100 years Since 1925 SIAP+MICROS Environmental Monitoring Solutions

t057-TSD

Sunshine duration sensor

User and Maintenance Manual

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Summary

1 Generic information

The qualitative level of our instruments is the result of a continuous evolution of the product. This may cause differences between what is reported in the manual and the instrument you have purchased.

Siap+Micros S.p.A. reserves the right to modify without notice technical specifications and dimensions to adapt them to the needs of the product.

1.1 Safety

Please read these safety instructions carefully before using this product:

- The warranty will be void if the product is used differently from the instructions described in this manual.
- Any sign of tampering will void the warranty
- Use the devices only according to the instructions (environmental management, operation, wiring, installation, etc.) provided in this manual
- The correct and safe operation of the device can only be guaranteed if the transport, storage, operation and management of the device are compliant. This also applies to product maintenance.
- The device shall not be exposed to aggressive chemicals or solvents that could damage the plastic casing and/or corrode the metal parts.
- Maintenance should only be performed by qualified and well trained personnel.

It is appropriate to carry out a careful risk assessment in relation to the context of installation and use of the device by the installer considering the possible meteorological station in its complexity without being limited to the sensor.

The instruments must be installed according to the rules of the trade, with equipment that complies with applicable regulations and using supports correctly sized by qualified technicians and designed for the specific purpose.

During installation operations, check the suitability of the surrounding environment and compliance with local safety regulations.

The manufacturer declines all responsibility in case of failure due to negligence of the instructions, tampering, uses not described in this manual, improper use, use by operators not trained.

Read the instructions and intended use carefully and be sure you understand before installing the device

Before starting the activities, check the integrity of the instrument to be installed, prepare the equipment necessary for the work and wear the necessary PPE.

Take adequate measures to prevent the access of foreign personnel (untrained and uninformed) during the installation, maintenance or replacement of the instrument.

Take precautions to avoid falling objects, both during the installation phases and during the operation of the instrument.

Do not perform any activity in bad weather conditions.

During maintenance, particularly if the station is not frequented, visually check for the absence of dangerous insects and, if not, use suitable insecticides.

Consider the presence of any animals near the station, if so, pay attention to them.

Use only SIAP+MICROS original spare parts.

The instrument is not classified suitable (according to Directive 2014/34/EU) for use in atmospheres with potential explosion risk pursuant to Directive 99/92/EC.

SIAP+MICROS strives to minimize health and safety risks in all phases of the instrument's life, including installation, use, maintenance, decommissioning and disposal.

1.2 Appropriate use of the equipment

Use the instrument for its intended purpose, do not use it for any other purpose or cause malfunctions and/or damage.

1.3 Storage

If you do not plan to use the equipment for an extended period of time (at least one year) disconnect all cables from the equipment, place it in a clear plastic bag along with a bag of desiccant salts and seal the bag with tape. Put appropriate indication on the bag of the contents and weight of the equipment by inserting the wording "HANDLE WITH CARE".

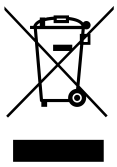
Store the instrument in an environment with a temperature between 0°C and 60°C with a humidity not exceeding 80%. Make sure that the instrument is stored in a stable position and that it cannot be damaged or moved by inexperience or carelessness. Do not stack other tools or weights. Do not place the instrument on top of other instruments and in any case ensure the solidity and stability of the underlying support.

Non esporre, stoccare lo strumento in ambienti con presenza di vapori e/o gas corrosivi.

1.4 Moving

In order to avoid any damage to the device during transportation, please keep it in upright position without shaking.

1.5 Disposal information



Electrical and electronic equipment marked with specific symbol in compliance with 2012/19/EU Directive must be disposed of separately from household waste. European users can hand them over to the dealer or to the manufacturer when purchasing a new electrical and electronic equipment, or to a WEEE collection point designated by local authorities. Illegal disposal is punished by law.

Disposing of electrical and electronic equipment separately from normal waste helps to preserve natural resources and allows materials to be recycled in an environmentally friendly way without risks to human health.

