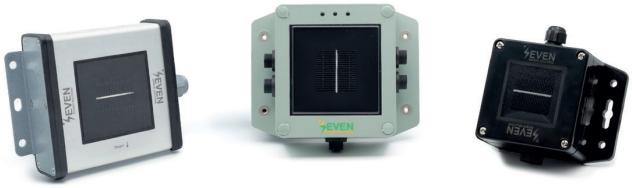
SENSOR SOLUTIONS

3S-IS/3S-IS+/3S-IS-LR



Irradiance Sensor

USER MANUAL

USER MANUAL TABLE OF CONTENTS

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Waste Disposal



This symbol indicates that the product is subject to European Union regulations on separate waste disposal. This applies to both the product itself and any accessories bearing the same symbol. Such products must not be disposed of as unsorted household waste.

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

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1. Introduction

Irradiance Sensors are part of the SEVEN meteorological sensor range, which includes professional, smart measurement sensors featuring a digital interface for environmental and industrial applications.



Figure 1 - 3S-IS+ Advanced Modbus Irradiance Sensor

Also referred to as a pyranometer with a photovoltaic (PV) reference cell, this sensor provides the user with real-time irradiance data in W/m² for calculating the performance ratio of PV plants. Depending on customer requirements, it is offered with different output options such as Modbus RTU, 4–20 mA, 0–1,5 V and 0–10 V. SEVEN products are designed to provide accurate meteorological measurement with reliable, high-quality components. The 3S-IS Irradiance Sensor complies with the IEC 61724 and IEC 60904 standards and meets the requirements of large-scale PV plant monitoring systems. For stable operation of the Modbus RS485 line in multi-sensor installations, the termination resistor can be easily enabled or disabled via the GUI, so daisy-chain connections can be configured quickly without additional hardware.

2. Preparation of Materials to Be Used in Installation

It is recommended that the products be tested before installation to make sure that all system components work properly. A general diagram of the installation steps is given below.

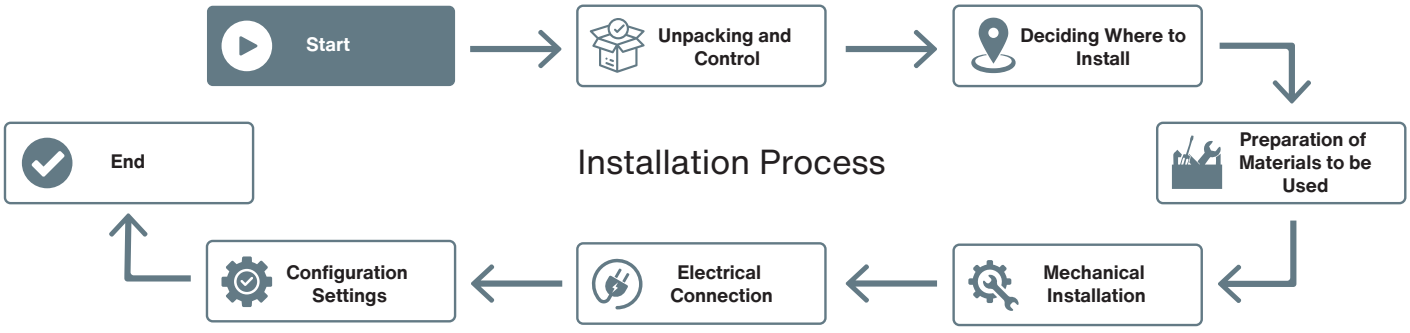


Figure 2 - Installation Process

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2.1. Unpacking and Control

When you receive the product, check carefully that the package contents are complete. If any component is missing, damaged or defective, contact SEVEN Sensor Solutions. For the package contents of external sensors, refer to the user manual of the relevant sensor.

2.1.1. 3S-IS+

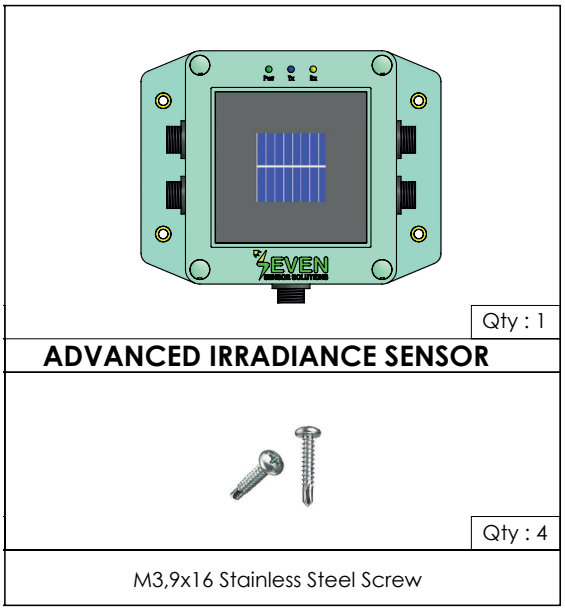


Figure 3 - 3S-IS+ Package Contents

2.1.2. 3S-IS

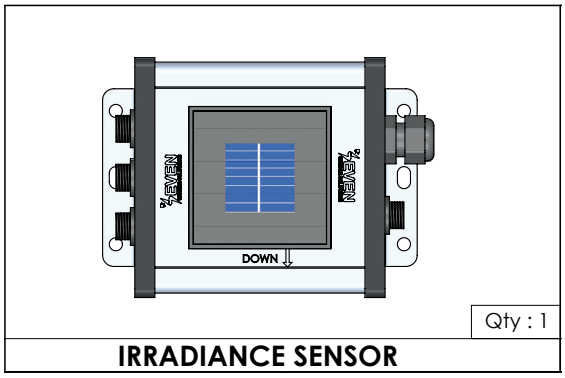


Figure 4 - 3S-IS Package Contents

2.1.3. 3S-IS-LR

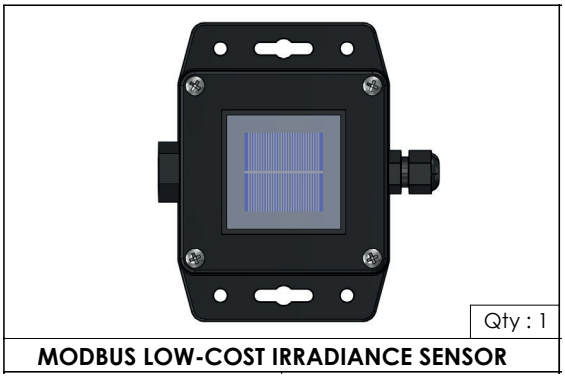


Figure 5 - 3S-IS-LR Package Contents

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2.2. Field Requirements and Considerations

Since each site has its own conditions and challenges, a site assessment should be carried out before deciding on the installation location. Irradiance, ambient temperature, wind speed and wind direction measurements can be directly affected by nearby obstacles, shading sources and local topography.

The Irradiance Sensor must be positioned at a distance of at least 10 times the height of any obstacle or shading source. In addition, it must be placed away from dark, reflective or heat-absorbing surfaces.

