SEVEN
SENSOR SOLUTIONS

3S-SMS-P

Portable Soiling Sensor

USER MANUAL

USER MANUAL TABLE OF CONTENTS

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1. Introduction

The Portable Soiling Sensor is an innovative, patent-pending product developed by SEVEN Sensor to measure the soiling ratio directly on panels in PV power plants. This sensor, with a compact mechanical design, contains lamps, sensors, an electronic board, and an LCD screen.

Figure 1: Portable Soiling Sensor

The Portable Soiling Sensor calculates the soiling ratio on panels by using the reflection and scattering properties of light based on optical principles. For this calculation, parameters related to the solar panel and soil characteristics, such as panel cell color, soil color on the panel, and soil tone, are first entered into the sensor by the user through the LCD screen. Then, the lamps inside the sensor project stable and high-lumen light onto the panel surface. The reflected light is detected and measured by high-precision sensors located within the mechanical structure. These irradiation values are read by the microcontroller on the integrated electronic board. Advanced software inside the microcontroller analyzes this data and calculates the soiling ratio. The calculated soiling ratio is displayed digitally to the user on the sensor's integrated LCD screen.

Note: *SEVEN has the right to make modifications on this documentation without prior notice.*

2. Unpacking and Control

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

		
A Qty: 1	B Qty: 1	C Qty: 1
Portable Soiling Sensor	Battery Box	Battery Charging Adapter
		
D Qty: 1	E Qty: 1	F Qty: 1
Power Cable	Communication Cable	USB to RS485 Converter

Figure 2: Packing List

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3. Measurement Instructions

1. Connect one end of the power cable to the **“Power/Charge”** connector on the battery box.

1st Step 2nd Step

Figure 3: Connecting the Power Cable to the Battery Box

2. Connect the other end of the power cable to the **“POWER”** connector on the Portable Soiling Sensor.

1st Step 2nd Step

Figure 4: Connecting the Power Cable to the Sensor

3. Press the **“ON/OFF”** button on the battery box to power on the sensor. When the Portable Soiling Sensor starts operating, the LCD screen on the device will turn on.

1st Step 2nd Step

Figure 5: Powering On the Sensor

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4. Click on the **"Settings"** button on the LCD screen.

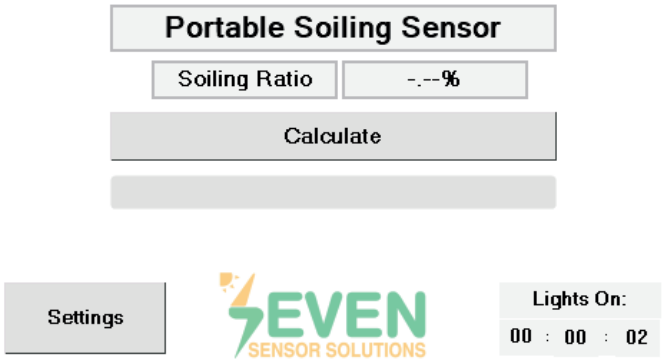
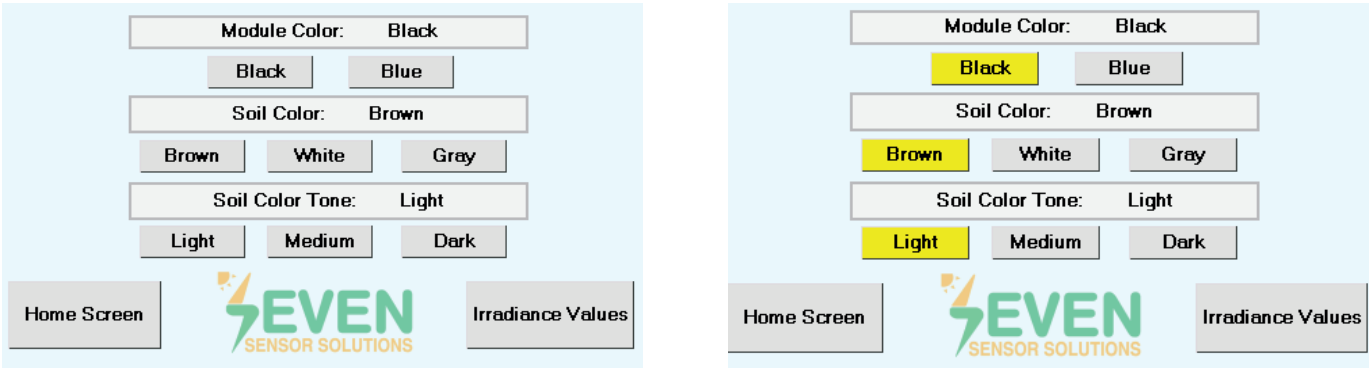


Figure 6: Homepage Screen

5. Select the parameters according to the characteristics of the panel and the soil to be measured.

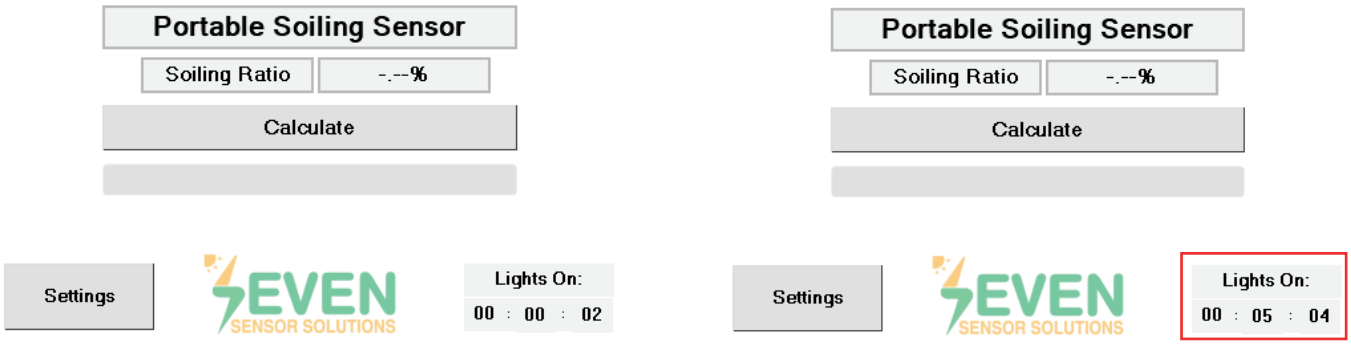


1st Step 2nd Step

Figure 7: Setting the Measurement Parameters

Note: *The measurement parameters should be selected based on the color of the solar panel cells, the color of the soil on the panel, and the tone of the soil.*

