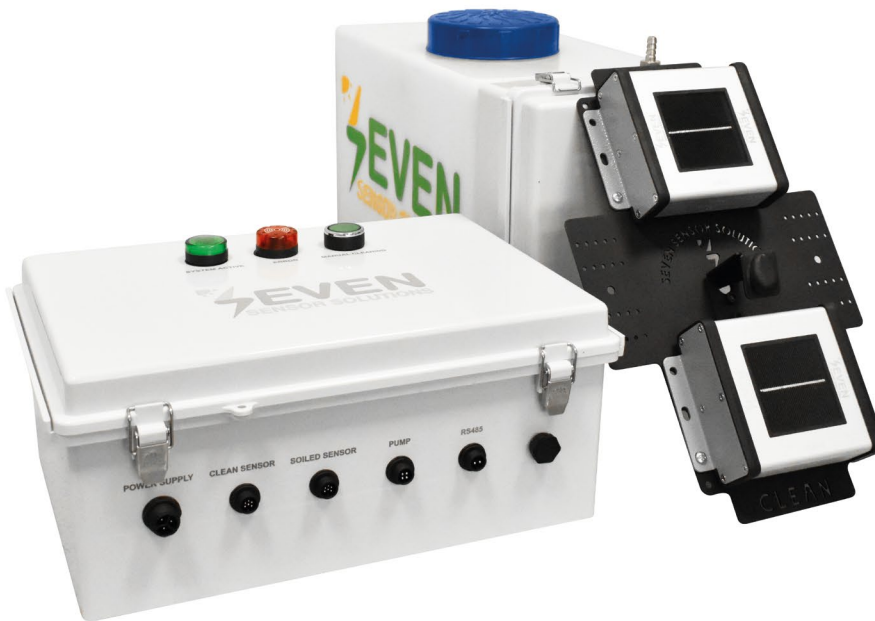


AUTOMATIC SOILING SENSOR



WORKING PRINCIPLES

SEVEN Soil Monitoring System measures the soiling due to environmental factors while causing energy loss.

PV Soiling = Energy Loss

The soil monitoring system, which is suitable for utility, commercial, industrial and roof-top projects, informs the user of production losses due to soiling. Thus, if the sensor reads 10% as Soiling Ratio, the energy loss in the PV system is 10% as well.

SEVEN soil monitoring system calculates the soiling ratio by comparing the irradiation values received from two irradiance sensors, which are the clean sensor and the dirty sensor of the PV system. The cleaning of the irradiance sensor is done automatically with pure water. The system provides the energy loss to the user, based on the data received from the cleaned and soiled irradiance sensors by comparing two irradiance values.

$$\text{Soiling Ratio} = \left[1 - \frac{\text{Normalized Irradiance}_{(\text{Dirty Cell})}}{\text{Normalized Irradiance}_{(\text{Clean Cell})}} \right] \times 100$$

According to IEC 61724-1 standard, the soiling ratio should be calculated as daily average single soiling ratio. Only one soiling ratio per day is recommended for the system because frequent measurements are affected by radiation fluctuations. Although Seven provides instantaneous soiling ratio values also. Low irradiance values and unstable weather conditions are not included in the calculation as per IEC 61724-1 standard. In addition, these measurements have to be made within ± 2 hours of local noon time. The user decides the cleaning of the module by checking the soiling ratio to prevent production loss and increase the efficiency of the PV system.

AUTOMATIC SOILING SENSOR

PRODUCT PHOTOS

Irradiance Sensors



Elektronic Box



Water Tank



AUTOMATIC SOILING SENSOR

SYSTEM FEATURES

AUTOMATIC SOILING SENSOR

General Information	
Soiling Ratio	%0 - %100
Resolution	%0.1
Uncertainty	≤1%
Followed Standard	IEC61724-1 (Annex C)
Interface	RS485 up to 38400 Baud
Communication Protocol	The sensor is connected via a 2-wire RS485 bus with open vendor-independent Modbus RTU Protocol, Sunspec compliant
Protection	IP65
Power Supply	100-240 V AC (Self powered model is optional)
Irradiance	0...1600 w/m ²
Calibration	Each sensor is calibrated under Class AAA Sun Simulator as per IEC 60904-2 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.
Operating Temperature	-20°C / +85°C
Water Tank Capacity	18 Liter
Water Consumption	36lt./year (2 times filling per year)
Cleaning Fluid	Pur Water
Antifreeze Ratio	%65 Pur Water + %35 Antifreeze (Weather conditions ≤ 0°)
*Max. Water Line Length	2,5 Meter
*Max. Water Line Height	2,5 Meter
Electrical Connection	
Input 1	100-220V AC, 3 Pin Connector
Input 2	Clean Reference Cell, 6 Pin Connector
Input 3	Soiled Reference Cell, 6 Pin Connector
Input 4	Water Pump, 4 Pin Connector
Input 5	RS485, 2 Pin Connector
Green	RS485 A / Data(+)
Yellow	RS485 B / Data(-)
Modbus Specification	
Baud Rate	4800, 9600, 19200, 38400
Parity	None, even, odd
Stop Bit	1, 2 (sadece none parite)
Factory Default	9600 Baud, 8N1, address: 1