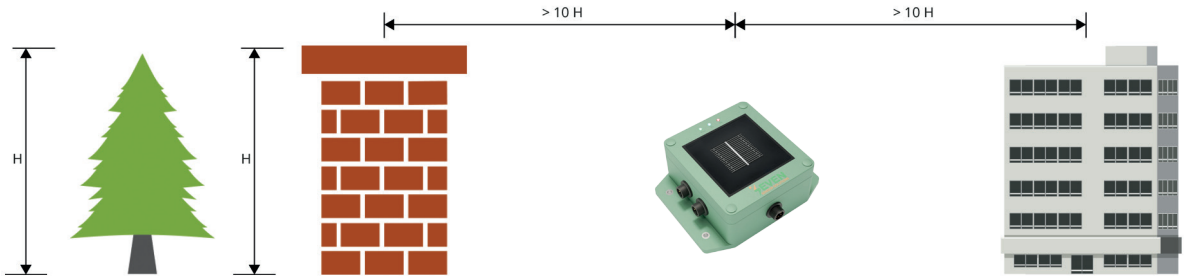


Figure 6 - Installation Site Selection

If the Irradiance Sensor set is mounted on a roof, the sensor should be placed where it is exposed to the wind and airflow as much as possible. In addition, placing the sensor near any heat source such as chimneys or ventilation outlets should be avoided.

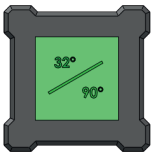
The Irradiance Sensor must be in the same orientation and at the same tilt as the solar panels. It must be positioned in the same plane as the solar panels or in a higher plane.

Read section 2.4.4 Irradiance Sensor Grounding for the points to consider when grounding.

Note: *To make the maintenance and cleaning of the Irradiance Sensor easier, especially in rooftop projects, the Irradiance Sensor set should be mounted in an easily accessible location.*

2.3. Required Hand Tools and Equipment

The sensor and the items listed in the package contents are provided by SEVEN. The user only needs to prepare the following hand tools and personal protective equipment. The material list below may vary depending on the fastener used.

Materials			
			
Gloves	Tape Measure	Drill	Suitable* Bolt
			
Pliers	Spirit Level	Screwdriver	Suitable* Screw

* For the suitable screw and bolt sizes to be used in mounting the sensor, follow the mounting steps under section 2.4 Installation.

Figure 7 - Materials Used in Installation

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2.4. Installation

The mechanical installation of the 3S-IS, 3S-IS+, 3S-IS-T-I, 3S-IS-T-1,5V, 3S-IS-T-10V and 3S-IS-LR Irradiance Sensors can be carried out in two ways:

- If a mounting structure has been purchased → follow the steps in Section 2.4.1.
- If a mounting structure has not been purchased → follow the steps in Section 2.4.2 to fix the sensor in a suitable location in the field.

Note: *Use only metric fasteners of the sizes specified in the installation instructions. Failures resulting from the use of fasteners of different sizes are not covered by the warranty, and the user is responsible for them.*

2.4.1. Mounting Structure

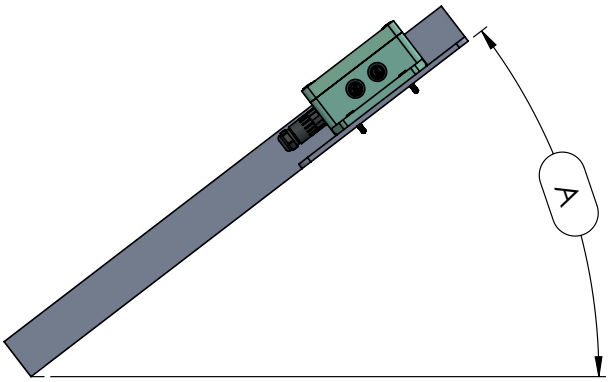
The mounting structure, on which the Irradiance Sensor and the connected external sensors are mounted, is very simple and quick to install.

Note: *If a mounting structure has been purchased, follow the mounting structure user manual.*

Mounting Structure User Manual: https://www.sevensensor.com/files/d/en/3S-MS_Mounting-Structure_User-Manual.pdf

2.4.2. Irradiance Sensor

2.4.2.1. 3S-IS+ Installation



Step 1

- The irradiance sensor must be mounted using the panel angle as reference.

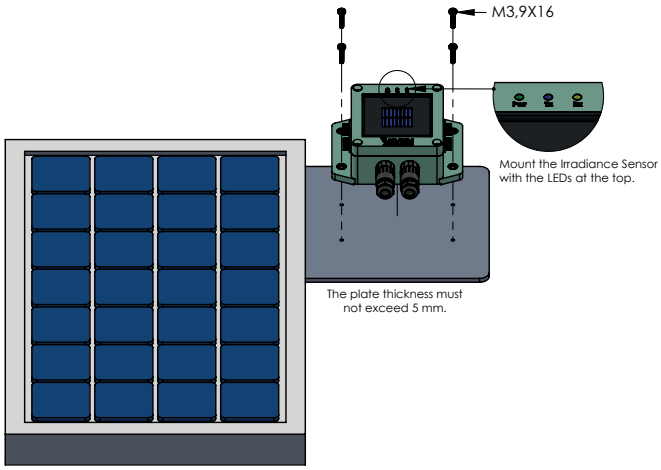
- The sensor must be mounted as high on the panel as possible.

Do not overlook the position of the status LEDs!

There are ventilation holes on the box. If the box is not positioned with the status LEDs positioned at the top edge of the sensor, water can get inside the box and damage the electronic board.

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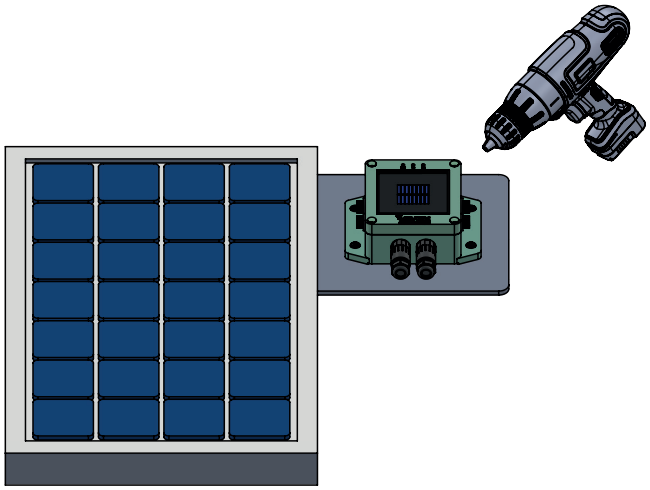
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Step 2

- The Irradiance Sensor must be mounted on the panel, on a sheet or profile with a maximum thickness of 5 mm, using M3,9x16 self-drilling screws.

- The screws must be installed as shown in the figure.



Step 3

- The screws must be installed using a hand drill.

M4 SCREW MOUNTING INSTRUCTIONS

1. Drill Settings

- Speed Selector: Set the speed selector on top of the drill to “1” (low speed).

- Torque Ring: Set the drill’s torque ring to the lowest setting (1 or 2). (Never set it to drill mode)

2. Screwing Procedure

- Angle: Hold the drill exactly perpendicular (90°) to the surface.

