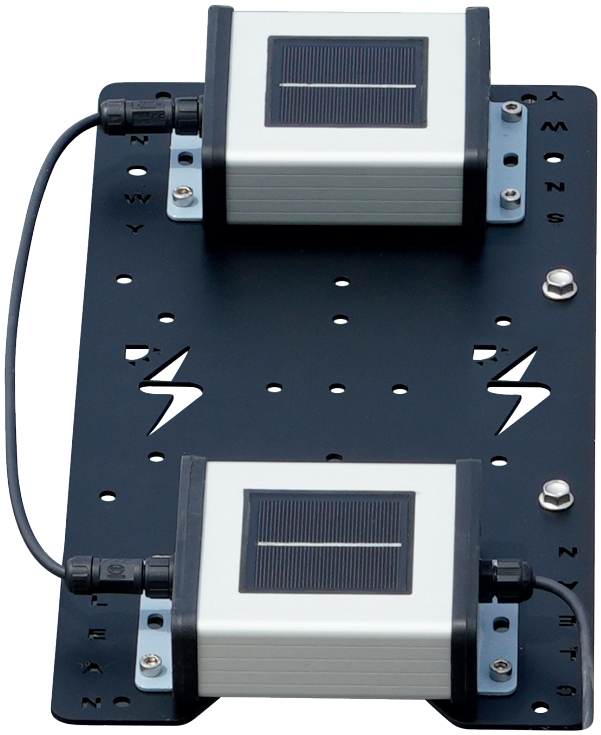
SEVEN
SENSOR SOLUTIONS



3S-SS-MB

Snow Sensor

USER MANUAL

USER MANUAL TABLE OF CONTENTS

Pinarcay OSB Mahallesi 11. Cadde, No: 35, Corum Organize Sanayi Bolgesi 19200 Merkez / Corum
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1. Introduction

Snow 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.

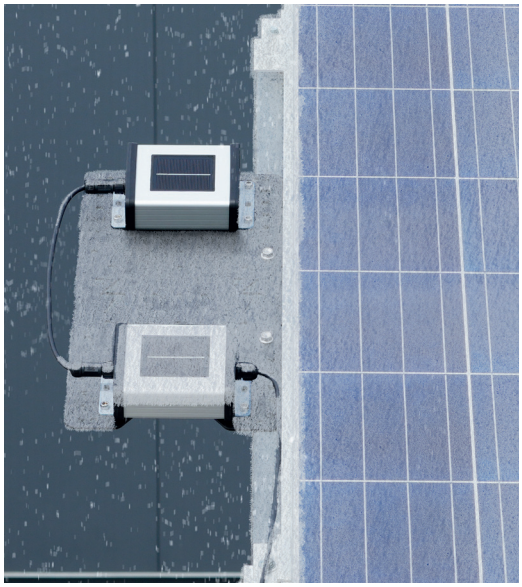

Figure 1 – Snow Sensor

SEVEN Snow Sensor is designed to measure the loss in energy production caused by snowfall on photovoltaic modules. Suitable for both ground and rooftop projects, the snow sensor notifies the user of production losses due to snowfall. If the snow rate read from the sensor is 10%, it means that there is 10% energy loss in the facility.

Snow Rate = Energy Loss

The SEVEN Snow Sensor calculates the snow rate of the PV plant by comparing the irradiance data received from two reference cells, with and without snow. The snowy reference cell is exposed to snowfall in the same way as the panels, while the snow-free reference cell is heated by the heater inside the box, thus preventing snow accumulation on the cell. Monitoring systems provide the user with energy loss by using the snow rate.

$$\text{Snow Ratio} = \left(1 - \frac{\text{Normalized Irradiance}_{\text{Snowy Cell}}}{\text{Normalized Irradiance}_{\text{Snow free Cell}}}\right) \times 100$$

SEVEN Snow Sensor is specially designed for Photovoltaic projects with Solar Tracker systems. In Solar Tracker systems, snow creates both a challenging and unwanted load for the system and a cover that reduces energy production. SEVEN Snow Sensor communicates with the Tracker control center and ensures that the stand takes the appropriate position depending on the snow rate on the module. With SEVEN Snow Sensor, the snow rate is calculated and when it reaches the level determined by the user, it is decided to bring the modules to the appropriate position. Thus, savings can be achieved by preventing unnecessary operation of the solar tracking system when there is snow.

