Modbus Specification
for Irradiance Sensors Si-RS485…-MB Series

1. Validity of this Document

This document describes the Modbus functionality of the sensor series Si-RS485…-MB with the firmware version 2.01. In addition, the previous firmware versions 1.51 to 1.55 are also covered in this document. Variations between firmware versions are mentioned using numbered notes.

2. Supported Bus Protocol

Baud Rate: 1200, 2400, 9600, 19200, 38400, 57600[3)]
Parity: No, even, odd
Stop Bit: 1, 2 (only at no parity)
Factory Default: 9600 Baud, 8N1, address: 1

For setting the bus protocol parameter the sensor offers the function code 0x46 of the Modbus protocol. Alternative you can use the software tool Si-Modbus-Configurator (free download on our website) for setting the bus parameter and testing the communication.

3. Modbus Specification

References:
- Modbus over Serial Line Specification and Implementation Guide V1.02
- Modbus Application Protocol Specification V1.1b

Transmission mode: Modbus RTU.
The Sensors will start Modbus operation 4 seconds after power up.

Supported function codes:
- 0x03: Read Holding Register
- 0x04: Read Input Register

Register	Value	Gain	Offset	Phys. Range	Data Range	Data Type
0000	Irradiance in W/m²	0.1	0	0…1500 W/m² [1)]	0…15000 [1)]	UINT16
0003	Wind Speed in m/s	0.1	0	0…80 m/s	0…800	UINT16
0007 [2)]	Cell Temperature in °C	0.1	0	-40…+90°C	-400…900	INT16
0008 [2)]	External Temp. no. 1 in °C	0.1	0	-40…+90°C	-400…900	INT16
0009 [3)]	External Temp. no. 2 in °C	0.1	0	-40…+90°C	-400…900	INT16

[1)] Up to Firmware Version 1.52 range is 0…1400 W/m²
[2)] Only available from Firmware Version 1.53
[3)] Only available from Firmware Version 2.01

Please note: The Register 0003, 0008 and 0009 are optional for some sensor types. If your sensor does not support this register, it will return the value 0 for this register.

To keep compatibility to old firmware versions, additional registers are available:

Register	Value	Gain	Offset	Phys. Range	Data Range	Data Type
0001	Cell Temperature in °C	0.1	-25	-25…+75°C	0…1000	UINT16
0002	External Temperature in °C	0.1	-25	-25…+75°C	0…1000	UINT16
0004	*reserved*	*./.*	*./.*	*./.*	*0*	*UINT16*
0005 [4)]	Cell Temperature in °C	0.1	-100	-40…+90°C	600…1900	UINT16
0006 [4)]	External Temperature in °C	0.1	-100	-40…+90°C [4)]	600…1900 [5)]	UINT16

[4)] Only available from Firmware Version 1.52

[5)] -40…+85°C for Firmware Version V1.52 / -40…+90°C from Firmware Version V1.53

Please note: The Register 0002 and 0006 are optional for some sensor types. If your sensor does not support this register, it will return the value 0 for this register.
For using the full temperature measurement range of -40…90°C use register 0005 to 0009.

- 0x08: Diagnostics
  - Sub function 0x00: Return Query Data
  - Sub function 0x01: Restart Communications Option
  - Sub function 0x04: Force Listen Only Mode
  - Sub function 0x0A: Clear Counters
  - Sub function 0x0B: Return Bus Message Count
  - Sub function 0x0C: Return Bus Communication Error Count
  - Sub function 0x0D: Return Slave Exception Error Count
  - Sub function 0x0E: Return Slave Message Count
  - Sub function 0x0F: Return Slave No Response Count
  - Sub function 0x10: Return Slave NAK Count
  - Sub function 0x11: Return Slave Busy Count
  - Sub function 0x12: Return Bus Character Overrun Count

- 0x46: Communication Parameter

Please note: These settings will take effect after restart of the sensor by power on reset or restart communication command (function 0x08, Sub function 01).

