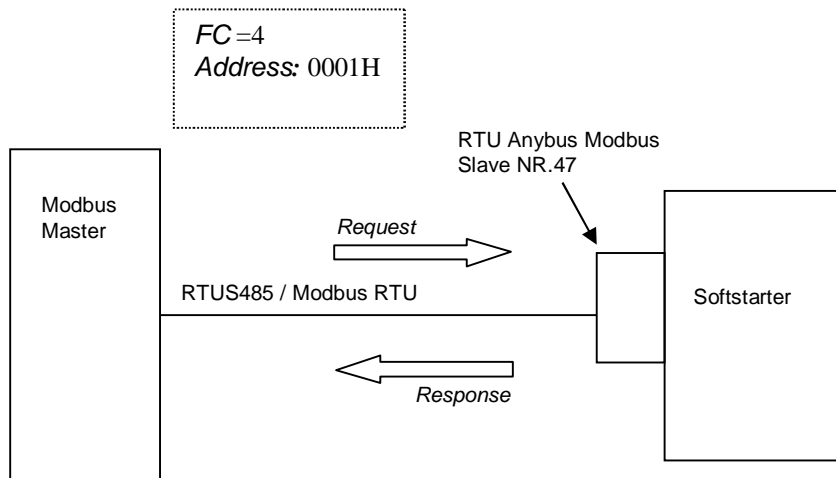
Slave 47
FC = 15
Address
16 bit
2 Byte
Output
CRC

Response:

2F 0F 00 00 00 10 52 49

Slave 47
5FC = 15
Address
16 bit
CRC

2.5 Read analog input telegram



E.g: Read analog output words 2 & 3. Phase L1 current and Phase L2 current with default settings.

Request:

2F 04 00 02 00 02 D6 45

Slave 47
FC = 04
Address
2 words
CRC

Response:

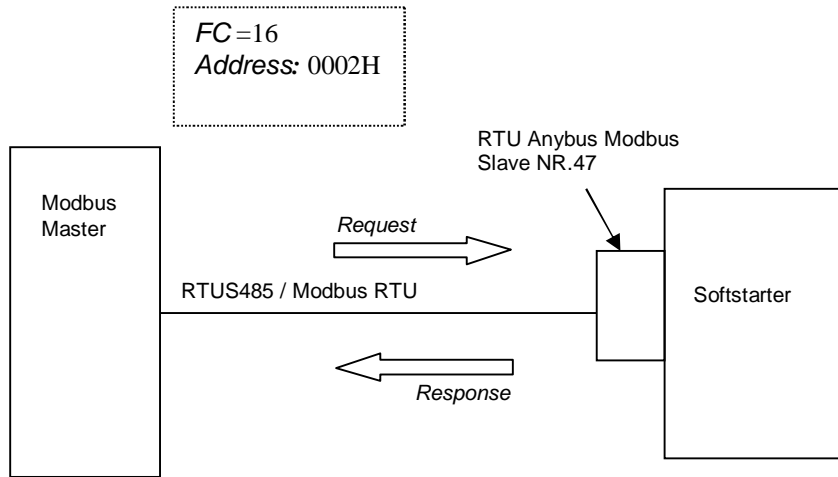
2F 04 04 00 00 00 35 86

Slave 47
FC = 04
4 Byte
W0
W1
CRC

W0: Phase L1 current

W1: Phase L2 current

2.6 Write analog output telegram



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

Request:

2F 10 00 02 00 02 04 00 00 00 00 ED 5E

Slave 47
FC = 16
Address
2 words
4 Byte
W0
W1
CRC

Response:

2F 10 00 02 00 02 E6 46

Slave 47
FC = 16
Address
2 words
CRC

W0: FBT Control Word

W1: FBT Argument 2

3 Fieldbus Tasks

By using Fieldbus Tasks it is possible to read/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 □ 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 □ 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 7.19 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 7.19 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 $10^{\text{numbers of decimals}}$.
 - Parameters values that are written from the fieldbus needs to be multiplied by $10^{\text{numbers of decimals}}$.

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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