- Application: Press the trigger in a controlled manner to tighten the screw slowly.

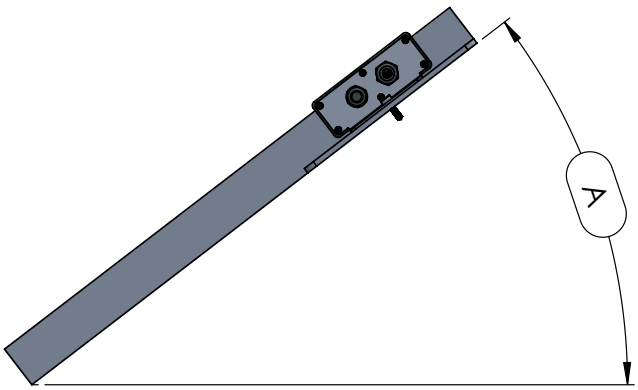
- Stop: As soon as the screw head seats on the plastic and you hear the drill’s torque clutch engage (clicking), release the trigger immediately.

Using sensors with an IP54 protection rating as “Rear Side Irradiance” sensors and in tracker systems may pose a risk in terms of sealing. This is because the range of motion angles that tracker systems perform during operation can affect the sealing performance. Using IP54 may not be a problem in systems that move at small angles; however, the sealing risk may increase in systems that move at large angles. For this reason, the choice of protection rating should be evaluated by the user in line with the application conditions and site requirements, and the IP class should be decided accordingly. You must state your protection-rating preference to the SEVEN Sales Team in your order.

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2.4.2.2. 3S-IS Installation



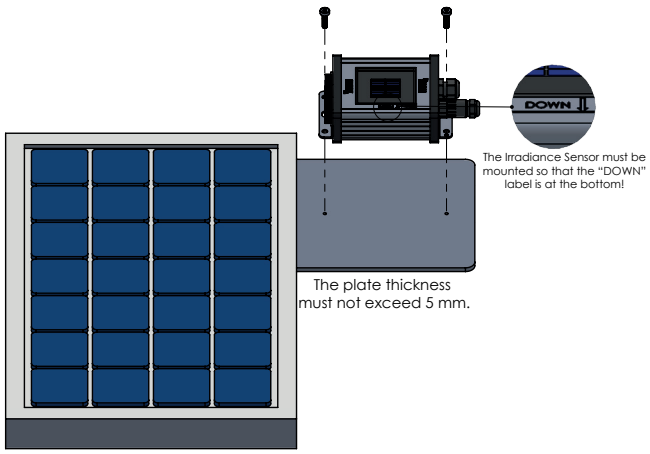
Step 1

- The irradiance sensor must be mounted using the panel angle as reference.

- The sensor must be mounted as high on the panel as possible.

Do not overlook the position of the arrow (↓) !

There are ventilation holes on the box. If the arrow (↓) is overlooked and these holes end up on the top of the box, water can get inside the box and damage the electronic board.

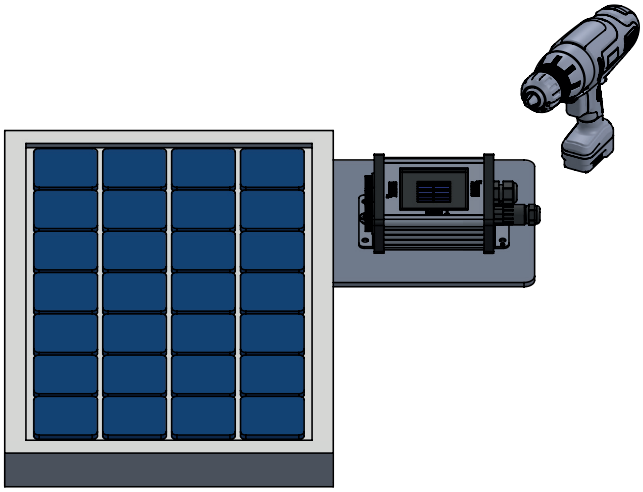


Step 2

- Pay attention to the “Down” marking indicated by the arrow on the irradiance sensor.

- The irradiance sensor must be mounted on the panel, on a sheet or profile with a maximum thickness of 5 mm, using M5x20 (x2) self-drilling screws. (The screws are supplied by the user. The user is responsible for any mounting errors caused by using fasteners other than the specified sizes.)

- The screws must be installed as shown in the figure.



Step 3

- The screws must be installed using a hand drill.

M5 SCREW MOUNTING INSTRUCTIONS

1. Drill Settings
- Speed Selector: Set the speed selector on top of the drill to “1” (low speed).
- Torque Ring: Set the drill’s torque ring to the lowest setting (1 or 2). (Never set it to drill mode)

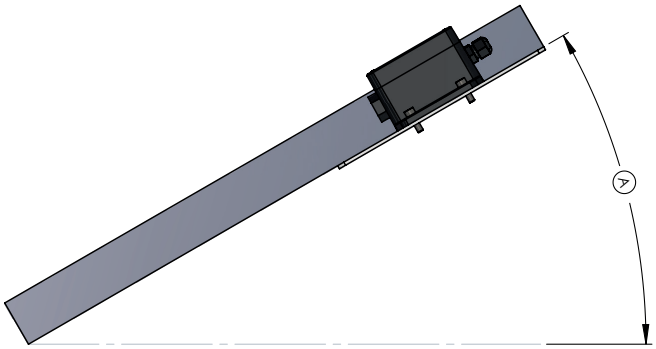
2. Screwing Procedure
- Angle: Hold the drill exactly perpendicular (90°) to the surface.
- Application: Press the trigger in a controlled manner to tighten the screw slowly.
- Stop: As soon as the screw head seats on the metal and you hear the drill’s torque clutch engage (clicking), release the trigger immediately.

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Using sensors with an IP54 protection rating as "Rear Side Irradiance" sensors and in tracker systems may pose a risk in terms of sealing. This is because the range of motion angles that tracker systems perform during operation can affect the sealing performance. Using IP54 may not be a problem in systems that move at small angles; however, the sealing risk may increase in systems that move at large angles. For this reason, the choice of protection rating should be evaluated by the user in line with the application conditions and site requirements, and the IP class should be decided accordingly. You must state your protection-rating preference to the SEVEN Sales Team in your order.

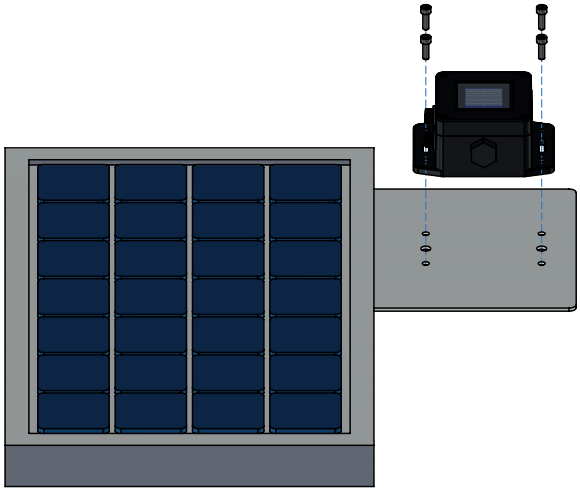
2.4.2.3. 3S-IS-LR Installation



Step 1

▪ The Low-Cost Irradiance Sensor must be mounted using the panel angle as reference.