6. The LCD screen includes a counter that displays the operating time of the lamps. The lamps should be allowed to stabilize for 5 minutes after being powered on before starting the measurements.



1st Step 2nd Step

Figure 8: Operating Time of the Lamps

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7. For the Portable Soiling Sensor to take measurements, first take three separate 1-minute measurements at three designated points on the soiled panel. Once these initial readings are complete, clean the panel thoroughly. Then, take another set of three 1-minute measurements at the same points on the now-clean panel. These measurements will be used to calculate the soiling ratio.

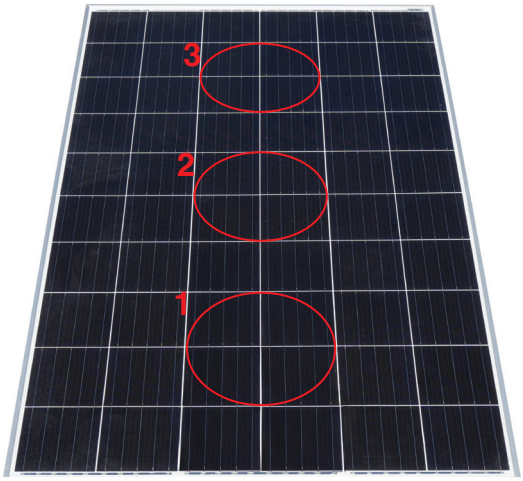

Figure 9: Measurement Points on the Panel

8. First, place the sensor at the bottom center point of the soiled panel.

Note: *The sensor should not be placed near the corners when installed at the bottom point of the panel.*

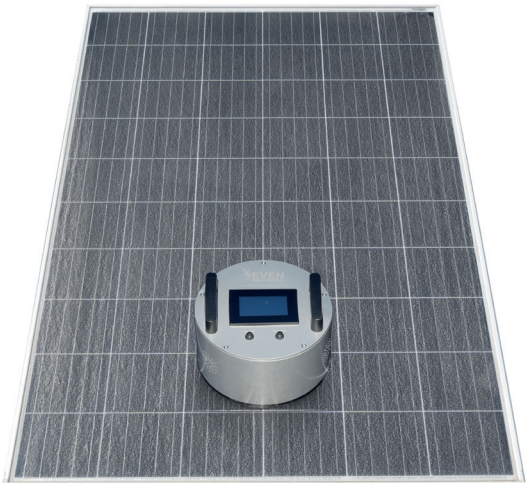

Figure 10: Placing the Sensor on the Soiled Panel for the First Measurement

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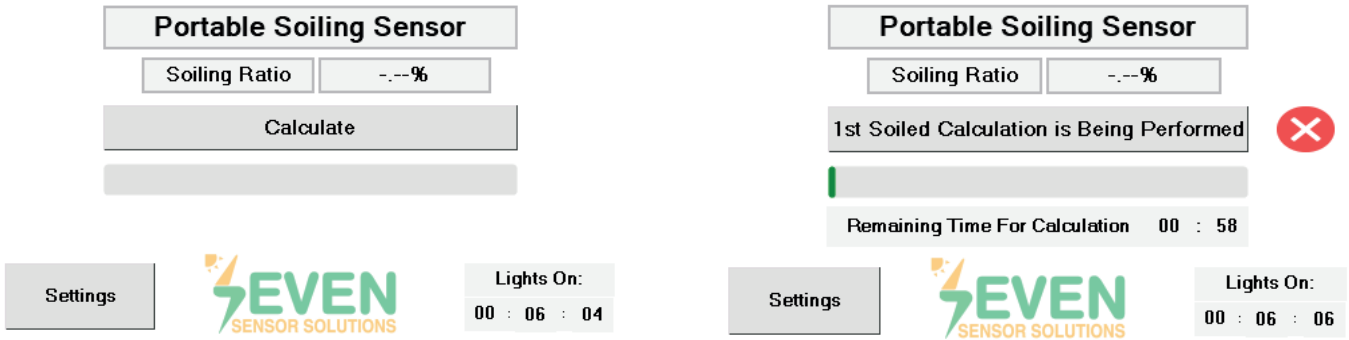
9. Click **"Calculate"** button to begin the first measurement on the soiled panel. The measurement will be completed in 1 minute.



