



3S-SMS-MB-M & 3S-SMS-HMI-M

Manual Soiling Sensor

USER MANUAL

USER MANUAL TABLE OF CONTENTS

1. Introduction	2
2. Manual Soiling Sensor Installation	3
2.1. Unpacking and Control	3
2.2. Installation and Considerations	3
2.3. Inspection and Maintenance	4
3. Normalization	4
3.1. Renormalization	4
4. Connections	5
5. Specifications	6
5.1. 3S-SMS-MB Configuration Tool	6
5.1.1. Establishing Connection	6
5.1.2. Change the Modbus Parameters	7
5.1.3. Setting Time Information	7
5.1.4. Setting the Minimum Stable Data Counter	8
5.1.5. Setting Location Info	9
5.1.6. Find the Modbus Parameters	9
5.1.7. Firmware Update	10
5.2. PLC HMI Display Usage	10
5.2.1. Home Page	10
5.2.2. Data Record Page	11
5.3. Modbus RTU Specifications	11
5.3.1. Supported Bus Protocol	11
5.3.2. Supported Function Codes	11
5.3.2.1. Read Holding Registers (0x03)	12
5.3.2.2. Read Input Registers (0x04)	13
5.3.2.3. Read & Change Parameters (0x46)	16
5.3.2.4. Diagnostic (0x08)	18
6. Specifications	18
6.1. Technical Specifications	18
7. Terms of Warranty	19
8. Additional Documents and Software	19
9. Contact Details	20

1. Introduction

Manual Soiling Sensor is a product of from the SEVEN meteorological sensors range of professional and intelligent measuring sensors with digital interface for environmental and industrial applications. Manual Soiling Sensor is available in 2 models. These are 3S-SMS-MB-M and 3S-SMS-HMI-M models. The only difference between the two models is the PLC used in the 3S-SMS-HMI-M model. The data received from the Manual Soiling Sensor can be monitored by PLC.



Figure 1 – 3S-SMS-MB-M



Figure 2 – 3S-SMS-HMI-M

SEVEN Soiling Sensor is designed to measure the loss of energy production due to pollution caused by environmental factors in photovoltaic panels. The Soiling sensor, which is suitable for commercial, utility, industrial and rooftop projects, notifies the user of production losses due to pollution. If soiling ratio read from the sensor is 10%, it means that there is 10% energy loss in the facility.

PV Soiling = Energy Loss

SEVEN Soiling Sensor calculates the soiling ratio of the PV system by comparing the irradiance values received from the two clean and dirty irradiance sensors. While the dirty irradiance sensor in the system is exposed to contamination in the same way as the panels, the clean irradiance sensor is cleaned manually by the user with a wet cloth. SEVEN Sensor has a 3S-SMS-MB model that performs this cleaning process automatically. Monitoring systems give the user energy loss by comparing the two irradiance values according to the data received from the cleaned and dirty irradiance sensors.

$$\text{Daily Average Soiling Level Percentage} = \left(1 - \left(\frac{\text{Normalized Irradiance}_{\text{Dirty Cell}}}{\text{Normalized Irradiance}_{\text{Clean Cell}}} \right) \right) * 100$$

According to IEC 61724-1, the soiling ratio should be calculated as a single soiling ratio with a daily average. It is recommended to calculate only one soiling ratio per day for the system because although SEVEN provides instantaneous soiling ratio values, frequent measurements are affected by irradiation fluctuations. According to the IEC 61724-1 standard, low irradiation values and unstable weather conditions should not be included in the calculation. In addition, these measurements must be made within ± 2 hours from local noon time. The user decides on the cleaning of the module by checking the soiling ratio to avoid loss of production and increase the efficiency of the PV system.

SEVEN products use reliable and high-quality instruments to provide accurate meteorological information in environmental and industrial applications.



Note: SEVEN reserves the right to make changes in this entire document without prior notice.

2. Manual Soiling Sensor Installation

It is suggested that the system be operated at ground level to make sure that all components are working properly prior to installation. A general diagram of the progress of the installation steps is given below.

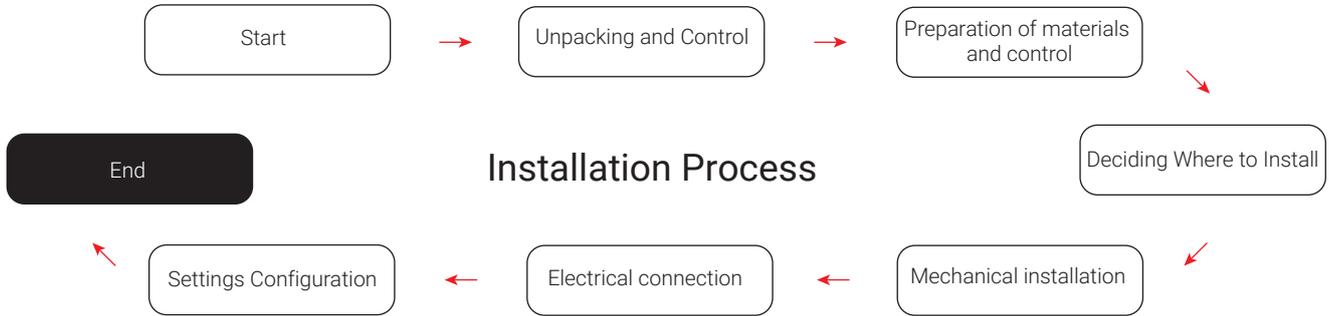


Figure 3 – Installation Process

2.1. Unpacking and Control

Upon receipt of the product, it must be carefully checked whether the package content is complete. Seven Sensor Solutions must be contacted if any of the components are missing, damaged or defective.