▪ The sensor must be mounted as high on the panel as possible.



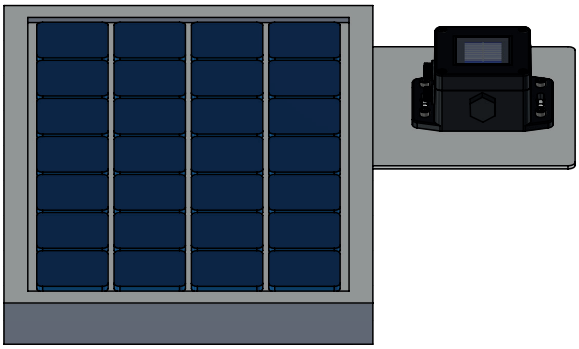
Step 2

▪ The sensor must be mounted on the panel using bolts or screws at least 20 mm long.

▪ The sensor must be mounted using one of the following:

* 4 x M5x20 bolts, or
* 4 x ST 4,8x20 self-drilling screws, or
* 2 x ST 6,3x20 self-drilling screws. (The bolts or screws must be supplied by the user to suit the thickness of the sheet metal on which the sensor is mounted.)

▪ The fasteners must be installed as shown in the figure.



Step 3

▪ Make sure that the bolts or screws are tightened properly.

▪ The sensor installation is complete.

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2.4.3. External Sensors

Module temperature, ambient temperature, wind speed, wind direction and relative humidity sensors can be connected to the Modbus Irradiance Sensor models, and a pressure sensor can additionally be connected to the 3S-IS+ model. For the installation of the other external sensors you have selected, follow the user manual of the relevant external sensor.

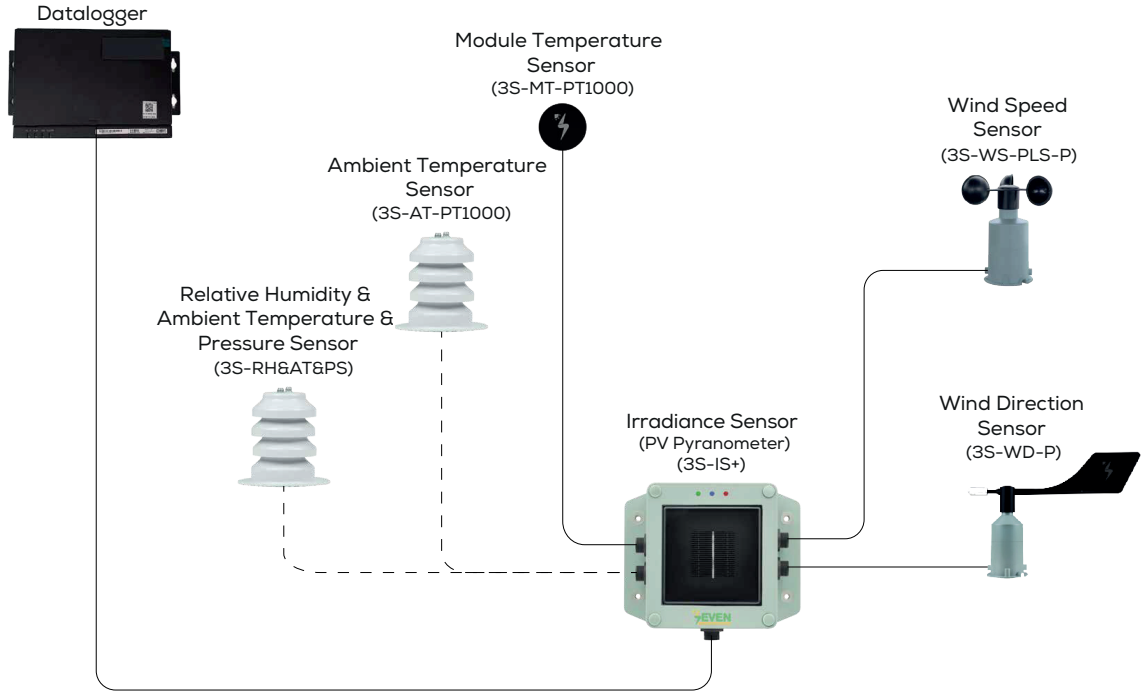


Figure 8 - External Sensors That Can Be Connected to the Advanced Modbus Irradiance Sensor

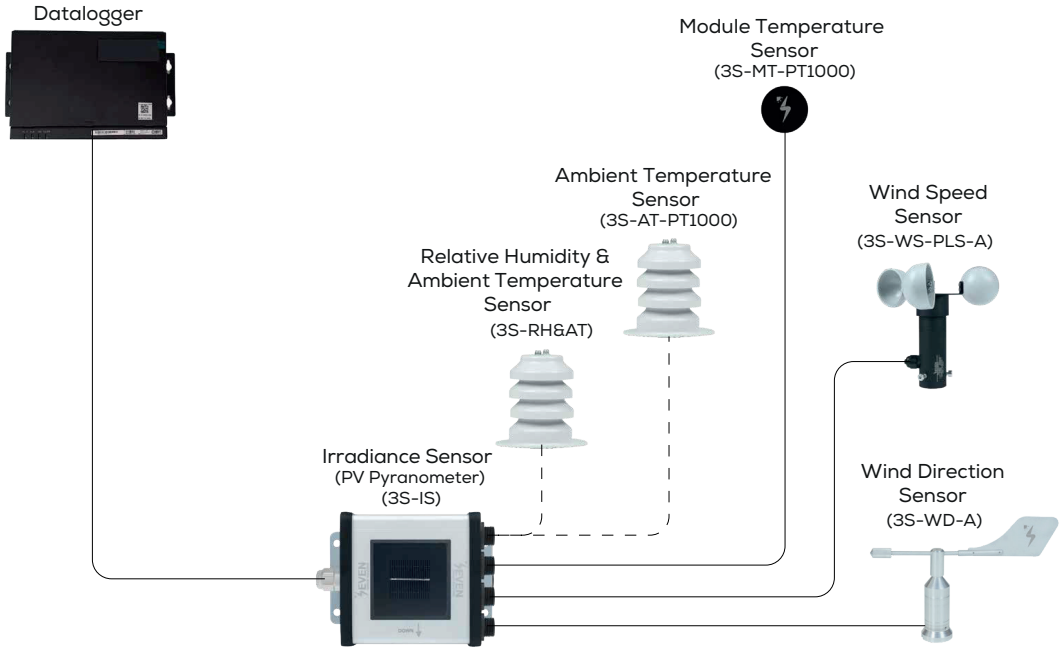


Figure 9 - External Sensors That Can Be Connected to the Modbus Irradiance Sensor