1st Step 2nd Step

Figure 11: Starting the First Measurement on the Soiled Panel

10. For the second measurement on the soiled panel, place the Portable Soiling Sensor at the center of the solar panel.

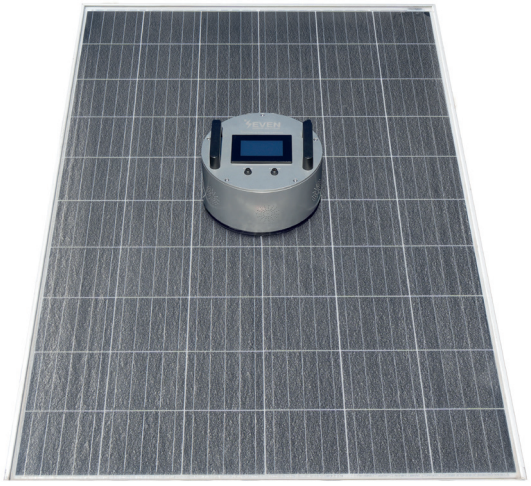
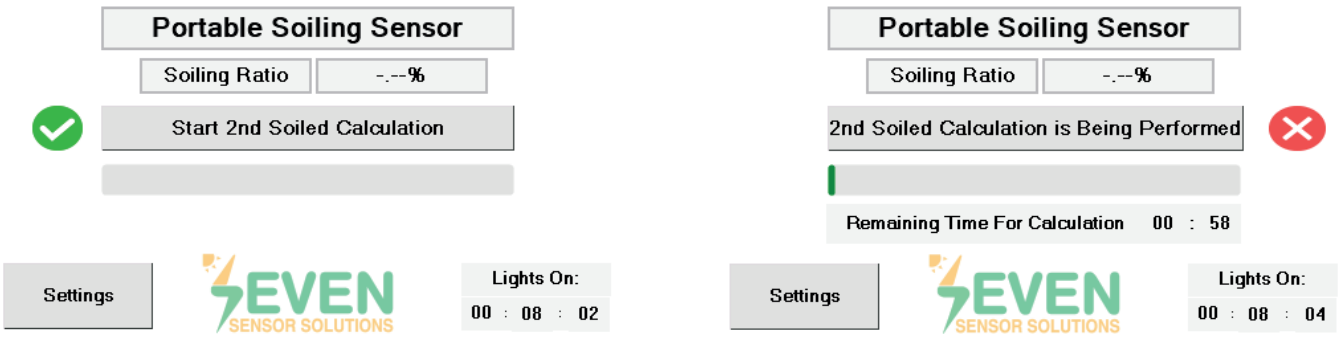


Figure 12: Second Measurement on the Soiled Panel

11. Click **"Start 2nd Soiled Calculation"** button to begin the second measurement on the soiled panel. The measurement will be completed in 1 minute.



1st Step 2nd Step

Figure 13: Starting the Second Measurement on the Soiled Panel

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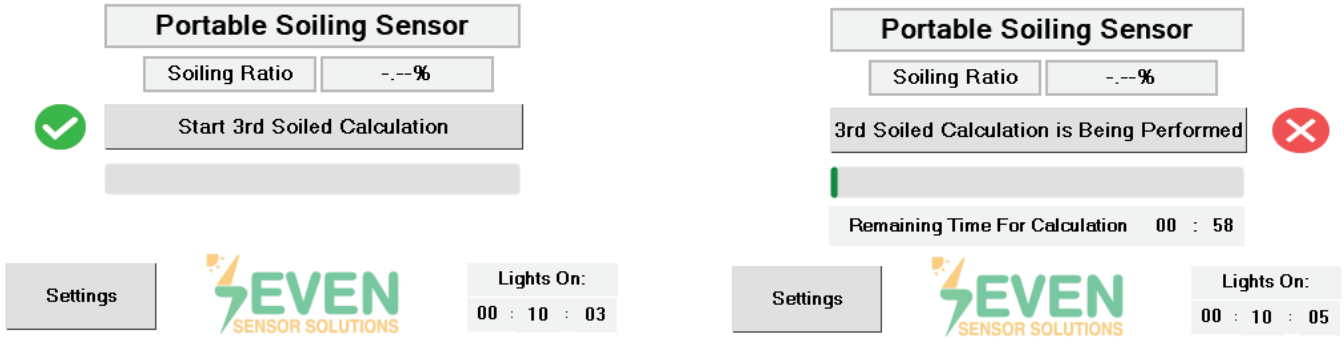
12. For the third measurement on the soiled panel, place the Portable Soiling Sensor at the top center point of the panel.

Note: *The sensor should not be placed near the corners when installed at the top point of the panel.*

Figure 14: Third Measurement on the Soiled Panel

13. Click **"Start 3rd Soiled Calculation"** button to begin the third measurement on the soiled panel. The measurement will be completed in 1 minute.



1st Step

2nd Step

Figure 15: Starting the Third Measurement on the Soiled Panel

14. After completing the soiled panel measurements, the solar panel used for those measurements must be cleaned before proceeding to the clean panel measurements.

Note: *Soiled and clean panel measurements must be performed on the same solar panel. Even panels of the same brand and with identical technical specifications can show different values in terms of reflected irradiation. Therefore, to ensure measurement accuracy, this point must be strictly observed.*

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15. For the first measurement of the clean panel, place the sensor at the bottom center point of the panel.

Note: *When placing the sensor at the bottom point of the panel, it should be positioned as close as possible to the same location used during the soiled panel measurement. This is crucial for ensuring measurement accuracy.*