Figure 4 – 3S-SMS-MB-M Packing List



Figure 5 – 3S-SMS-HMI-M Packing List



Note: : Quantity and content of the received material may be different based on customer confirmed order.

2.2. Installation and Considerations

Each site is different and has its own challenges. For this reason, the installation of the product may differ in each site. First of all, it should be decided where the product will be installed.

The Manual Soiling Sensor should be contaminated at the same rate as the site. Therefore, placing the sensor close to any dust source, such as a chimney or ventilation, which will create extra pollution, should also be avoided. It should also be placed away from dark, reflective and heat absorbing surfaces that will affect the irradiation measurement.

The Manual Soiling Sensor needs to be in the same direction and the same inclination as the solar panels. They should be positioned in the same plane the solar panels.



Figure 6 – Installation Site Selection



Note: To facilitate the maintenance and cleaning of the Manual Soiling Sensor must be installed in an easily accessible location, especially for rooftop projects.

2.3. Inspection and Maintenance

The dirty cell in the Manual Soiling Sensor is exposed to fouling in the same way as the panels, while the clean cell must be manually cleaned daily by the user with a wet cloth. However, cleaning of the dirty cell should be carried out periodically together with site cleaning. The surface of cell glass can be gently cleaned with a soft cloth and soapy water.

Fastener tightness and cable conditions, looking for damage, deterioration, or disconnection of sensors and electrical enclosures, soiling or displacement of optical sensors, evidence of moisture or vermin in enclosures, loose wiring connections, embrittlement of attachments and other potential problems, should be checked periodically.

According to IEC 61724-1:2021, the monitoring system should be inspected at least annually and preferably at more frequent intervals.

3. Normalization

Seven Sensor sends all Soiling Sensors through normalization process. Under the same conditions, such as cleanliness, weather, position of the panels, etc., there should be no difference in the irradiance data from the dirty and clean sensor. Seven Sensor should be contacted in case of any difference.

The Manual Soiling Sensor uses 2 solar cells, dirty and clean. SEVEN delivers all Soiling Sensors with calibration certificates.

The clean solar cell of the Manual Soiling Sensor is calibrated under a Class AAA Solar Simulator according to IEC 60904-2 and IEC 60904-4 standards using a reference cell calibrated by the Institute for Solar Energy Research (ISFH) in Germany.

Calibrated solar cells are tested under natural sunlight using a reference cell calibrated by the Fraunhofer Institute for Solar Energy Systems ISE in Germany

The dirty cell normalization process is performed on the clean cell after the calibration and testing processes are completed.

3.1. Renormalization

According to standard IEC_61724-1, normalization must be repeated at least once a year. The soiling rate measured immediately after normalization must be 0. A significant deviation of the contamination rate from 0 indicates a problem with the installation. This can be used as a check of the normalization so that normalization can be repeated if necessary.

4. Connections

The sensor connection box has waterproof and UV resistant. The supply voltage for the Manual Soiling Sensor is 12 - 30 V DC. Operation with a supply voltage of 24 V is recommended.

PLC supply for the 3S-SMS-HMI-M model is 24 volts. Sensor and PLC supply can be made from the same power supply.

The Manual Soiling Sensor has an electrically isolated, half-duplex, 2 wire RS485 interface for configuration, communication and the firmware update.

The communication and power cable of Manual Soiling Sensor should be always laid separated from AC/DC cables.

⚠ Note: The installation and electrical connections of SEVEN sensors should be carried out by a qualified electrician.

Wire Assignment for Power & Communication

RS485 A / Data (+)	Green
RS485 B / Data (-)	Yellow
Positive Supply Voltage	Brown
Supply Voltage Ground	White