2 Technical Specifications

Sensitive elements	16 Silicon photodiodes
Spectral range	360…1100 nm
Direct radiation SRD measuring range	0…2000 W/m^2
Accuracy of the measurement of direct radiation	Better than 90% on the monthly total
Accuracy of the measurement of the sunshine duration sensor	Better than 90% on the monthly total
Response time	<1 ms
Threshold value	120 W/m^2
Sunshine duration resolution	1 s
Power supply **Consumption**	7…30 Vdc 5mA @ 12V
Heating system **Anti-condensation device consumption** **Antifreeze device consumption**	12…15 Vdc 1 W @ 12 V 5 W @ 12 V ON for internal Temp. < 6 °C, OFF for internal Temp. > 10 °C
Internal temperature **Measuring range** **Accuracy**	 -40…+80 °C ± 0.5 °C
Operating temperature	-40…+80 °C
Weight	0.9 kg
Protection degree	IP66
Order code	**Output**
PSM-t057-TSD	• RS485 MODBUS-RTU • Galvanically isolated contact closed = SRD ≥ 120 W/m^2 open = SRD < 120 W/m^2

2.1 Dimensions

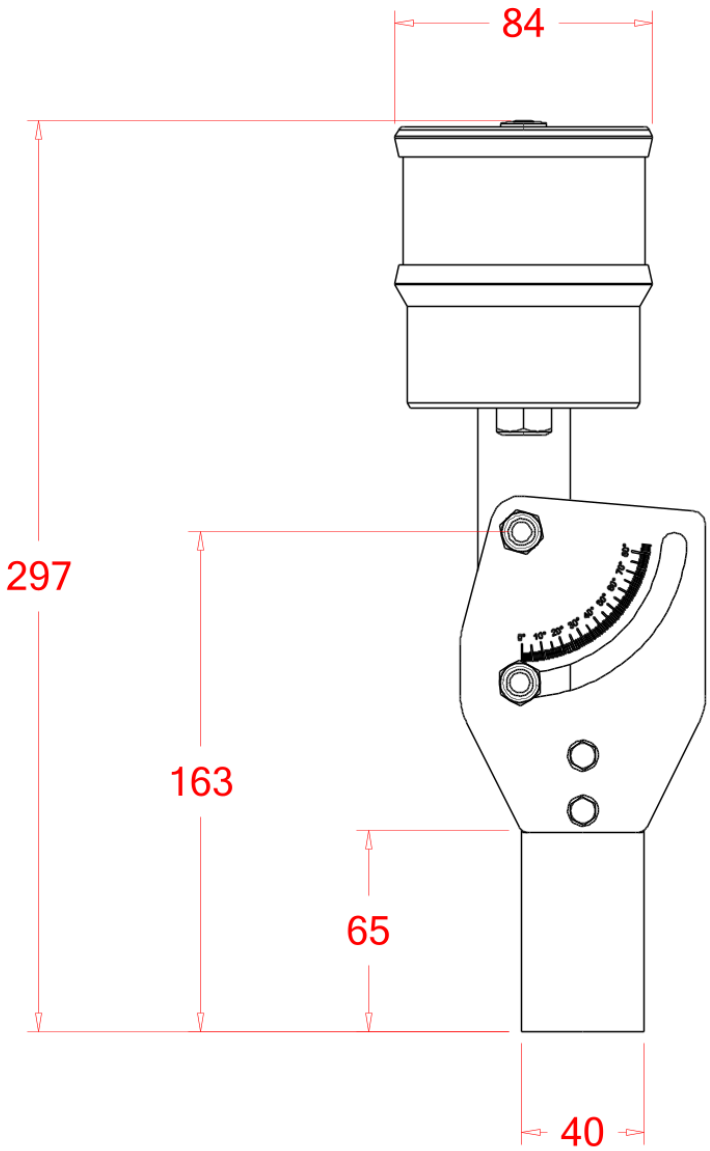


Fig. 2.1: dimensions

3 Introduction

The T057-TSD heliometer measures the duration and intensity of sunshine. The WMO (World Meteorological Organization) defines the duration of sunshine as the period during which direct solar radiation exceeds 120 W/m².

Radiation measurement is performed using a series of photodiodes arranged in a specific geometric configuration that ensures accurate measurement under all conditions. This design eliminates the need for moving mechanical parts and guarantees high long-term reliability.

In addition to indicating the presence of sunlight as prescribed by the WMO, the instrument also measures direct solar radiation (SRD), and can therefore be used as a low-cost alternative to a pyranometer, the use of which requires a solar tracker.

The T057-TSD is equipped with a separately powered and galvanically isolated heating element, which prevents condensation from forming on the glass surface facing the sensing elements. For harsh climates, versions equipped with a second heating element (option R) are available, which prevents ice formation and stops snow from accumulating.