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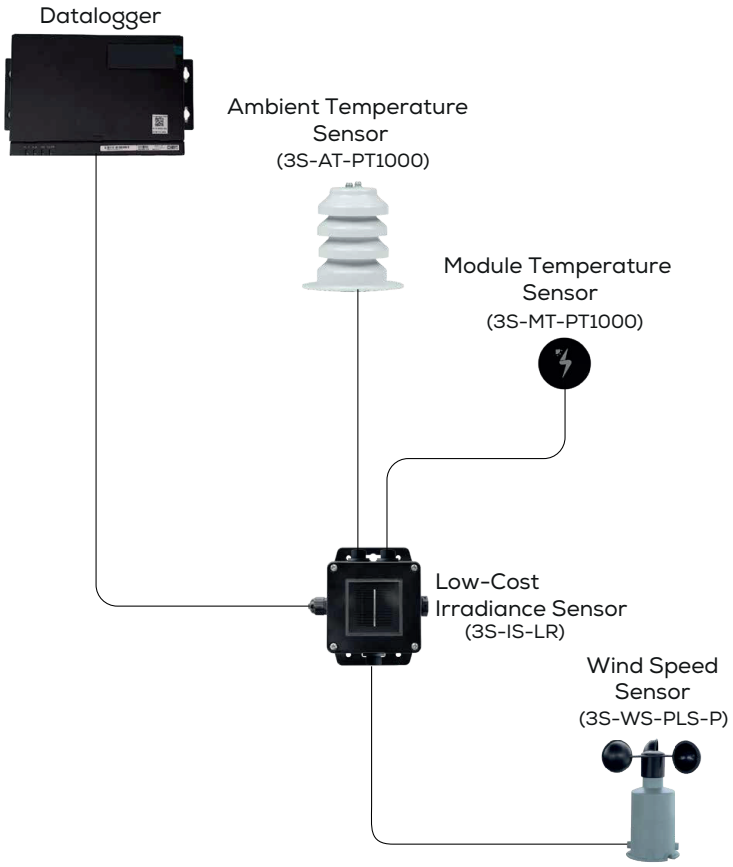


Figure 10 - External Sensors That Can Be Connected to the Low-Cost Modbus Irradiance Sensor

Note: *For the installation of the external sensors connected to the sensor, follow the installation instruction document of the relevant sensor.*

Module Temperature Sensor User Manual:
https://www.sevensensor.com/files/d/en/3S-MT-PT1000_Module-Temperature-Sensor_User-Manual.pdf
Ambient Temperature Sensor User Manual:
https://www.sevensensor.com/files/d/en/3S-AT-PT1000_Ambient-Temperature-Sensor_User-Manual.pdf
Wind Speed Sensor User Manual:
https://www.sevensensor.com/files/d/en/3S-WS_Wind-Speed-Sensor_User-Manual.pdf
Wind Direction Sensor User Manual:
https://www.sevensensor.com/files/d/en/3S-WD_Wind-Direction-Sensor_User-Manual.pdf
Relative Humidity, Ambient Temperature and Pressure Sensor User Manual:
https://www.sevensensor.com/files/d/en/3S-RH-AT-PS_Relative-Humidity-Ambient-Temperature-Pressure-Sensor_User-Manual.pdf

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2.4.4. Irradiance Sensor Grounding

Proper grounding is mandatory for the Irradiance Sensor to operate correctly and reliably. Grounding directly affects both the protection of the sensor against electrical noise (EMI/EMC) and the accuracy of the measurements.

In PV plants, RS485 communication lines and power cables can be exposed to high-frequency electromagnetic interference from the surroundings. If grounding is inadequate, this interference can reach the sensor's electronic board and cause deviations in the measured values, communication errors or permanent hardware damage. For this reason, both the Earth GND wire in the communication cable and the sensor housing must be connected to the facility's protective earth (PE) system.

The grounding method varies depending on the sensor model. The 3S-IS+ has a plastic housing, and grounding must be provided by connecting the grounding point on its back to the mounting structure tied to the PE system, using a grounding lug and cable. On the aluminium-housed models (3S-IS, 3S-IS-T-I, 3S-IS-T-1,5V, 3S-IS-T-10V), the dedicated grounding point on the mounting bracket is used. Model-specific details are explained in the subsections below.

All grounding operations must be carried out by qualified technical personnel on site using appropriate equipment and methods.

2.4.4.1. 3S-IS+ Housing and Communication Cable Ground Connection

The 3S-IS+ has a plastic housing; housing grounding must be provided by connecting the grounding point on its rear to the mounting structure tied to the PE system, using a grounding lug and cable. In addition, the Earth GND (black) wire in the communication cable must be connected to the grounding bus in the power panel.

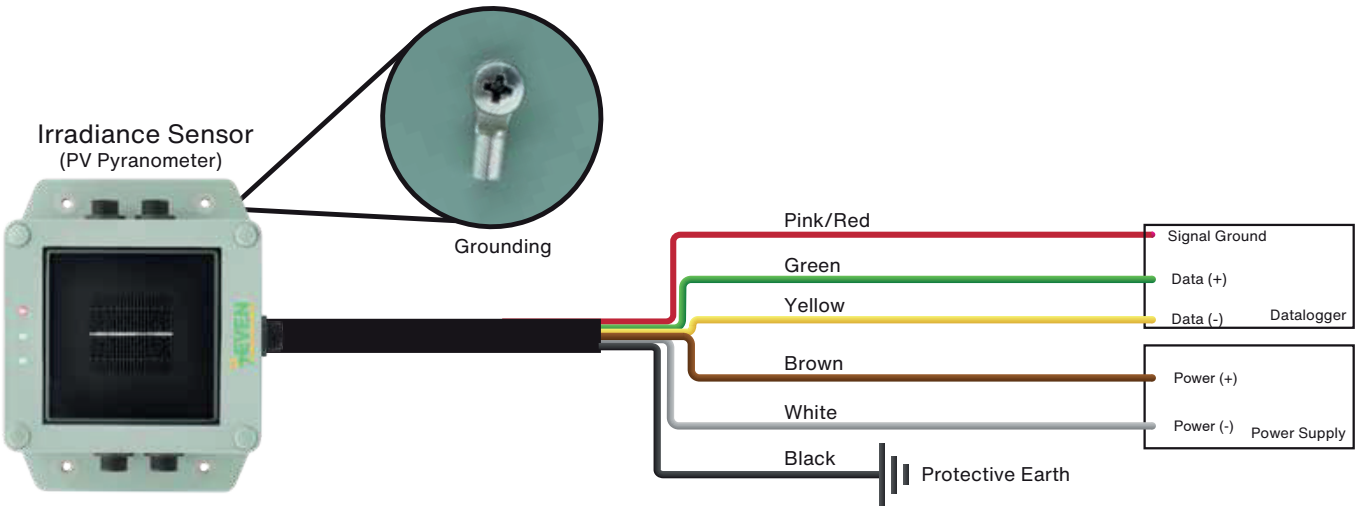


Figure 11 - 3S-IS+ Grounding

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2.4.4.2. 3S-IS Housing and Communication Cable Ground Connection

On the aluminium-housed models (3S-IS, 3S-IS-T-I, 3S-IS-T-1,5V, 3S-IS-T-10V), housing grounding is provided by mounting the sensor, at the marked grounding point on the mounting bracket, to a mounting structure or pole tied to the PE system. If the sensor is not mounted at this point, no housing grounding is formed and the EMC protection is insufficient. The Earth GND (black) wire in the communication cable must be connected to the grounding bus in the power panel.