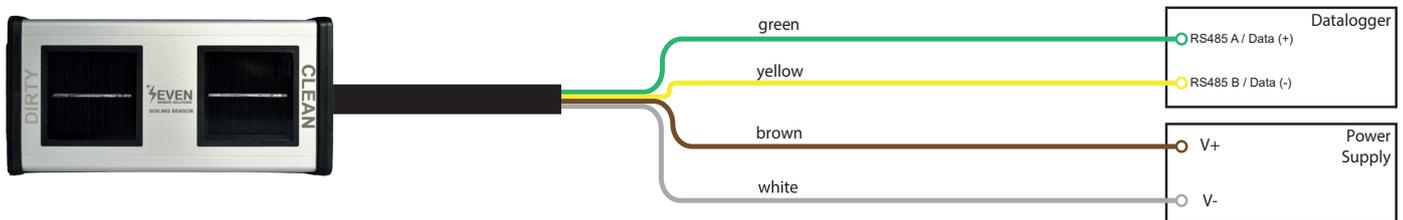


Figure 7 – 3S-SMS-MB-M Wire Assignment for Power & Communication

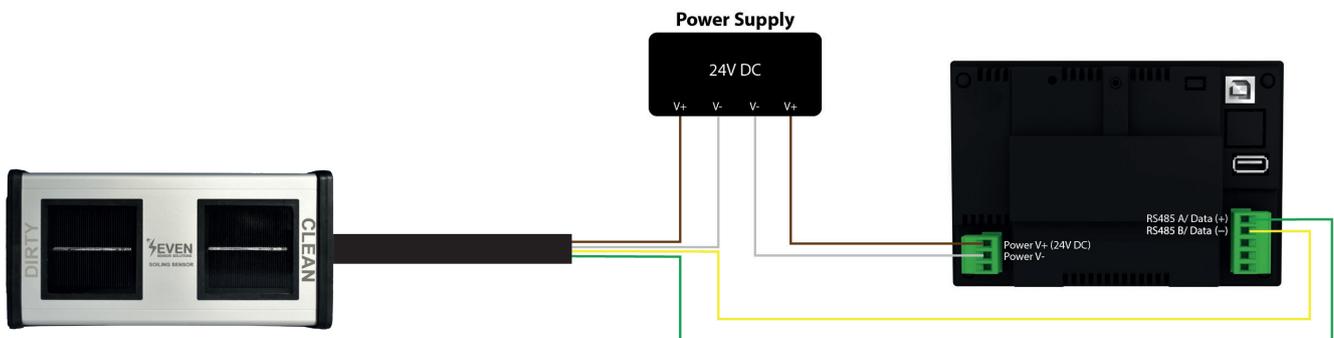


Figure 8 – 3S-SMS-HMI-M Wire Assignment for Power & Communication

5. Configuration and Communication

Once the Manual Soiling Sensor has been installed and connected correctly, the sensor begins autonomously to take measurements.

Attention must be paid to the following points:

- A measurement request should be made to the Manual Soiling with the 3S-SMS-MB Configuration Tool and it should be checked whether it correctly operation in the site.
- If several Modbus Device are operated on a network, a unique device ID must be assigned to each device.

Follow SEVEN instructions to configure the Manual Soiling Sensor on dataloggers.

5.1. 3S-SMS-MB Configuration Tool

3S-SMS-MB Configuration Tool is a software tool for testing communication and adjusting Modbus parameters on the Manual Soiling Sensor. The 3S-SMS-MB Configuration Tool can also be used to update the firmware of the Manual Soiling Sensor.

A Windows® PC with a serial bus interface set as a serial COM port, 3S-SMS-MB Configuration Tool software, and USB to RS485 Converter are required for configuration and testing purposes.

Download the software 3S-SMS-MB Configuration Tool and install it on your computer. Download link is below.
https://www.sevensensor.com/files/d/s/3S-SMS_Configuration_Tool_v1.1.zip



Note: If the serial COM port does not appear when the 3S-SMS-MB Configuration Tool is connected to the computer via USB to RS485 Converter, the serial COM port driver must be updated.

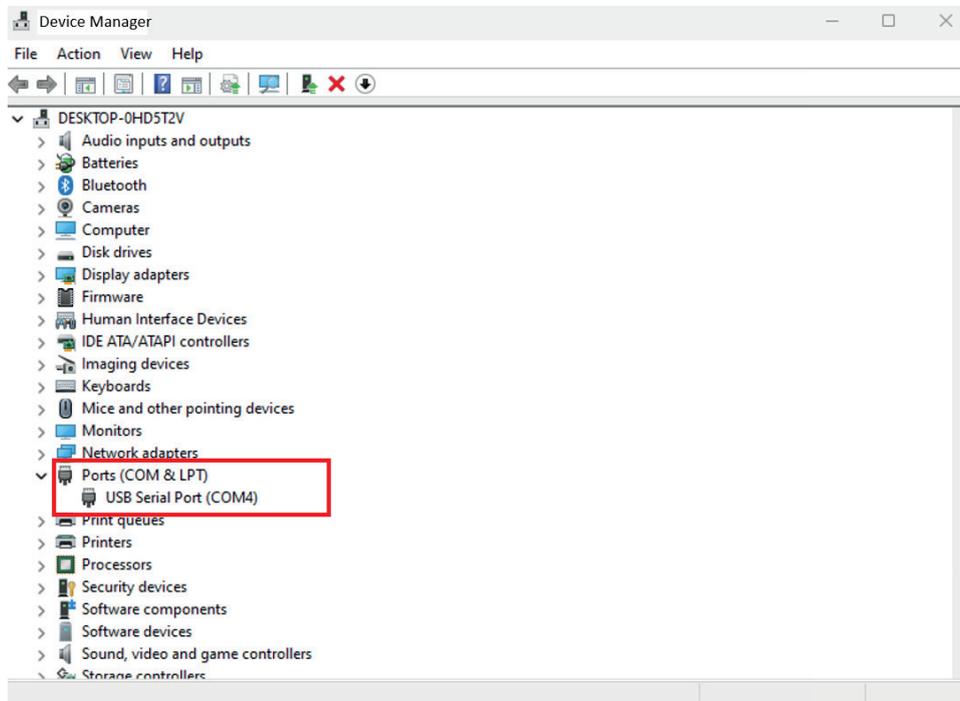


Figure 9 – Serial COM Port



Note: Make sure to always use the correct and current version of the 3S-SMS-MB Configuration Tool for Manual Soiling configuration.

5.1.1. Establishing Connection

The Manual Soiling Sensor is connected to the computer via USB to RS485 Converter by making a cable connection as described in the “4. Connections” section. After launching the 3S-SMS-MB Configuration Tool, the following screen will appear.