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.*

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2. Snow 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.

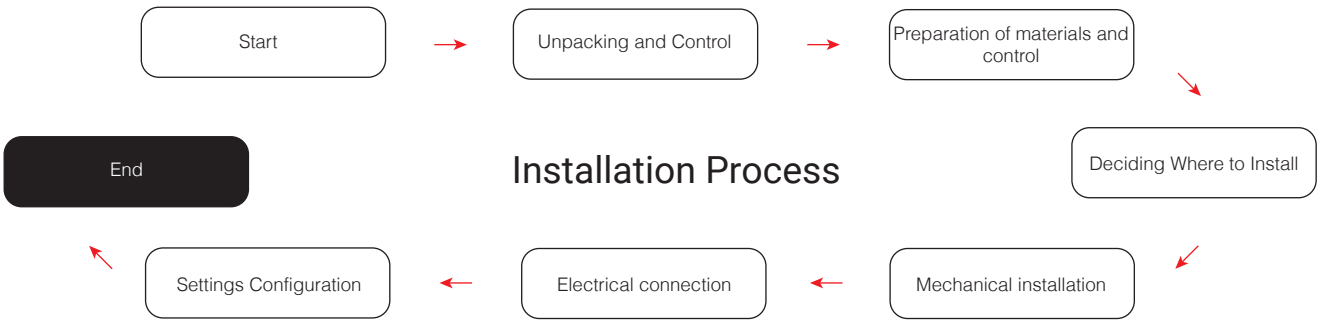
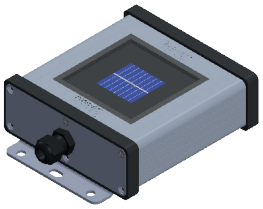
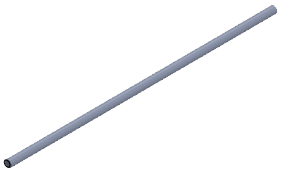
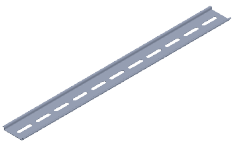


Figure 2 – Installation Process

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 is missing, damaged or defective.

			
A Qty: 2	B Qty:8	C Qty:8	D Qty:1
Irradiance Sensor	M5x12 Hexagon Head Bolt	M5 Fibre Nut	Snow Sensor Connection Apparatus
			
E Qty: 4	F Qty: 4	G Qty: 2	H Qty: 12
Hexagon Head Trapez Bolt	Threaded Rod	Support Aparatus	M6 Fibre Nut

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No	Part Name	Qty
A	Irradiance Sensor	2
B	M5x12 Hexagon Head Bolt	8
C	M5 Fibre Nut	8
D	Snow Sensor Connection Apparatus	1
E	Hexagon Head Trapez Bolt	4
F	M6 Threaded Rod	4
G	Support Apparatus	2
H	M6 Fibre Nut	12

Figure 3 – Snow Sensor 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. Therefore, the installation of the product may differ at each site. First of all, it must be decided where the product will be installed. The Snow Sensor should be placed no closer than 10 times the height of any obstruction.