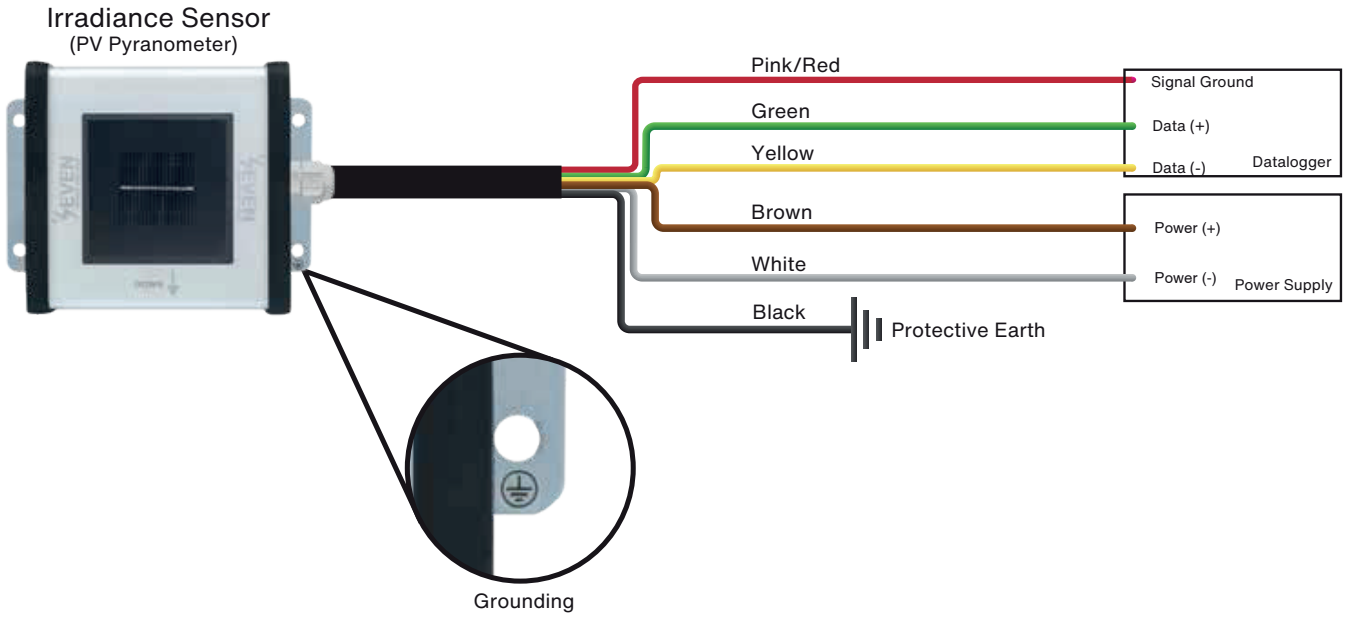


Figure 12 - 3S-IS Grounding

Note: *The 3S-IS-LR model does not have EMC protection or a grounding option. In environments where these are required, the 3S-IS+ and 3S-IS models should be preferred.*

2.5. Maintenance and Repair

The Irradiance Sensor does not require any maintenance or spare-part replacement. However, in line with the standards, the surface of the solar cell must be cleaned periodically. The glass surface of the solar cell can be cleaned gently with a soft cloth and soapy water. If manual cleaning is not feasible, the 3S-SCIS model, which has a periodic automatic cleaning feature, can be used.

Periodically check the tightness of the fasteners and the condition of the cables, any damage, deterioration or disconnection of the sensors and electrical enclosures, soiling or displacement of the optical sensors, signs of moisture or pests in the enclosures, loose cable connections, detachment of the temperature sensors, brittle or cracked connectors, and other possible issues.

Note: *We recommend using a thread-locking fluid for the fasteners.*

3. Calibration

The calibration certificates of all SEVEN irradiance sensors can be downloaded from the website:

https://www.sevensensor.com/download

The 3S-IS+ and 3S-IS irradiance sensors are calibrated under a Class AAA sun simulator in accordance with the IEC 60904-2 and IEC 60904-4 standards, using a reference cell calibrated by the Institute for Solar Energy Research (ISFH) in Germany.

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Recalibration

According to the IEC 61724-1 standard, the recalibration of irradiance sensors should be carried out with minimum interruption and risk of sensor failure so that the monitoring process is not disrupted. Effective methods may include:

- Replacing the installed sensors with new or recalibrated sensors
- Recalibrating the sensors in the field where possible
- Accommodating laboratory calibration schedules by providing spare sensors.

According to the IEC 61724-1 standard, “For Class A systems, irradiance sensors should be recalibrated every 2 years, or more frequently according to the manufacturer’s recommendations. For Class B systems, irradiance sensors should be recalibrated according to the manufacturer’s recommendations.”

The recommended recalibration interval is at least once every 2 years from the installation of the irradiance sensors in the field.

4. Connections

The supply voltage of the Irradiance Sensor is between 12 - 30 V DC. It is recommended to operate it with a 24 V supply voltage.

The communication and power cable of the Irradiance Sensors must always be routed separately from AC/DC cables.

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

4.1. Irradiance Sensor (3S-IS/3S-IS+)

The external sensors are designed on a plug-and-play principle. The sensor connection box has waterproof and UV-resistant connectors. Since each external sensor has a different pin configuration, it is not possible to make an incorrect connection. The minimum bending diameter of the cables is 35 mm.

Connector Information for External Sensors	
Wind Speed Sensor	3-Pin Connector
Wind Direction Sensor	4-Pin Connector
Module Temperature Sensor	5-Pin Connector
Ambient Temperature Sensor	6-Pin Connector
Humidity & Pressure & Temperature Sensor	7-Pin Connector

The 3S-IS/3S-IS+ Irradiance Sensor has an electrically isolated, half-duplex, 3-wire RS485 interface for configuration, communication and firmware update.