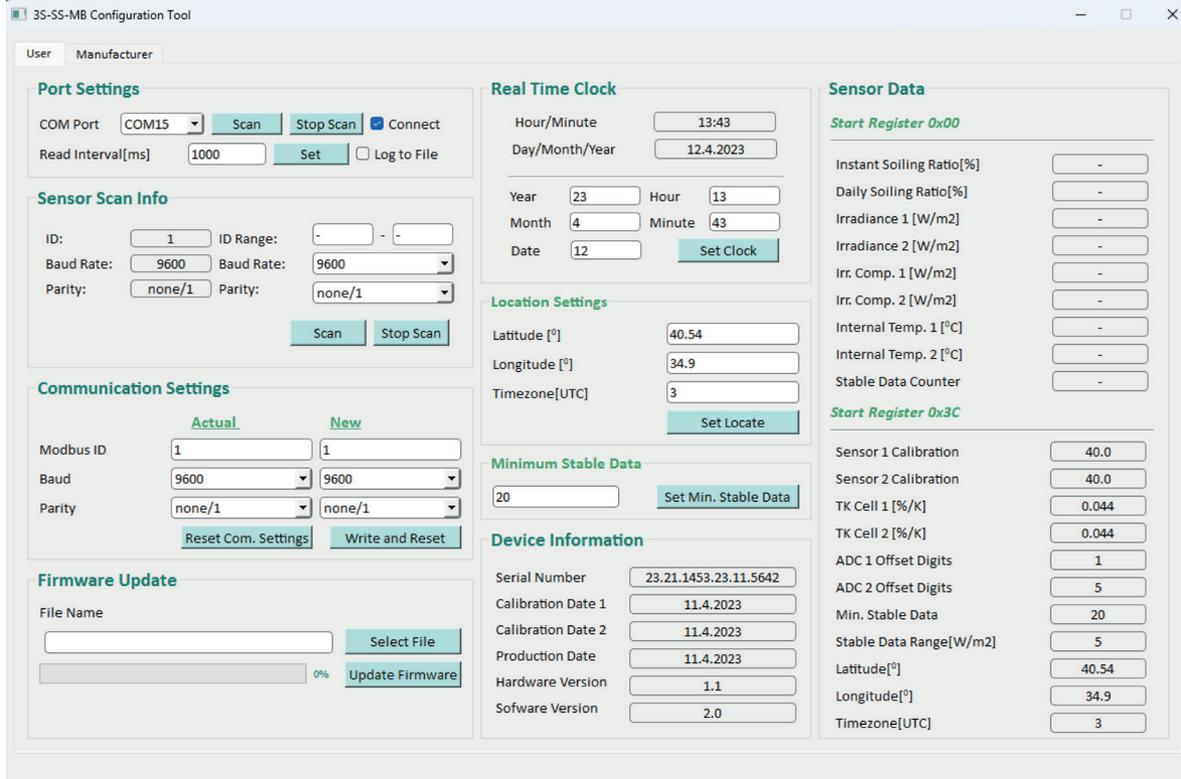


Figure 10 – 3S-SMS-MB Configuration Tool

Follow the steps below to connect to the Manual Soiling Sensor with the 3S-SMS-MB Configuration Tool.

- Select the serial COM port to which the USB to RS485 converter is connected.
- Enter the Modbus ID, Baud rate and Parity of the Manual Soiling Sensor in the “**Actual**” section of the “**Communication Settings**”.
- Click on “**Connect**”.

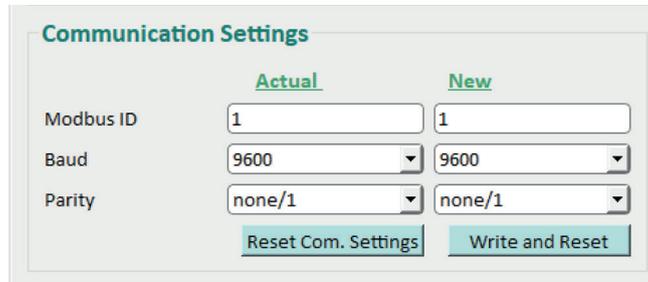


Note: Factory defaults of the Manual Soiling Sensor: Modbus ID 1, Baud rate 9600, Parity none/1.

Once the connection is successfully completed, the data received from the device will be displayed in the “**Sensor Data**” section. Manual Soiling Sensor details can be found in the “**Device Information**” section.

5.1.2. Change the Modbus Parameters

To change the Modbus parameters (Modbus ID, Baud rate and Parity) of the device, enter the values you want to assign in the “New” section of the “Communication settings” and click on “Write and Reset”.



	Actual	New
Modbus ID	1	1
Baud	9600	9600
Parity	none/1	none/1

Figure 11 – Changing Modbus Parameters

5.1.3. Setting Time Information

The values to be adjusted are entered in the relevant fields as 2 digits, respectively. (Example Date: 23.04.23 Time: 13:43)

Click on the “Write” button.



Hour/Minute: 13:43
Day/Month/Year: 12.4.2023

Year: 23 Hour: 13
Month: 4 Minute: 43
Date: 12

Figure 12 – Setting Time Information

5.1.4. Setting the Minimum Stable Data Counter

To ensure accurate calculations, the minimum number of stable data points that the sensor needs to measure should be entered. The recommended minimum stable data value is 20.

Then click on the “Set Min. Stable Data” button.



Figure 13 – Setting Minimum Stable Data

5.1.5. Setting Location Info

The latitude and longitude values of the location to be set are entered with 2 decimal places after the dot.

The UTC (GMT) time zone of the location is entered.

Then click on the “Set Locate” button.