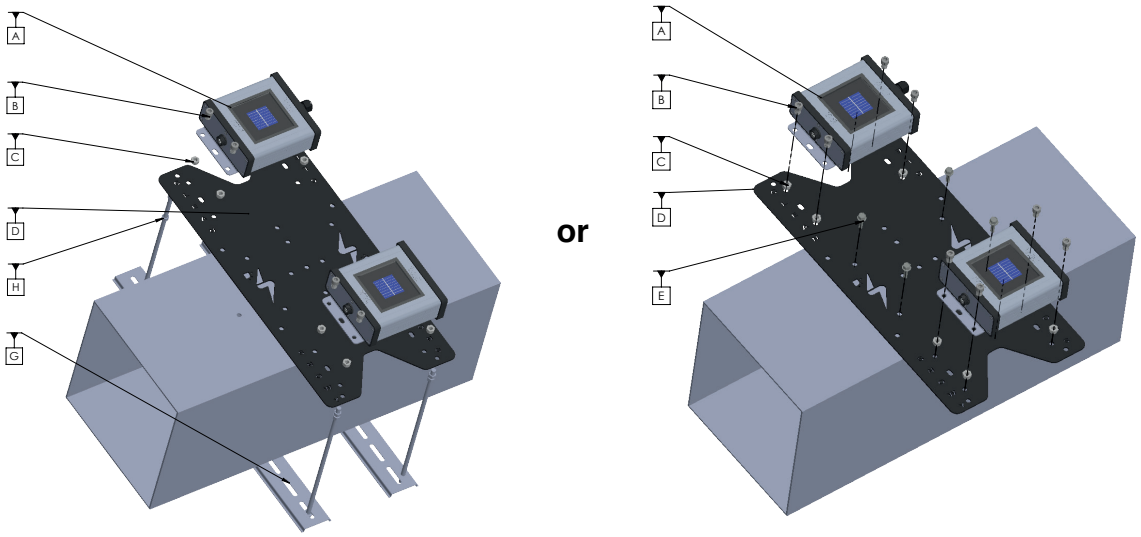

Figure 4 – Installation Site Selection

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If the Snow Sensor is to be mounted on a roof, it should preferably be mounted on the prevailing wind side of the building. Placing the station near any heat source such as a chimney or ventilation should also be avoided.

The Snow Sensor must be in the same direction and at the same inclination as the solar panels.

2.3. Preparation of Materials to be Used in Installation

The materials needed during installation are provided by SEVEN Sensor. The user should only prepare the following hand tools and personal protective equipment

Materials		
		
Gloves	Meter	Drill
		
6 mm Concrete Screw Drill Bit	Spirit Level	

Figure 5 – Materials to be used in Installation

2.4. Tracker Systems

The Snow Sensor should receive the same amount of snowfall as the site. Therefore, the tracker should rotate at the same angles as the system. The snow sensor must be mounted on the tracker system.

When the tracker system is cleared by angling the panels at 90°, the snowy cell is also cleared.

Figure 6 – Tracker Systems

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2.5. Fixed Systems

The Snow Sensor should be in the same direction and at the same inclination as the solar panels. It should be positioned in the same way as the solar panels.

The Snow Sensor should receive the same amount of snowfall as the site. Therefore, placement of the sensor close to sources of influence such as chimneys or vents should be avoided. It should also be placed away from dark, reflective and heat absorbing surfaces that will affect the irradiation measurement.

Figure 7 – Fixed Systems

2.6. Inspection and Maintenance

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

Note: *We recomend to use thread-locking fluid for fasteners.*

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

3. Connections

The sensor connection box is waterproof and UV resistant. The supply voltage for the Snow Sensor is 22 - 30 V DC@1 Amper. Operation with a supply voltage of 24 V is recommended.

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

The communication and power cable of Snow 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.*

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Wire Assignment for Power & Communication	
RS485 A / Data (+)	Green
RS485 B / Data (-)	Yellow
Power (+)	Brown
Power (-)	White