Wire Assignment for Power and Communication	
Data (+)	Green
Data (-)	Yellow
Power (+)	Brown
Power (-)	White
Signal Ground	Pink/Red
Protective Earth	Black

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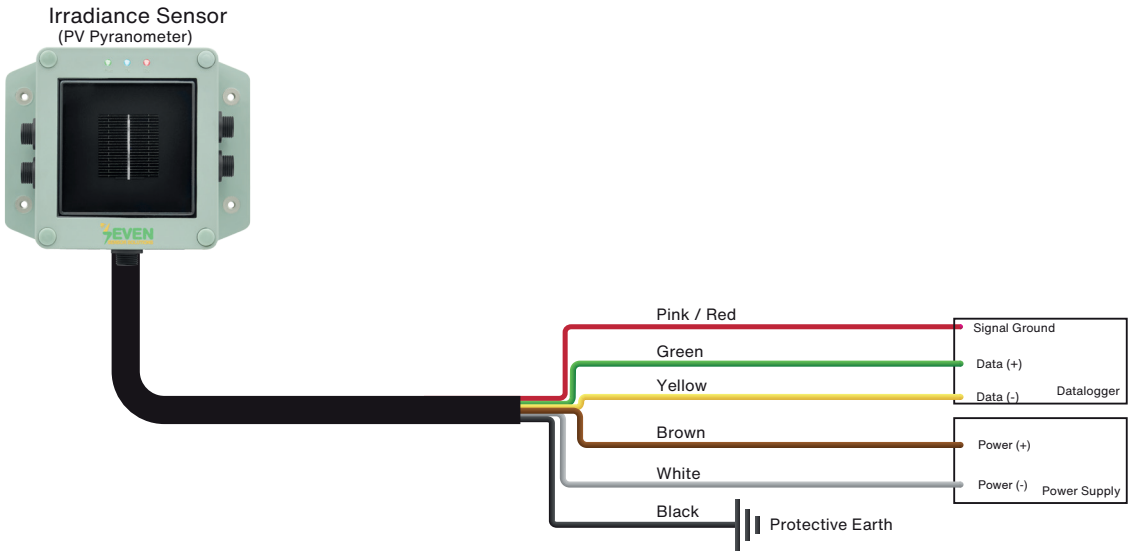


Figure 13 - 3S-IS+ Power and Communication Cable Connection

4.2. 0-1,5 V Irradiance Sensor (3S-IS-T-1,5V)

Wire Assignment for Power and Communication		
Data	**Irradiance (+)**	Blue
	Irradiance (-)	Red
	Temperature (+)	Green
	Temperature (-)	Yellow
Power	**Power (+)**	Brown
	Power (-)	White
	Protective Earth	Black

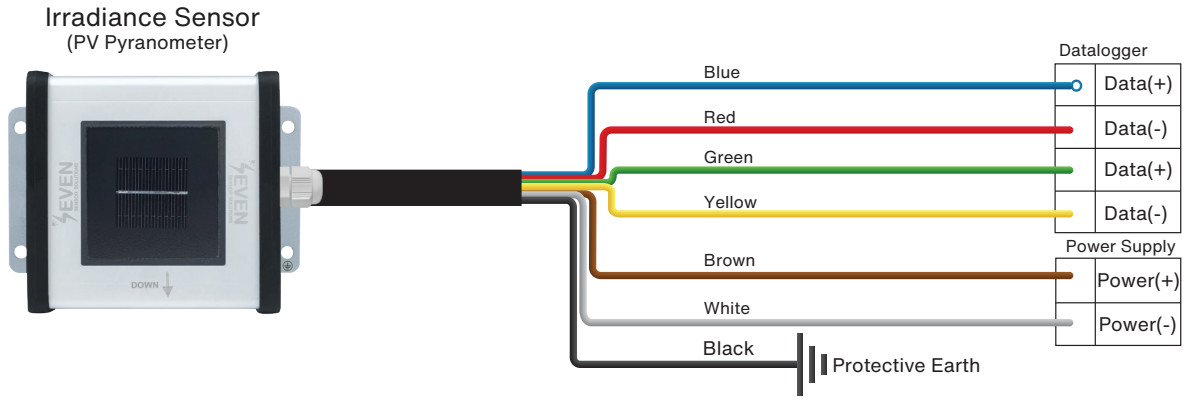


Figure 14 - 0-1,5 V Irradiance Sensor Power and Communication Cable Connection

Parameter	
Irradiance Lower Limit	0 w/m^2
Irradiance Upper Limit	1500 w/m^2
Temperature Lower Limit	-40°C
Temperature Upper Limit	+85°C
Start V	0 V
End V	1,5 V

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4.3. 0-10 V Irradiance Sensor (3S-IS-T-10V)

Wire Assignment for Power and Communication		
Data	Irradiance (+)	Blue
	Irradiance (-)	Red
	Temperature (+)	Green
	Temperature (-)	Yellow
Power	Power (+)	Brown
	Power (-)	White
	Protective Earth	Black

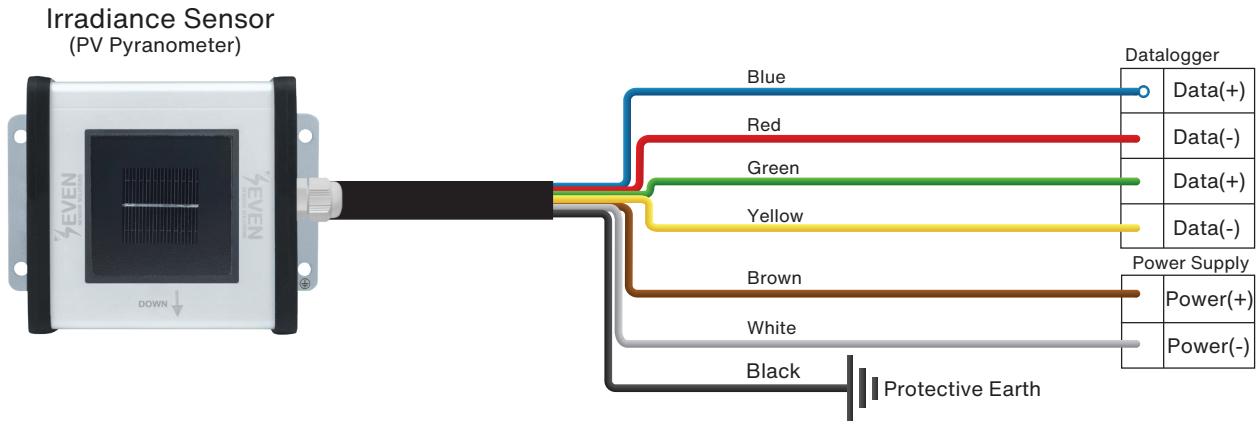


Figure 15 - 0-10 V Irradiance Sensor Power and Communication Cable Connection

Parameter	
Irradiance Lower Limit	0 w/m²
Irradiance Upper Limit	1500 w/m²
Temperature Lower Limit	-40°C
Temperature Upper Limit	+85°C
Start V	0 V
End V	10 V

4.4. 4-20 mA Irradiance Sensor (3S-IS-T-I)

Wire Assignment for Power and Communication	
Irradiance (+)	Green
Temperature (+)	Yellow
Power (+)	Brown
Power (-)	White
Protective Earth	Black