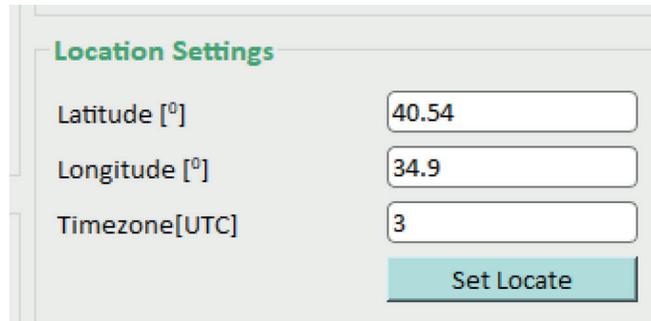


Figure 14 – Setting Location Info

5.1.6. Find the Modbus Parameters

If Modbus parameters are changed and the connection cannot be established with the device, the following steps should be followed to find the Modbus parameters of the Manual Soiling Sensor.

- Modbus parameters of device can be found with “Scan” button in the “Sensor Scan” section.

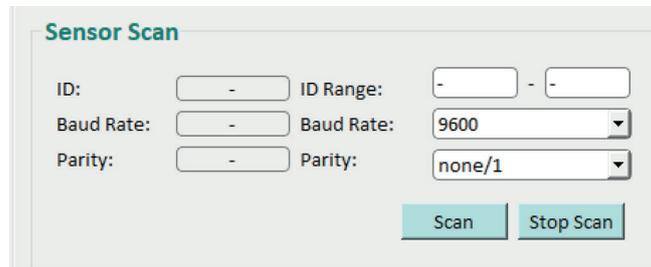


Figure 15 – Finding Modbus Parameters

- When the search is completed and the Modbus parameters of the device are found, a message “Sensor Device is connected” (as in Figure 13) will appear on the desktop. The found parameters are filled in automatically.

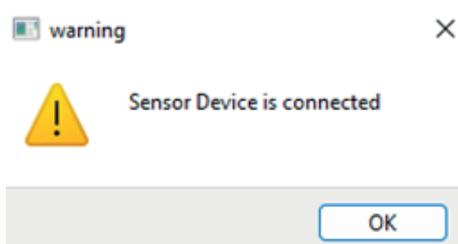


Figure 16 – Sensor Device is connected

- Reconnect with the “Connect” button.



Note: Modbus parameters search can be stopped at any time with the “Stop Scan” button.

5.1.7. Firmware Update

Manual Soiling Sensor firmware can be updated by SEVEN depending product developments. SEVEN provides this updated firmware to users free of charge. If the Manual Soiling Sensor firmware needs to be updated, the following steps should be followed.

- Clicking on the “**Select File**” button in the “**Firmware Update**” section, the current firmware file with the “.bin” extension is selected.
- The firmware update is started with the “**Update Firmware**” button. The update process is confirmed in the pop-up message box and can be followed on the loading bar.

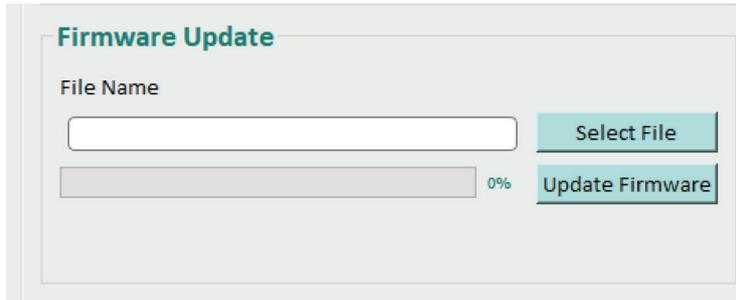


Figure 17 – Software Update Process

- After the firmware update process is completed, reconnection can be established clicking on the “Connect” button.



Note: Please contact SEVEN sales team for the current firmware version.

5.2. PLC HMI Display Usage

5.2.1 Home Page

This is the first page opened after the system is started. The calculated pollution rate is displayed on this page. All other pages can be easily accessed from this page.

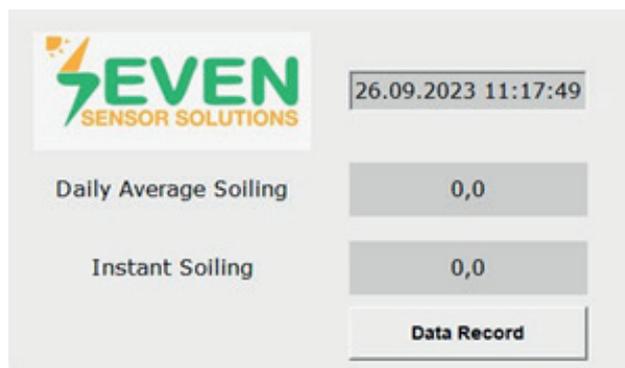


Figure 18 – Home Page

Daily Average Soiling (%) : This section shows the daily dust rate.

Instant Soiling (%) : This is the section where the instantaneous dust rate is displayed.

5.2.2. Data Record Page

The system records the dust rate every 1 hour. It allows us to open the page where we can view these records and burn them to the flash disk.