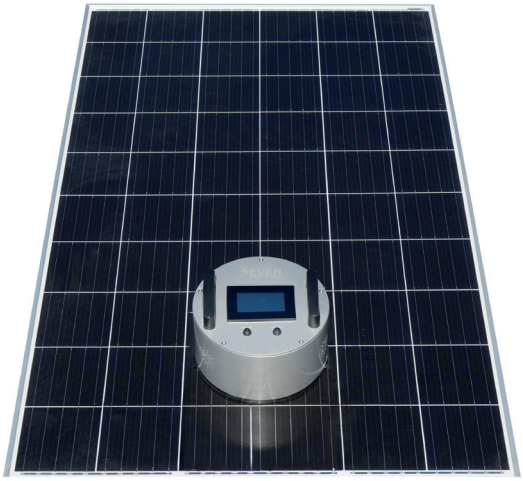
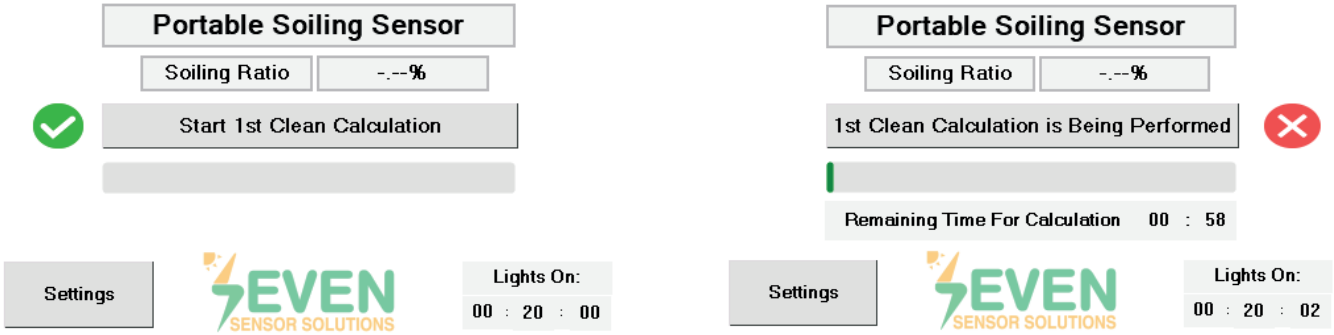


Figure 16: First Measurement on the Clean Panel

16. Click **"Start 1st Clean Calculation"** button to begin the first measurement on the clean panel. The measurement will be completed in 1 minute.



1st Step 2nd Step

Figure 17: Starting the First Measurement on the Clean Panel

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17. For the second measurement on the clean panel, place the Portable Soiling Sensor at the center of the solar panel.

Note: *When placing the sensor at the middle point of the panel, it should be positioned as close as possible to the same location used during the soiled panel measurement. This is crucial for ensuring measurement accuracy.*

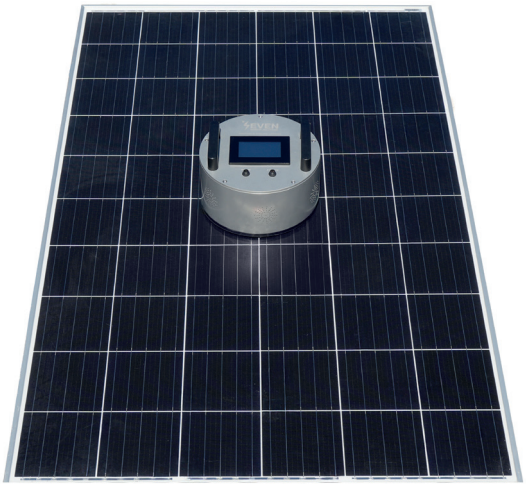
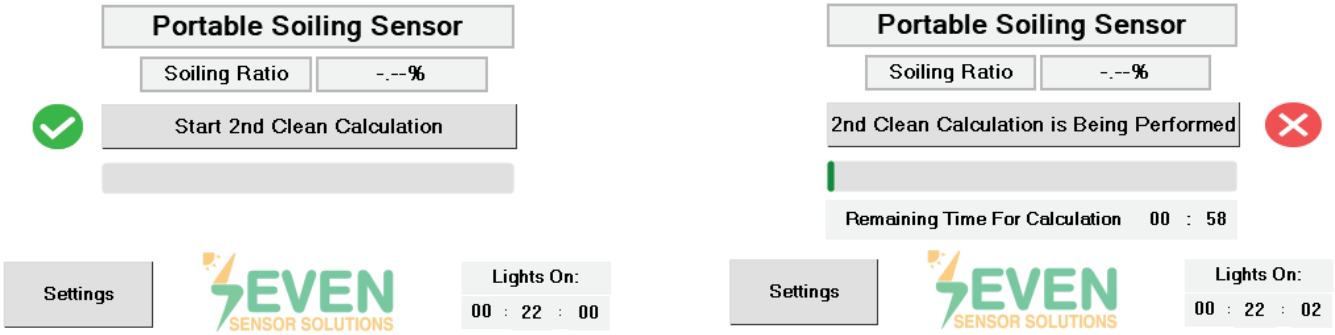


Figure 18: Second Measurement on the Clean Panel

18. Click **"Start 2nd Clean Calculation"** button to begin the first measurement on the clean panel. The measurement will be completed in 1 minute.



1st Step 2nd Step

Figure 19: Starting the Second Measurement on the Clean Panel

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19. For the third measurement on the clean panel, place the Portable Soiling Sensor at the top center point of the panel.

Note: *When placing the sensor at the top point of the panel, it should be positioned as close as possible to the same location used during the soiled panel measurement. This is crucial for ensuring measurement accuracy.*

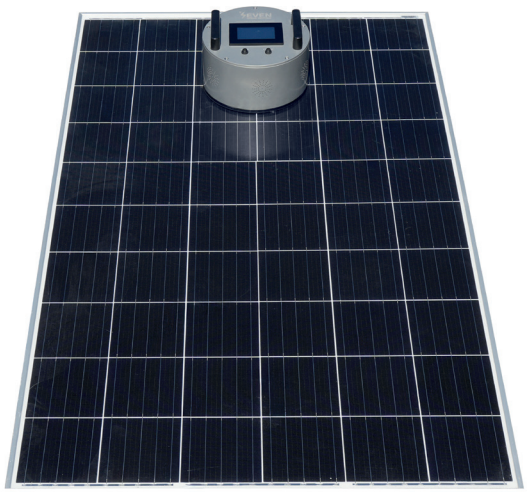
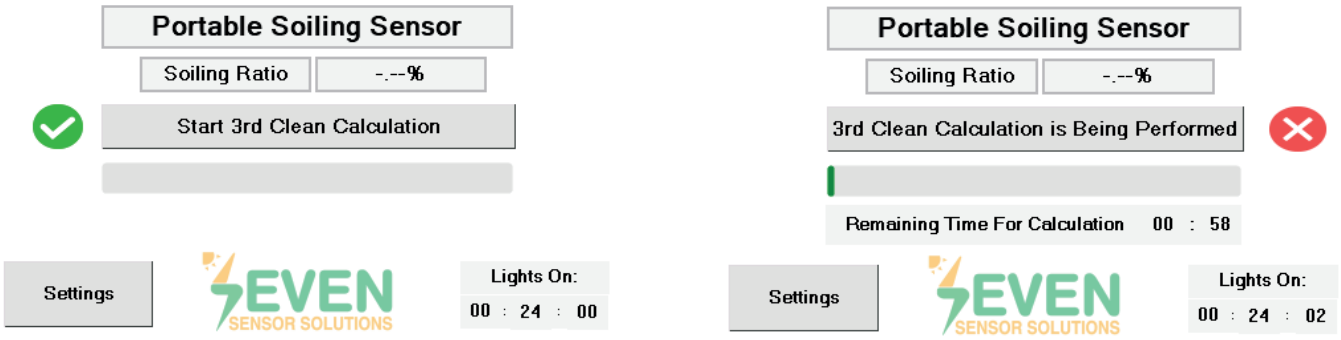