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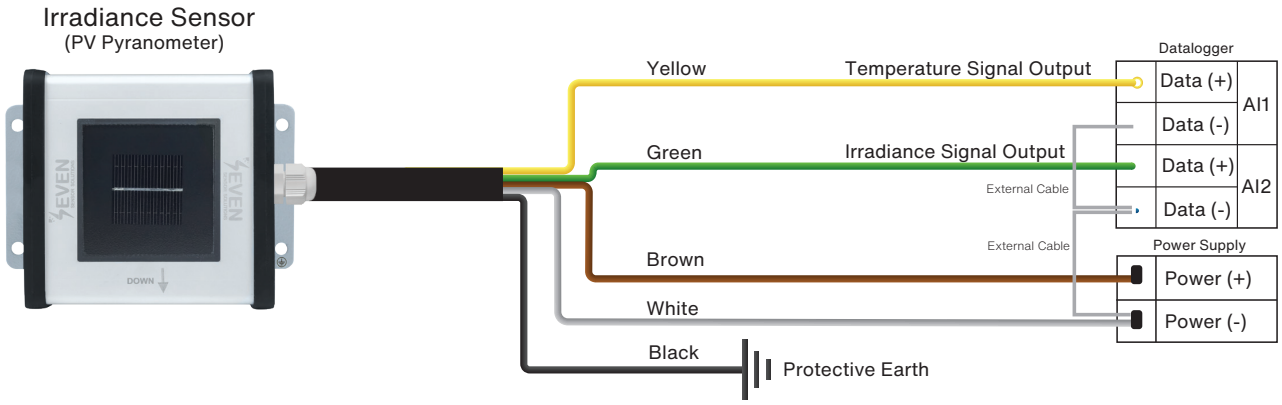


Figure 16 - 4-20 mA Irradiance Sensor Power and Communication Cable Connection

Parameter	
Irradiance Lower Limit	0 w/m²
Irradiance Upper Limit	1500 w/m²
Temperature Lower Limit	-40°C
Temperature Upper Limit	+85°C
Start mA	4 mA
End mA	20 mA

4.5. Low-Cost Irradiance Sensor (3S-IS-LR)

The external sensors are designed on a plug-and-play principle. The sensor connection box has waterproof and UV-resistant connectors. Since each external sensor has a different pin configuration, it is not possible to make an incorrect connection. The minimum bending diameter of the cables is 35 mm.

Connector Information for External Sensors	
Wind Speed Sensor	3-Pin Connector
Module Temperature Sensor	5-Pin Connector
Ambient Temperature Sensor	6-Pin Connector

The 3S-IS-LR Irradiance Sensor has an electrically isolated, half-duplex, 2-wire RS485 interface for configuration, communication and firmware update.

Wire Assignment for Power and Communication	
Data (+)	Green
Data (-)	Yellow
Power (+)	Brown
Power (-)	White

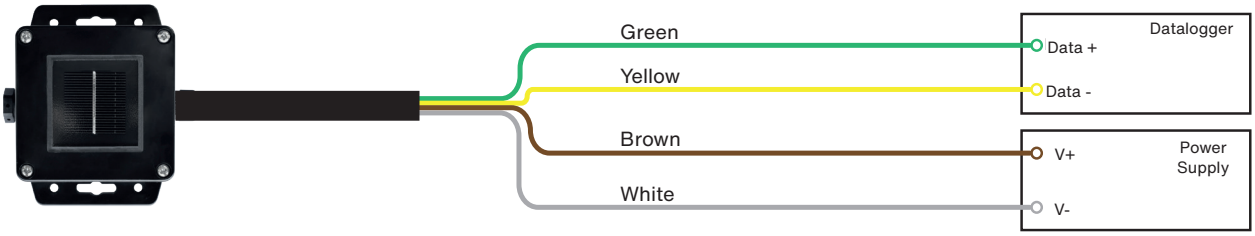


Figure 17 - 3S-IS-LR Power and Communication Cable Connection

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5. Communication

After the Irradiance Sensor is correctly installed and connected, the sensor starts measuring automatically. The default factory settings are as follows:

Modbus ID	1
Baud Rate	9600
Data Bits	8
Parity	None
Stop Bit	1

The points to consider are as follows:
- The data exchange of the 3S-IS/3S-IS+ and 3S-IS-LR Irradiance Sensors with the Configuration Tool should be checked, and it should be verified that they work correctly in the field.
- If more than one Modbus device is operated on a network, a different ID must be assigned to each device.
- The grounding connections of the communication cable must be made correctly.
- A sensor that is to receive a firmware update must be disconnected from any line with multiple Modbus devices and updated using a suitable converter.
- If the product is used as the last device on a daisy-chain line, the termination resistor must be enabled via the GUI.

To configure the Irradiance Sensor on data loggers, follow the instructions provided by SEVEN.

3S-IS Configuration Tool

The Configuration Tool is a software tool used to test communication on the Irradiance Sensors and set the Modbus parameters.

For configuration and testing, a Windows® PC, a serial bus interface set as a serial COM port, the 3S-IS Configuration Tool software and a USB-to-RS485 converter are required.

Follow the instructions in the 3S-IS Configuration Tool User Manual:
https://www.sevensensor.com/files/d/en/3S-IS_Irradiance-Sensor_GUI.pdf

Follow the instructions in the 3S-IS+ Configuration Tool User Manual:
https://www.sevensensor.com/files/d/en/3S-IS-Plus_Advanced-Irradiance-Sensor_GUI.pdf

Follow the instructions in the 3S-IS-LR Configuration Tool User Manual:
https://www.sevensensor.com/files/d/en/3S-IS-LR_Low-Cost-Irradiance-Sensor_GUI.pdf

Modbus Map

A standard input (0x04) register address map has been created for SEVEN Sensor Modbus devices. The following register addresses can be read individually or as a block.

ID-Dec	ID-Hex	Register Address	Measurement Range	Resolution
30000	0x00	Irradiance	0...1600 W/m²	0,1 W/m²
30006	0x06	Temperature-Compensated Irradiance	0...1600 W/m²	0,1 W/m²
30012	0x0C			
30015	0x0F	Internal Temperature	-40...+85 °C	0,1°C
30021	0x15	*Module Temperature	-40...+85 °C	0,1°C
30022	0x16		-40...+85 °C	0,1°C
30029	0x1D	*Ambient Temperature	-40...+85 °C	0,1°C
30032	0x20	*Ambient Temperature (SHT)	-40...+85 °C	0,1°C
30033	0x21	*Relative Humidity (SHT)	0...%100	%0,1
30035	0x23	*Pressure	260...1260 hPa	0,1 hPa
30052	0x34	*Wind Direction	0...359°	1°
30053	0x35	*Wind Speed (m/s)	0...60 m/s	0,1 m/s

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Note: *Register addresses marked with an asterisk (*) can only be read if the relevant external sensor is connected to the 3S-IS Modbus Irradiance Sensor. If the external sensor is not connected, the values at these addresses should be considered invalid.*

Note: *The table above lists the addresses that need to be monitored by the user for Irradiance Sensor software version 8. For Modbus and SunSpec addresses belonging to other software versions, the software features of these addresses, or if you have a different software version, you can access the detailed Modbus map from the link below.* *https://www.sevensensor.com/download*

6. Contact Details

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

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Website: www.sevensensor.com

Technical Support Portal: https://www.sevensensor.com/support

Through the portal, you can create and follow your support requests, view our responses, and check the status of your requests.

For easier access and to receive notifications regarding your support requests, you can also download our Meetlys application:

- iPhone / iPad: Meetlys – App Store
- Android: Meetlys – Google Play
- Windows: Meetlys – Microsoft Store

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