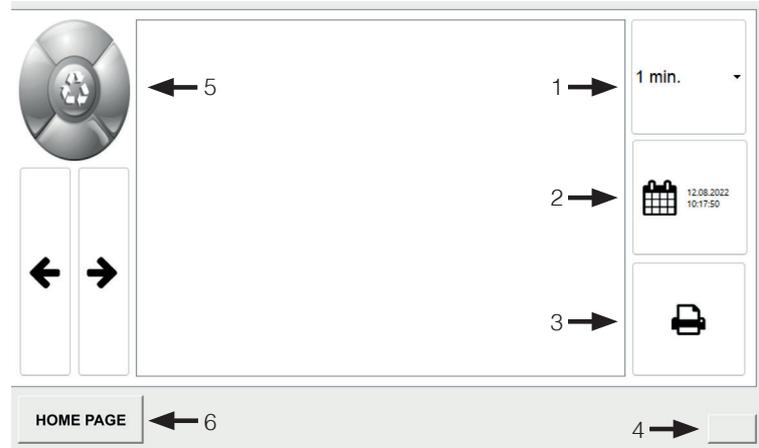


Figure 19 – Data Record Page

- 1) **Data Table Period** : Determines the period of the data to be pulled to the table. For example, if it is desired to see data recorded in 1 minute in the table, only 1 minute data will be pulled to the table.
- 2) **Data Table Start** : Specifies the start date and time of the data to be retrieved to the table. After the time specified here and as long as the time in the Data Table Duration section, the data will be pulled to the table.
- 3) **Data Recording** : Allows the data drawn to the table to be written to flash
- 4) **Error Log Page** : Redirects to the error log page.
- 5) **Table Refresh** : After determining the start and period of registration, the refresh button must be pressed to bring the data to the table.
- 6) **Home Page** : It redirects to the page at the first opening.

5.3. Modbus RTU Specifications

5.3.1. Supported Bus Protocol

The Manual Soiling Sensor is equipped with an RS-485 communication port that supports Modbus RTU commands. The Manual Soiling Sensor can be configured to operate in different communication parameters. The table that follows describes each supported bus protocol.

Baud Rate	9600, 19200, 38400
Parity	None, Even, Odd
Stop Bit	1, 2 (only at None parity)
Factory Default	9600 Baud, 8N1, address: 1

5.3.2. Supported Function Codes

The Manual Soiling Sensor supports a specific subset of Modbus RTU commands. The table that follows lists each supported function code.

0x03	Read Holding Registers
0x04	Read Input Registers
0x46	Read & Change Parameters
0x08	Diagnostics



Note: All checksums of the Modbus protocol are omitted in this document. These checksums must always be calculated and sent during communication.

5.3.2.1. Read Holding Registers (0x03)

The Manual Soiling Sensor supports a specific subset of Modbus RTU commands. The table that follows lists each supported function code.

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x03
Start Register	2 Byte (Big Endian)	see register table below
End Register	2 Byte (Big Endian)	see register table below

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x03
Number of Bytes	1 Byte	0 to 255 (2xN) N = Number of Registers
Data	2 Byte (Big Endian)	see register table below

Holding Register Map

The Manual Soiling Sensor holding register map is based on the “SunSpec Alliance” communication standards.

Start	End	Value	Type	Units	Scale Factor	Constant
40000	40001	SunSpec ID	uint32	N/A	N/A	“SunS”
40002	40002	SunSpec Device ID	uint16	N/A	N/A	0x0001
40003	40003	SunSpec Length	uint16	Registers	N/A	65
40004	40019	Manufacturer	String (32)	N/A	N/A	“SevenSensor”
40020	40035	Model	String (32)	N/A	N/A	“3S-SMS-MB”
40036	40043	Hardware Version	String (16)	N/A	N/A	“1.0”
40044	40051	Software Version	String (16)	N/A	N/A	“3.0”
40052	40067	Serial Number	String (32)	N/A	N/A	“23.12.345.65.0013”
40068	40068	Device ID	uint16	N/A	N/A	1
Sunspec Device Model Measurement Registers						
40069	40069	Block ID	int16	N/A	N/A	307
40070	40070	Length	int16	Registers	N/A	11
40081	40081	Soiling Ratio	int16	%	0	Measured

Irradiance Model Registers						
40082	40082	Block ID	int16	N/A	0	302
40083	40083	Length	int16	Registers	0	5
40084	40084	Clean Cell Irradiance	uint16	W/m ²	1.0	Measured
40085	40085	Soiled Cell Irradiance	uint16	W/m ²	1.0	Measured
Back of Module Temperature Registers						
40089	40089	Block ID	int16	N/A	N/A	303
40090	40090	Length	int16	Registers	N/A	3
40091	40091	Module Temp 1	int16	°C	0.1	N/A
40092	40092	Module Temp 2	int16	°C	0.1	N/A
End of Block Registers						
40100	40100	End of SunSpec Block	uint16	N/A	N/A	0xFFFF
40101	40101	Length	uint16	Registers	0	0
Device Address Read/Write Register						
40199	40199	Modbus ID – Write Register	uint16	N/A	N/A	1

5.3.2.2. Read Input Registers (0x04)

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x04
Sub Function Code	2 Byte (Big Endian)	see register table below
End Register	2 Byte (Big Endian)	see register table below

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x04
Number of Bytes	1 Byte	0 to 255 (2xN) N = Number of Registers
Data	2 Byte x N (Big Endian)	see register table below

Input Register Map

A common input register map has been created for all SEVEN Modbus devices. All data marked in the common input register map below are defined for Manual Soiling Sensor.



Note: Values marked as “raw data” are for information only and should not be used for serial applications.

The following Modbus data can be read individually or in blocks.