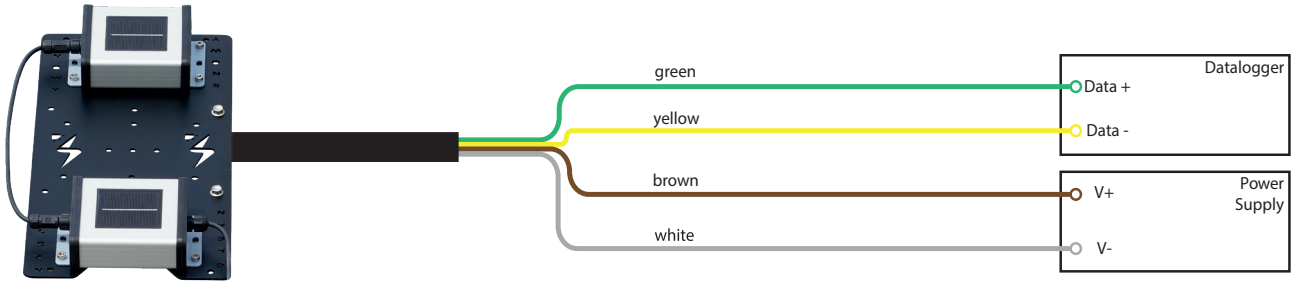

Figure 8 – Wire Assignment for Power&Communication

4. Configuration and Communication

Once the Snow Sensor has been installed and connected correctly, the sensor begins autonomously to take measurements.
Attention must be paid to the following points:

• If several Modbus Device are operated on a network, a unique device ID must be assigned to each device.

4.1. 3S-SS-MB Configuration Tool

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

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

Download the software 3S-SS-MB Configuration Tool and install it on your computer.

You can find the suitable configuration tool as per the Hardware & Software versions of the sensor you have via the following link.

https://www.sevensensor.com/download

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4.2. Modbus RTU Specifications

4.2.1 Supported Bus Protocol

The following information applies to SW1 software. Modbus maps for other software can be downloaded from the link below.

https://www.sevensensor.com/download

The Snow Sensor is equipped with an RS-485 communication port that supports Modbus RTU commands. The Snow 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, 8N1, address: 1

4.2.2. Supported Function Codes

The Snow 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	Reset Communication Command

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

4.2.2.1. Read Holding Registers (0x03)

Master Request:

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

Slave Resonse:

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 x N (Big Endian)	see the register table below

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Holding Register Map

The Snow Sensor holding register map is based on the **"SunSpec Alliance"** communication standards. All data marked in bold below are defined for the Snow Sensor.

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-IS"**
40036	**40043**	**Hardware Version**	String (16)	N/A	N/A	**"1.1"**
40044	**40051**	**Software Version**	String (16)	N/A	N/A	**"2.0"**
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**
40077	**40077**	**Snow**	int16	inches	0	**N/A**
Irradiance Model Registers						
40082	**40082**	**Block ID**	int16	N/A	0	**302**
40083	**40083**	**Length**	int16	Registers	0	**5**
40084	**40084**	**Plane of Array** **Plane of Array 1**	uint16	W/m²	0.1	**Measured**
40085	**40085**	**Plane of Array 2**	uint16	W/m²	0.1	**Measured**
End of Block Registers						
40107	**40107**	**End of SunSpec Block**	uint16	N/A	N/A	**0xFFFF**
40108	**40108**	**Length**	uint16	Registers	0	**0**
Device Address Read/Write Register						
40109	**40109**	**Modbus ID – Write Register**	uint16	N/A	N/A	**1**

4.2.2.2. Read Input Registers (0x04)

Master Request:

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

Slave Resonse:

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 the register table below

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4.2.2.3. Input Register Map

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

ID-Dec	ID-Hex	Value	Range	Resolution
30039	0x27	Instant Snow Ratio Percent	0..100%	0.1%
30040	0x28	Average Snow Ratio Percent	0..100%	0.1%

Additionally, the following internal data can be read individually or in blocks.

ID-Dec	ID-Hex	Value		Range
30301	0x12D	Hardware Version		Manufacturer Parameters Read Only
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		
30335	0x14F	Stable Data Range		
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 Month 2	
30356	0x164		Calibration Year 2	
30334	0x14E	Stable Data Min		
30336	0x150	Latitude		
30337	0x151	Longitude		
30338	0x152	Time zone		

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4.2.2.4. Read & Change Parameters (0x46)

Sub Function (0x04): Write Device Address

Master Request:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x04
New Address	1 Byte	1 to 247

Slave Response:

Address	1 Byte	1 to 247
Function Code	1 Byte	0x46
Sub Function Code	1 Byte	0x04
New Address	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.*

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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	2	**None/2**	1
19200	3	**Odd**	2
38400	4	**Even**	3
38400	3	**Even**	3

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

Master Request:

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

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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

4.2.2.5 Restart Communication Command (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

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5. Contact Details

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

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