Figure 20: Third Measurement on the Clean Panel

20. Click **"Start 3rd Clean Calculation"** button to begin the third measurement on the clean panel. The measurement will be completed in 1 minute.



1st Step 2nd Step

Figure 21: Starting the Third Measurement on the Clean Panel

21. Once the third clean panel measurement is completed, the Soiling Ratio will be displayed on the LCD screen.

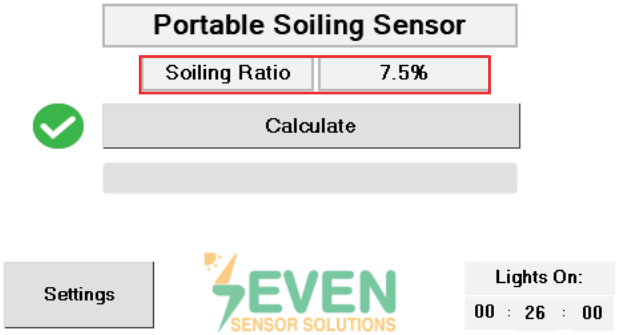


Figure 22: Display of the Calculated Soiling Ratio

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22. After the measurement is completed, the soiling ratio of different panels can be calculated by repeating the same processes.

23. The Portable Soiling Sensor's battery can operate the sensor for up to 5 hours. At the end of the usage period, the battery need to be recharged. The battery charge level can be monitored via the **"Battery Capacity Voltage"** indicator located on the battery box. For an accurate reading of the charge level, the indicator should be checked while the **"ON/OFF"** button is in the OFF position.

1st Step 2nd Step

Figure 23: Battery Capacity Voltage

Note: *It is recommended to operate the Portable Soiling Sensor for a maximum of 2 hours continuously, followed by a minimum 15-minute shutdown period. This process is intended to prevent the internal lamps of the sensor from overheating.*

24. After the battery is depleted, it should be charged using the battery charger via the **"POWER/CHARGE"** connector. Once the adapter is connected to the connector on the battery box, the **"ON/OFF"** button must be pressed and held. If this button is not pressed, the battery will not charge. It takes approximately 3 hours for the battery to fully charge.

4. Sensor Firmware Update Instructions

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 firmware update purposes.

Please follow the steps below to update the sensor firmware.

4.1. Cable Connections

1. Connect the communication cable to the 'RS485' connector on the Portable Soiling Sensor.

1st Step 2nd Step

Figure 24: Connection of the Communication Cable to the Sensor

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2. Connect the green wire (RS485 A) of the communication cable to USB-RS485 Converter Data (+) and connect the yellow wire (RS485 B) of the communication cable to USB-RS485 Converter Data (-) like shown at Figure 24.

Figure 25: Cable Connections of the USB-RS485 Converter

3. Connect the USB-RS485 converter to the USB port on your computer.

4.2. RS485 Driver Control

The PC system has to have an RS485 port set up as a serial COM port. If your PC system has an RS485 connection, you can skip these steps and proceed to the “Configuration Tool Connection” process.

If the PC system does not have an RS485 port configured as a serial COM port, please follow the steps below.

1. Download the driver for the RS485 converter you are using to your computer.

Note: *When this driver is required, please ask SEVEN Sensor technical team to send you this file.*

2. Go to **“Device Manager”** in your PC.

3. Double Click on the port to which the USB-RS485 converter is connected from the **“Ports (COM and LPT)”** section.

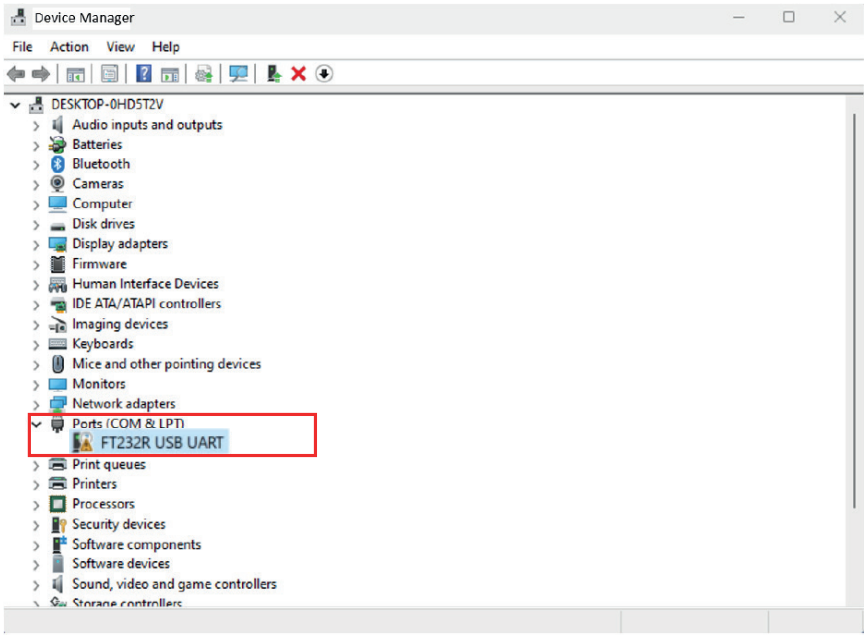

Figure 26: Ports (COM and LPT)