ID-Dec	ID-Hex	Value	Range	Resolution	Description
30000	0X00	Irradiance 1	0-1600 W/ m ²	0.1W/m ²	Irradiance value of the clean reference cell for the Soil Monitoring System in W/m ² without temperature compensation.
30001	0x01	Irradiance 2	0-1600 W/ m ²	0.1W/m ²	Irradiance value of the soiled reference cell for the Soil Monitoring System in W/m ² without temperature compensation.
30006	0x06	Temperature Compensated Irradiance 1	0-1600 W/ m ²	0.1W/m ²	Irradiance value of the clean reference cell for the Soil Monitoring System in W/m ² . Is a temperature compensated and calibrated value.
30007	0x07	Temperature Compensated Irradiance 2	0-1600 W/ m ²	0.1W/m ²	Irradiance value of the soiled reference cell for the Soil Monitoring System in W/m ² . Is a temperature compensated and calibrated value.
30015	0x0F	Internal Temperature 1	(-40)-(+85) °C	0.1 °C	Internal cell temperature value of the clean reference cell for the Soil Monitoring System.
30016	0x10	Internal Temperature 2	(-40)-(+85) °C	0.1 °C	Internal cell temperature value of the soiled reference cell for the Soil Monitoring System.
30042	0x2A	Instant Soiling Ratio	0 - 1	0.01	Instantaneous value of the ratio of the temperature compensated irradiance value of the soiled reference cell to that of the clean reference cell, in the Soil Monitoring System.
30043	0x2B	Daily Average Soiling Ratio	0 - 1	0.01	Daily average value of the ratio of the temperature compensated irradiance value of the soiled reference cell to that of the clean reference cell, in the Soil Monitoring System.
30044	0x2C	Instant Soiling Level	0 - 1	0.01	Instantaneous value of fractional power loss due to soiling, given by 1 – Instant Soiling Ratio.
30045	0x2D	Daily Average Soiling Level	0 - 1	0.01	Daily average value of fractional power loss due to soiling, given by 1 – Daily Average Soiling Ratio.
30046	0x2E	Instant Soiling Level Percentage	0 - 100 %	0.1 %	Instantaneous Soiling Level value in %. Computed as the percent.
30047	0x2F	Daily Average Soiling Level Percentage	0 - 100 %	0.1 %	Daily average Soiling Level value in %. Computed as the percent.
30048	0x30	Soiling Rate	0 - 100 %	0.1 %	The rate of change of the daily average soiling level percentage. It is calculated by comparing it with the previous day's value and is usually expressed as a daily percentage.
30050	0x32	Wash Tank Status	0 - 1	-	Automatic cleaning unit wash tank status. (1:full or 0:empty)

3S-SMS-MB-M&3S-SMS-HMI-M

Manual Soiling Sensor User Manual



Note: From the soiling data given in the table, it is recommended to use the “Daily Average Soiling Level Percentage” found in register 30047.

The following Modbus data can be read individually or in blocks.

ID-Dec	ID-Hex	Value	Range	
30221	0xDD	Digit value of the ADC 1	Manufacturer Parameters Read Only	
30222	0xDE	Digit value of the ADC 2		
30229	0xE5	Solar Noon Time Hour		
30230	0xE6	Solar Noon Time Minute		
30231	0xE7	Stable Data Counter		
30301	0x12D	Hardware Version	User Parameters Read / Write	
30302	0x12E	Software Version		
30304	0x130	Calibration Value 1		
30305	0x131	Calibration Value 2		
30310	0x136	Temperature Coefficient Value 1		
30311	0x137	Temperature Coefficient Value 2		
30323	0x143	ADC Offset Value 1		
30324	0x144	ADC Offset Value 2		
30329	0x149	T90 value		
30334	0x14E	Stable Data Min		
30335	0x14F	Stable Data Range		
30336	0x150	Latitude		
30337	0x151	Longitude		
30338	0x152	Timezone		
30342	0x156	Serial Number		Production Year
30343	0x157			Production Code
30344	0x158			Cell Serial Number
30345	0x159			Board Serial Number
30346	0x15A			Box Serial Number
30347	0x15B			Sensor Serial Number
30348	0x15C	Production Date		Production Day
30349	0x15D			Production Month
30350	0x15E			Production Year
30351	0x15F	Calibration Date 1	Calibration Day 1	
30352	0x160		Calibration Month 1	
30353	0x161		Calibration Year 1	
30354	0x162	Calibration Date 2	Calibration Day 2	
30355	0x163		Calibration Day 1	
30356	0x16		Calibration Month 1	

5.3.2.3. Read & Change Parameters (0x46)

Sub Function (0x04): Write Device Address

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Start Register	1 Byte	0x04
Number of Registers	1 Byte	1 to 247

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Start Register	1 Byte	0x06
Number of Registers	1 Byte	1 to 247

Sub Function (0x06): Write Communication Parameters

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x06
New Baud Rate	1 Byte	0 to 3, see table below
New Parity / Stop Bit	1 Byte	0 to 3, see table below

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x06
New Baud Rate	1 Byte	0 to 3, see table below
New Parity / Stop Bit	1 Byte	0 to 3, see table below



Note: When the “Write Communication Parameters” command is used, the “Write Device Address” command must also be used before the restart communication command.

Communication Parameter Settings

Parameter changes will take effect after restart of the sensor by power on reset or restart communication command.