- Sub function 04: Write Module Address

Request:

00	Address	1 Byte	1 to 247
01	Function Code	1 Byte	0x46
02	Sub Function Code	1 Byte	0x04
03	New Address	1 Byte	1 to 247

Response:

00	Address	1 Byte	1 to 247
01	Function Code	1 Byte	0x46
02	Sub Function Code	1 Byte	0x04
03	New Address	1 Byte	1 to 247

- Sub function 05: Read Communication Parameter

Request:

00	Address	1 Byte	1 to 247
01	Function Code	1 Byte	0x46
02	Sub Function Code	1 Byte	0x05

Response:

00	Address	1 Byte	1 to 247
01	Function Code	1 Byte	0x46
02	Sub Function Code	1 Byte	0x05
03	Baud rate	1 Byte	0 to 4, see table below
04	Parity / Stop Bit	1 Byte	0 to 3, see table below

- Sub function 06: Write Communication Parameter

Request:

00	Address	1 Byte	1 to 247
01	Function Code	1 Byte	0x46
02	Sub Function Code	1 Byte	0x05
03	Baud Rate	1 Byte	0 to 4, see table below
04	Parity / Stop Bit	1 Byte	0 to 3, see table below

Response:

00	Address	1 Byte	1 to 247
01	Function Code	1 Byte	0x46
02	Sub Function Code	1 Byte	0x05
03	Baud Rate	1 Byte	0 to 3, see table below
04	Parity / Stop Bit	1 Byte	0 to 3, see table below

- Communication Parameter Setting Sub Function 05 and 06:

Baud Rate	Value
1200	0
2400	1
9600	2
19200	3
38400	4

Parity / Stop Bit	Value
8N1 (10 Bit)	0
8N2 (11 Bit)	1
8E1 (11 Bit)	2
8O1 (11 Bit)	3

- Sub function 07: Hardware and Firmware Version

Request:

00	Address	1 Byte	1 to 247
01	Function Code	1 Byte	0x46
02	Sub Function Code	1 Byte	0x07

Response:

00	Address	1 Byte	1 to 247
01	Function Code	1 Byte	0x46
02	Sub Function Code	1 Byte	0x07
03	Hardware Version	2 Byte	0 to 65535
04	Firmware Version	2 Byte	0 to 65535

- Sub function 08: Read Serial Number (from Firmware Version 1.54)

Request:

00	Address	1 Byte	1 to 247
01	Function Code	1 Byte	0x46
02	Sub Function Code	1 Byte	0x08

Response:

00	Address	1 Byte	1 to 247
01	Function Code	1 Byte	0x46
02	Sub Function Code	1 Byte	0x08
03[1)]	Serial Number	30 Byte	Char

The response for the Read Serial Number Function are 30 character with a structure as followed:
- All characters "-“ printed on the sensor label are left out.
- For serial numbers with less than 30 characters the output is filled with null bytes “\0“ (0x00)

[1)] In Firmware Version 1.54 and 1.55 the length of the serial number is defined as 20 bytes. If the serial number is less than 20 characters, the output is filled with “blank” (0x20)

Example:

Serial number printed on the sensor label:
485-12003-17-20311234

Output of Read Serial Number Function:
4851200317203112340\0\0\0\0\0\0\0\0\0\0\0\0

Output of Read Serial Number Function in hex:
3438 3531 3230 3033 3137 3230 3331 3132 3334 0000 0000 0000 0000 0000 0000

Identifying the sensor type by the serial number:

Serial Number, beginning with	**Sensor Type**	**Active Registers**
485-1	Si-RS485TC-T-MB	0000, 0007
485-2	Si-RS485TC-2T-MB	0000, 0007, 0008
485-3	Si-RS485TC-2T-v-MB	0000, 0003, 0007, 0008
485-4	Si-RS485TC-T-Tm-MB	0000, 0007, 0008

Exception Codes:
- 01: Illegal Function
- 02: Illegal Data Access
- 03: Illegal Data Value
- 04: Slave Device Failure