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4. In the window that is opened, go to **“Driver”** section and click on **“Update Driver”.**

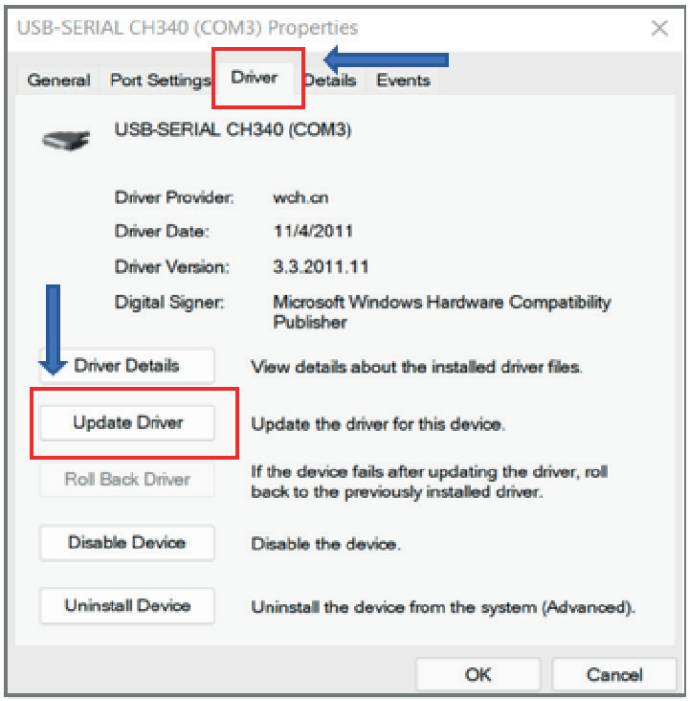

Figure 27: Update the Driver

5. Click on **“Browse my computer for drivers”.**

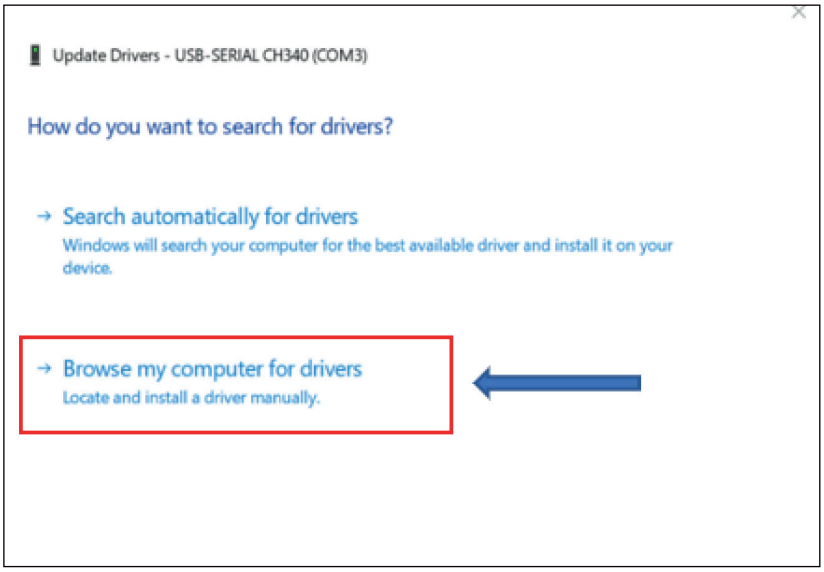

Figure 28: Search Drivers in PC

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6. Click the **“Browse”** button to select the driver file you downloaded, then click on **“Next”** to complete the driver update.

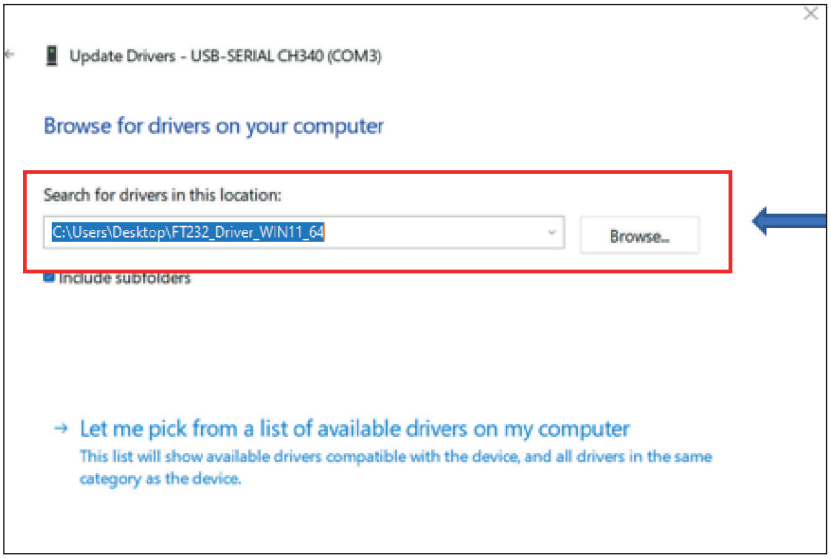

Figure 29: Completing the Driver Update

4.3. Configuration Tool Connection

1. Download the 3S-SMS-MB Configuration Tool software from the following link and install it on your computer.

https://www.sevensensor.com/files/d/s/v4.1_3S-SMS-MB_Configuration_Tool.zip

2. Launch the 3S-SMS-MB Configuration Tool. After the Configuration Tool is started, the following screen will appear.

Note: *The Portable Soiling Sensor must be powered on to connect it to the configuration tool.*