Baud Rate	Value	Parity / Stop Bit	Value
9600	1	None/2	1
19200	2	Odd	2
38400	3	Even	3

Sub Function (0x07): Read Hardware & Software Versions

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Start Register	1 Byte	0x07

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x07
Hardware Version	2 Byte (Little Endian)	0 to 65535
Software Version	2 Byte (Little Endian)	0 to 65535

Sub Function (0x08): Read Serial Number - Production Date - Calibration Date

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x08

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x08
Production Year	1 Byte	0 to 99
Production Code	1 Byte	0 to 99
Cell Serial Number	2 Byte (Little Endian)	0 to 999
Board Serial Number	1 Byte	0 to 99
Box Serial Number	1 Byte	0 to 99
Sensor Serial Number	2 Byte (Big Endian)	0 to 9999
Production Day	1 Byte	1 to 31
Production Month	1 Byte	1 to 12
Production Year	1 Byte	0 to 99
Calibration Day 1	1 Byte	1 to 31
Calibration Month 1	1 Byte	1 to 12
Calibration Year 1	1 Byte	0 to 99
Calibration Day 2	1 Byte	1 to 31
Calibration Month 2	1 Byte	1 to 12
Calibration Year 2	1 Byte	0 to 99

5.3.2.4. Diagnostics (0x08)

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x08
Restart Code	4 Byte	0x00000000

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x08
Restart Code	4 Byte	0x00000000

6. Specifications

The Manual Soiling Sensor must be used in combination with suitable power supply and a data acquisition system which uses the Modbus communication protocol via RS485. It is equipped with a RS485 communications port that supports a subset of Modbus RTU commands. Baud rates of 9600, 19200, and 38400 are supported. Holding and input registers are supported.

The Manual Soiling Sensor should be powered from an external power supply. The power supply input is nominally rated for 24 V DC but can accept a voltage in the range of 12 to 30 V DC. The inputs are reverse polarity and surge protected. The power supply and RS485 bus are isolated from each other.

The instrument is classified according to IEC 61724-1 and should be used in accordance with the recommended practices of IEC, WMO and ASTM.

6.1. Technical Specifications

General Specifications	
Soiling Ratio	0% - 100%
Resolution	0,1%
Uncertainty	≤1%
Irradiance	0...1600 W/m ²
Follower Standard	IEC61724-1 (Annex C)
Data Output	RS485 up to 38400 Baud
Communication Protocol	Modbus RTU
Output Rate	1/s
Operating Temperature Range	40°C to +85°C
Operating Humidity Range	0 to 100 %RH
Power Supply	12 to 30 V DC
Power Consumption	20 mA @ 24 V DC
Electrical Connection	3 m LIYYC11Y PUR Cable, UV and weather resistant
Galvanic Isolation	1000 V between power supply and RS485 Bus
IP Rating	IP 65
Dimensions	245 mm x 108 mm x 42 mm (W x L x H)
Weight	500 g
Calibration	Each sensor is calibrated under Class AAA Sun Simulator as per IEC 60904-2 and IEC 60904-4 by using a reference cell calibrated by ISFH-Germany
Test	Each sensor is tested under natural sunlight by using a calibrated reference cell from Fraunhofer ISE, Germany.
Origin	TÜRKİYE

7. Terms of Warranty

Limited Sensor Warranty

SEVEN Sensor Solutions guarantees that its products comply with the specifications published by SEVEN, and are completely free from all manufacturer defects for a period of 2 years from the invoice date.

Firmware

SEVEN guarantees that the firmware included in the sensor, when used with the hardware specified by SEVEN and installed correctly, will operate according to the published specifications for 5 years from the date of invoice.

Exceptions to the 5-years warranty period, if any, will be specified in the sensor manual, user manual or other sensor documentation provided by SEVEN.

Solutions for The Manufacturing Defects

SEVEN commits to the clients to repair or replace the defective sensor if the problem is related to the production.

First; define the problem. Then, prepare a technical report and share the problem with SEVEN technical team, who will to work on resolving this problem.

Clients must return the defective item, part or component to SEVEN with handling shipping charges.

If SEVEN confirms that the sensor has a defect covered by the warranty, the repaired or replaced sensor will be warranted for the remainder of the original sensor warranty period.

Warranty Limitations

- Before using the sensor, clients should determine the suitability of the sensor for its intended use. Thus, the clients assume all risk and responsibilities arising from misuse.
- SEVEN disclaims all responsibilities for any damages arising from the ordinary and improper use of the sensors.
- SEVEN does not warrant the following;
 - Sensors subjected to misuse, negligence, improper storage, installation or accidental damage.
 - Defects caused by improper or insufficient site preparation and maintenance of the site by the customer.
 - Indirect damages resulting from loss or alteration of data and loss of profits or unrealized savings resulting from these damages.
 - Any damage caused by the use of sensors with other than the original cables and accessories of the sensors.
 - Damage caused by a lack of equipment inspections, lack of timely calibration, and lack of proper maintenance or cleaning.
 - Damage caused by the unauthorized opening of the sensor case.
 - Damage due to natural disasters such as; hail, hurricane storm, flooding, fire, lightning...etc.

Besides, SEVEN reserves the exclusive right to decide, whether a sensor is covered by the warranty or not. A sensor found damaged or defective under warranty may be either repaired or replaced, at the sole discretion of SEVEN. Should a sensor fail prematurely, the replacement sensor is warranted for the remainder of the original sensor warranty period.

8. Additional Documents and Software

The following documents and software can be downloaded from www.sevensensor.com or requested from SEVEN Sensor Solutions.

User Manual	This document
Datasheet	Manual Soiling Sensor brochure
3S-SMS-MB Configuration Tool	Windows® software for testing, firmware updates and configuration of the device
Firmware	Current device firmware

9. Contact Details

Please feel free to contact us if you face any difficulties during installation or configuration.

Address	Pinarçay OSB Mahallesi Organize Sanayi Tesisleri Teknokent Idare Binasi o: 7, D:1, 19100 Merkez / Corum / Turkey
Phone	+90 530 889 8019
Email	sales@sevensensor.com
Website	www.sevensensor.com