*The system consumes approx. 100 mililiter water for single run for 2,5 meters water hose length. The water tank is able to serve 180 days (6 months). Consult SEVEN if the water hose longer than 2,5 meters.

AUTOMATIC SOILING SENSOR

Modbus RTU Technical Specifications

Supported Bus Protocol

Baud Rate: 4800 , 9600 , 19200 , 38400

Parite: None, even, odd

Stop Bit: 1, 2 (only none parite)

Factory Settings: 9600 Baud, 8N1, Address: 1

Communication Protocol: MODBUS RTU

Supported Function Code: 0x04: Read Input Register

Configuration Map:

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

ID-Dec.	ID-Hex	Değer
6	0x03	Clean Cell Temperature Compensated Irradiance Value 0. 16000 0.1 W/m ²
7	0x04	Soiled Cell Temperature Compensated Irradiance Value 0. 16000 0.1 W/m ²
12	0x9	Clean Cell Temperature -400 ... +900[range -40°C ... +90°C], 0.1°C
13	0x10	Soiled Cell Temperature -400 ... +900[range -40°C ... +90°C], 0.1°C
24	0x23	Instantaneous Soiling Ratio 0...100[%], 0.1%
25	0x24	Daily Soiling Ratio 0...100[%], 0.1%

AUTOMATIC SOILING SENSOR

SunSpec and Modbus

Serial/ General

Baud Rate: 9600

Parity: None

Stop Bits: 1

RS-485

Interface Mode: 2-Wire Half Duplex

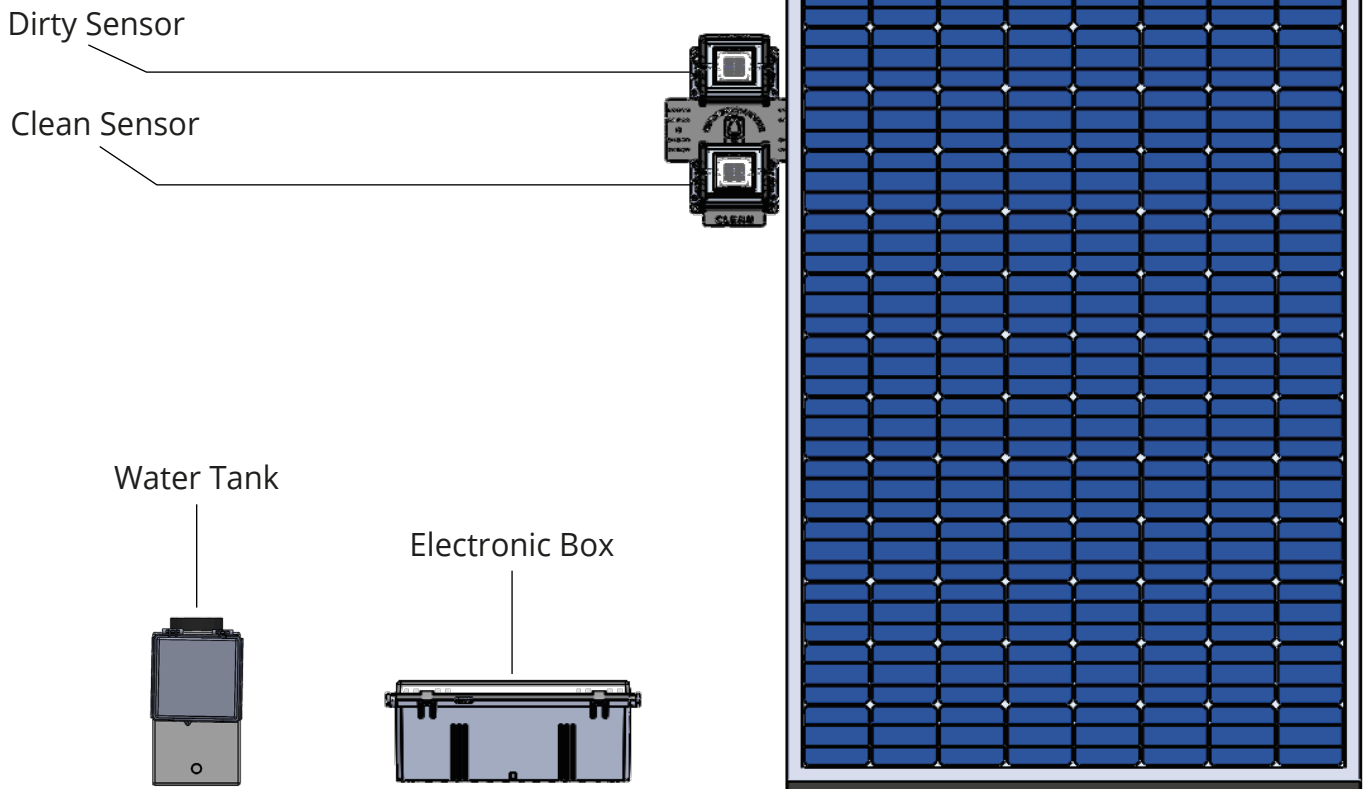
Register Map:

Start	End	#	Name	Type	Units	Scale Factor	Contents	Description
0001	0002	2	C_SunSpec_ID	uint32	N/A	N/A	"SunS"	Well-known value. Uniquely identifies this as a SunSpec Modbus Map
0003	0003	1	C_SunSpec_DID	uint16	N/A	N/A	0x0001	Well-known value. Uniquely identifies this as a SunSpec Common Model block
0004	0004	1	C_SunSpec_Length	uint16	registers	N/A	65	Length of common model block
0005	0020	16	C-Manufacturer	String(32)	N/A	N/A	"SEVEN"	Well-known value
0021	0036	16	C-Model	String(32)	N/A	N/A	"3S-IS"	Manuf specific value
0037	0044	8	C-Options	String(16)	N/A	N/A	"0"	Manuf specific value
0045	0052	8	C-Version	String(16)	N/A	N/A	"1"	Manuf specific value
0053	0068	16	C_Serial Number	String(32)	N/A	N/A	"Serial"	Manuf specific value
0069	0069	1	C_DeviceAddress	uint16	N/A	N/A	60	Modbus Id
0070	0070	1	C_SunSpec_DID	int16	N/A	N/A	307	Start of next Device
0071	0071	1	C_SunSpec_Length	int16	N/A	N/A	11	Device Model Block Size
0082	0082		E_BaseMet-SoilMoisture	int16	Degress	0	Measured	Daily Soiling Ratio
0083	0083	1	C_SunSpec_DID	int16	N/A	0	302	Well-known value. Uniquely identifies this as a SunSpec Irradiance Model
0084	0084	1	C_Sunspec_Length	int16	N/A	0	5	Variable length model block =(5*n), where n=number of sensors blocks
0085	0085	1	E_Irradiance-Plane-of Array-1	int16	W/m ²	0	Measured	Clean Cell Irradiation
0086	0086	1	E_Irradiance_Plane-of-Array_2	uint16	W/m ²	0	Measured	Soiled Cell Irradiation
0095	0095	1	C_SunSpec_DID	int16	N/A	0	308	Well-known value. Uniquely identifies this as a SunSpec Back of Module Temperature Model
0096	0096	1	C_Sunspec_Length	int16	N/A	0	2	Variable length model block =(5*n), where n=number of sensors blocks
0100	0100	1	E_xxx-BOM-Temp_1		°C	-1	Measured	Back of module temperature_1
0101	0101	1	E_xxx-BOM-Temp_2	int16	°C	-1	Measured	Back of module temperature_2
0105	0105	1	EndOfSunspecBlock	uint16	N/A	N/A	0xFFFF	End of SunSpec Block
0106	0106	1	C_Sunspec_Length	uint16	N/A	0	0	Terminate length, zero
0200	0200	1	Modbus Id - Write Register	int16	N/A	N/A	60	Modbus device address, write register