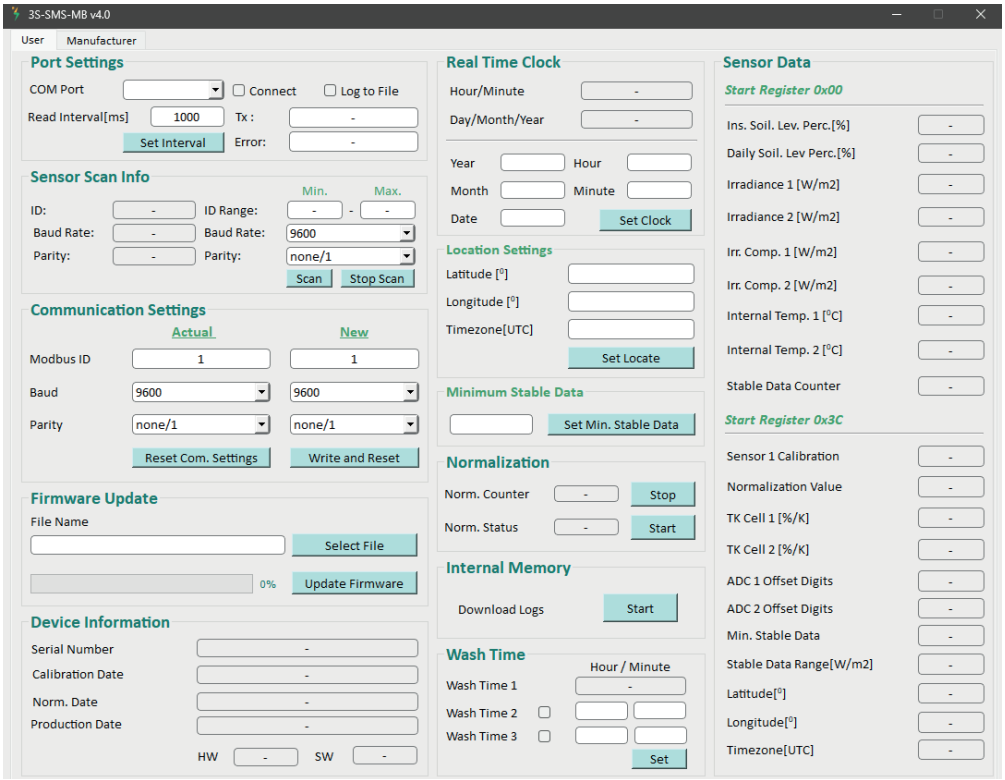

Figure 30: 3S-SMS-MB Configuration Tool

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3. Select the COM Port to which the device is connected.

4. Enter Modbus ID and Baud of Sensor on **“Communication Settings”** in **“Actual”** section.

Note: *At Factory Default: Modbus ID:1 Baud:9600 Parity: None/1.*

5. Click the **”Connect”** button.

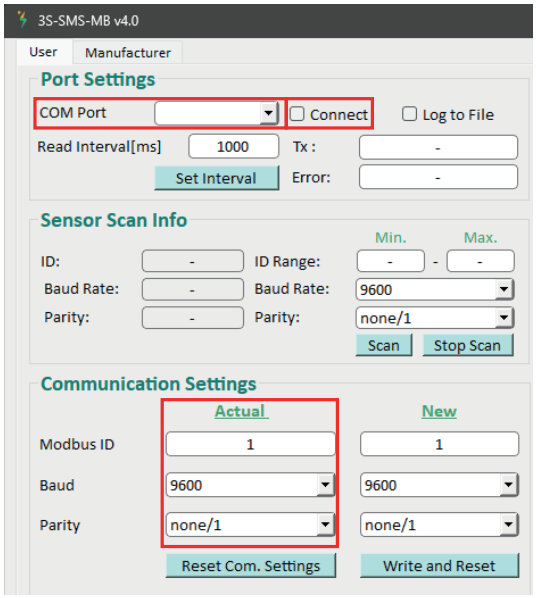

Figure 31: 3S-SMS-MB Configuration Tool Connection

6. Select the software update file (.bin) using the **“Select File”** button.

Note: *Software update file (.bin) will be sent to you by SEVEN Sensor technical team.*

7. Click the **“Update Firmware”** button.

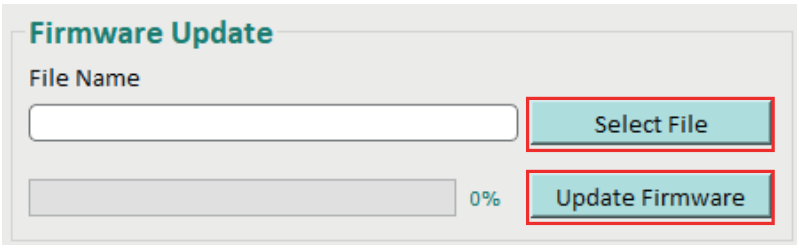

Figure 32: Remote Firmware Installation

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8. Once the software installation is complete, the message **“file transmission is completed”** will appear on the screen, indicating that the process is finished.

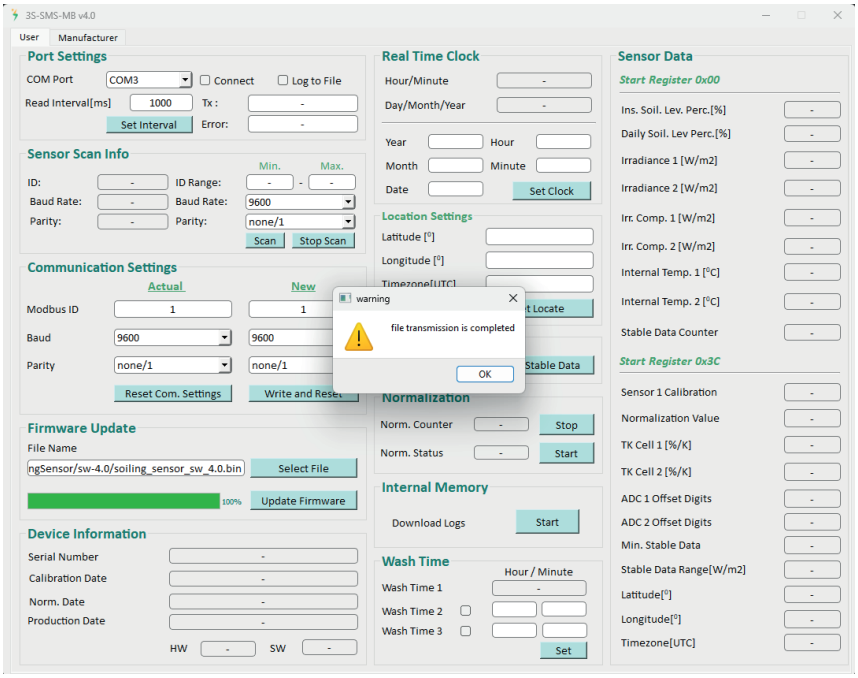
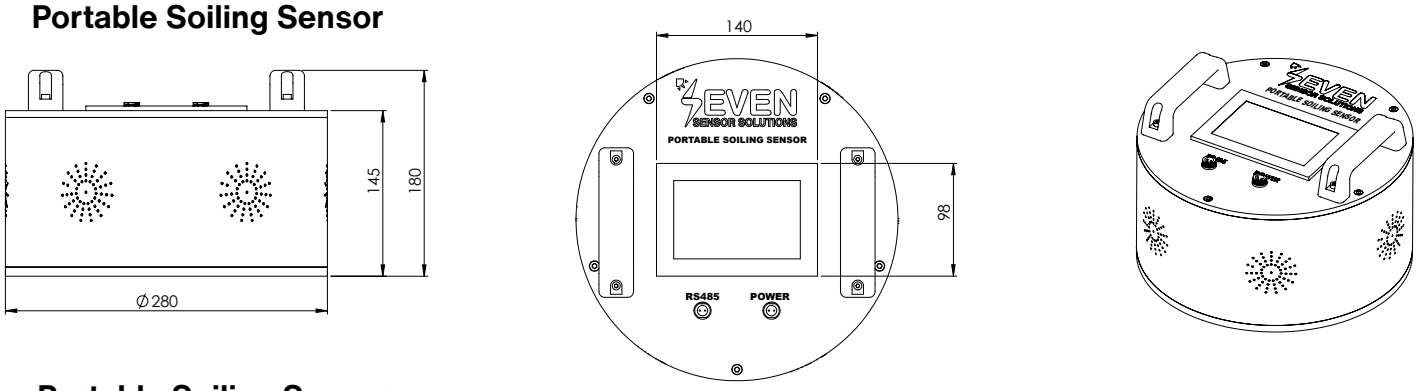


Figure 33: Firmware Installation Message

Technical Drawings

Portable Soiling Sensor



Portable Soiling Sensor

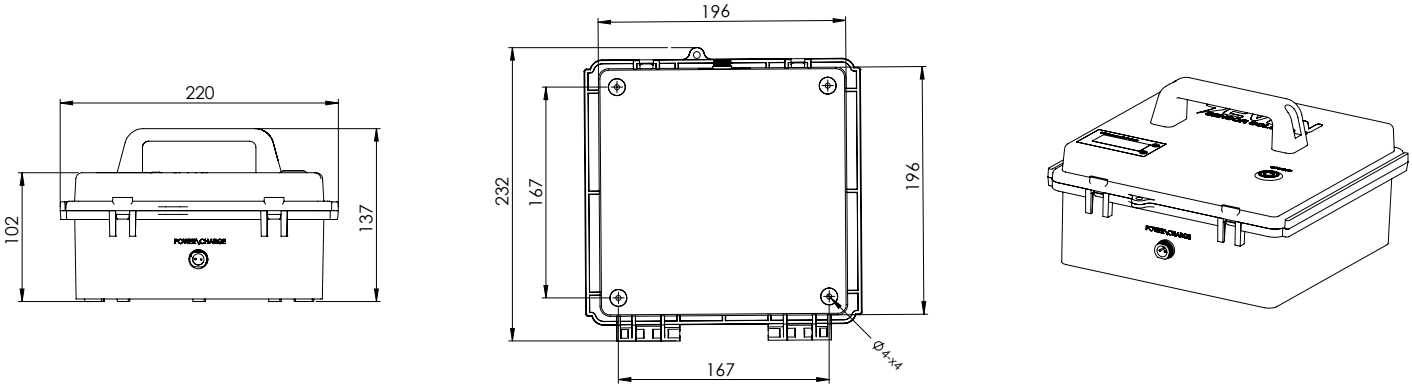


Figure 34: Technical Drawing of the Portable Soiling Sensor

Note: *All dimensions are given in millimeters.*

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6. Calibration

The Portable Soiling Sensor requires periodic calibration to ensure accurate and reliable measurements. It is recommended that your sensor be calibrated after 500 hours of operation. Performing the calibration process before exceeding this period will increase the accuracy and reliability of the measurements.

Calibration processes are carried out by SEVEN Sensor. For this, please contact the SEVEN Sensor technical support team.

7. Inspection and Maintenance

The battery life of the Portable Soiling Sensor is between 2 and 3 years, after which the battery should be replaced. Please contact the SEVEN Sensor sales team for battery replacement.

Fastener tightness and cable conditions, 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.

8. Contact Details

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

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