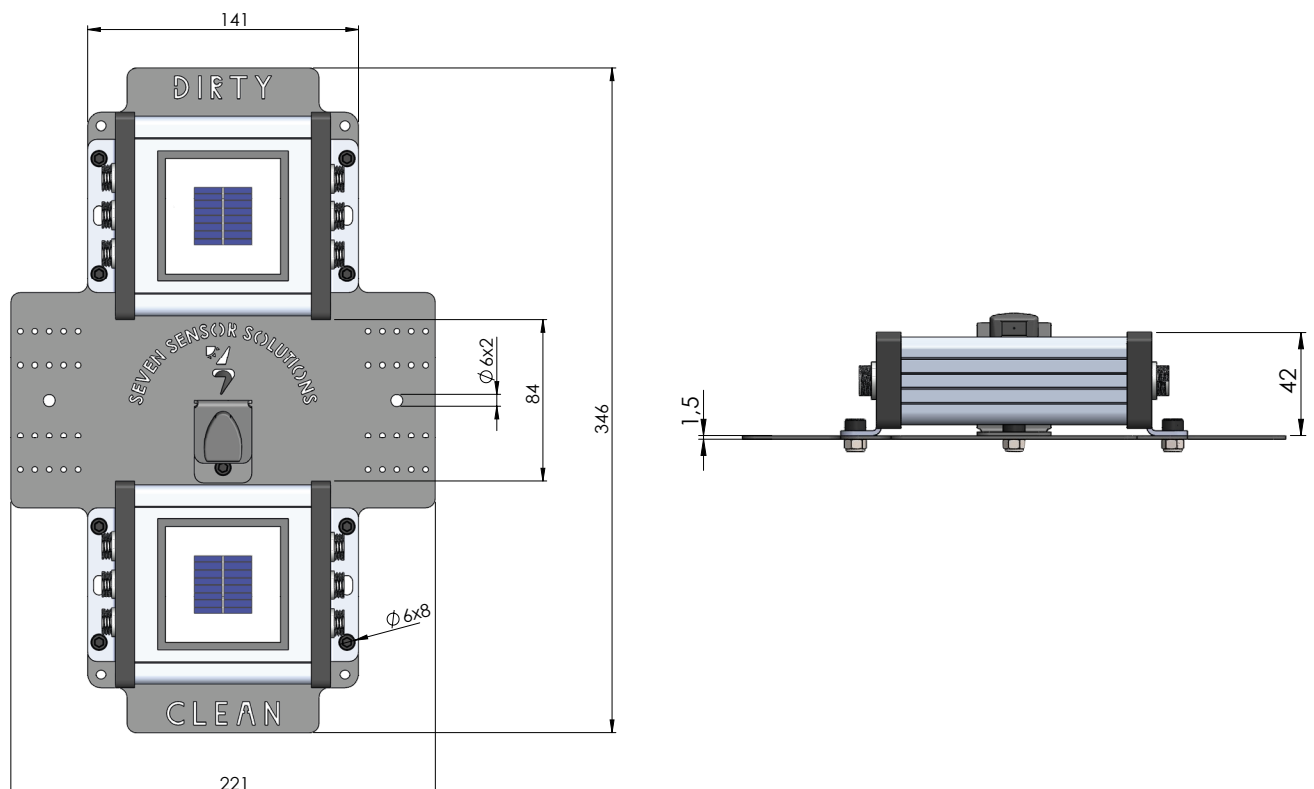
AUTOMATIC SOILING SENSOR

TECHNICAL DRAWINGS

System Components

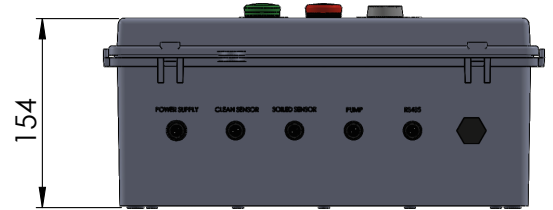
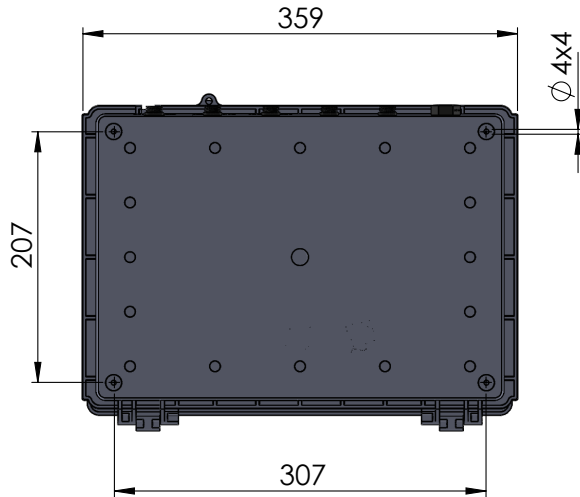


Irradiance Sensor / Mounting



AUTOMATIC SOILING SENSOR

Electronic Box



Water Tank