The instrument is available with an output:

	OUTPUT					**Heating**
Modell	**RS485 Modbus-RTU**	**SDI-12**	**Voltage free contact**	**Analog 0…1 V**	**Digital voltage**	
t057-TSD [R]	√		√			With option **R** in the code

Voltage-free contact: closed ⇒ SRD ≥ 120 W/m², open ⇒ SRD < 120 W/m²

The device does not require any adjustments to its positioning throughout the year.

It has a wide range of applications: from agronomy—to study crop trends—to photovoltaic systems—to monitor their output—to building automation—for the automatic opening and closing of roller shutters, blinds, and, more generally, all sectors where it is necessary to monitor sunlight exposure.

3.1 Operating principle

The heliometer relies on 16 sensors arranged in such a way that, when the sun is out, at least one of the photodetectors receives light directly from the sun (in addition to the diffuse component).

The sensors not directly illuminated by the sun are used to measure diffuse light, which is subtracted from the reading of the sensor facing the sun directly to calculate direct solar radiation.

The cylindrical glass protects the sensors and the instrument's internal circuits from the elements, while also ensuring excellent transparency to sunlight.

To prevent condensation from forming inside the instrument, the T057-TSD is equipped, in addition to the heating element, with a cartridge that must be filled with colloidal silica desiccant (silica gel).

4 Installation

Before installing the sunshine duration sensor, refill the cartridge containing silica-gel crystals.

Do not touch the silica-gel crystals with your hands while refilling the cartridge. Carry out the following instructions in an environment as drier as possible:

- Unscrew the silica gel cartridge using a coin.
- Remove the cartridge perforated cap.
- Open the sachet containing silica gel (supplied with the sunshine duration sensor).
- Fill the cartridge with the silica gel crystals.
- Close the cartridge with its own cap, paying attention that the sealing O-ring be properly positioned.
- Screw the cartridge to the sunshine duration sensor body using a coin.
- Check that the cartridge is screwed tightly (if not, silica gel life will be reduced).

The figure below shows the operations necessary to fill the cartridge with the silica gel crystals.

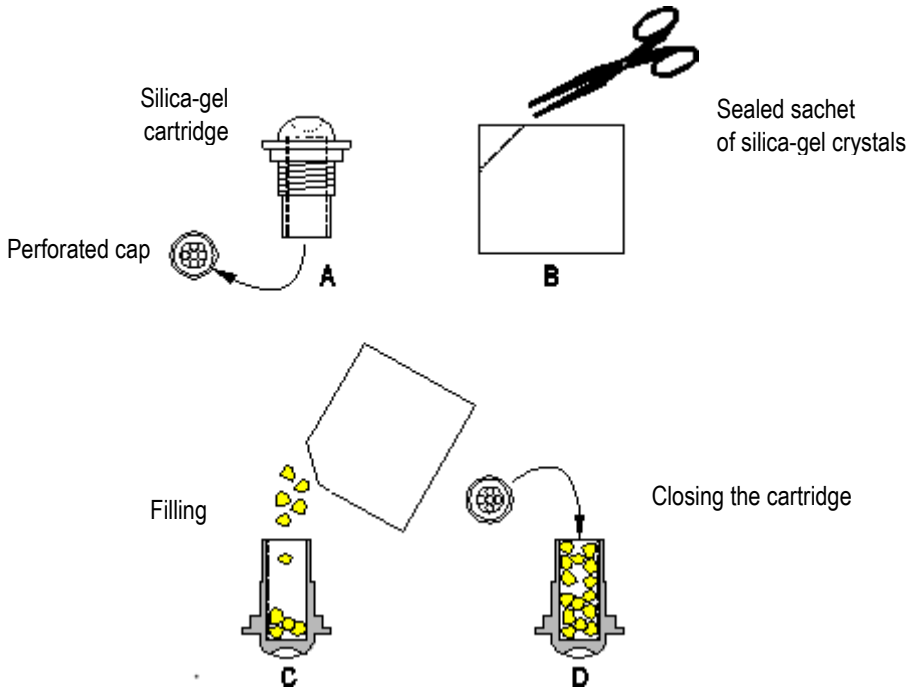


Fig. 4.1: filling the silica gel cartridge

The heliometer should be installed in a location that is easily accessible for periodic cleaning of the glass and maintenance. At the same time, care must be taken to ensure that buildings, trees, or obstacles of any kind do not extend above the horizontal plane on which the heliometer rests. It is acceptable to choose a location where obstacles in the sun's path from sunrise to sunset are less than 5° above the horizontal plane of the heliometer. You must also ensure that there are no reflective elements that could alter the measurement.

t057-TSD does not require any adjustments to its orientation during the year.

Installation on a vertical pole using the Ø 40 mm bracket.

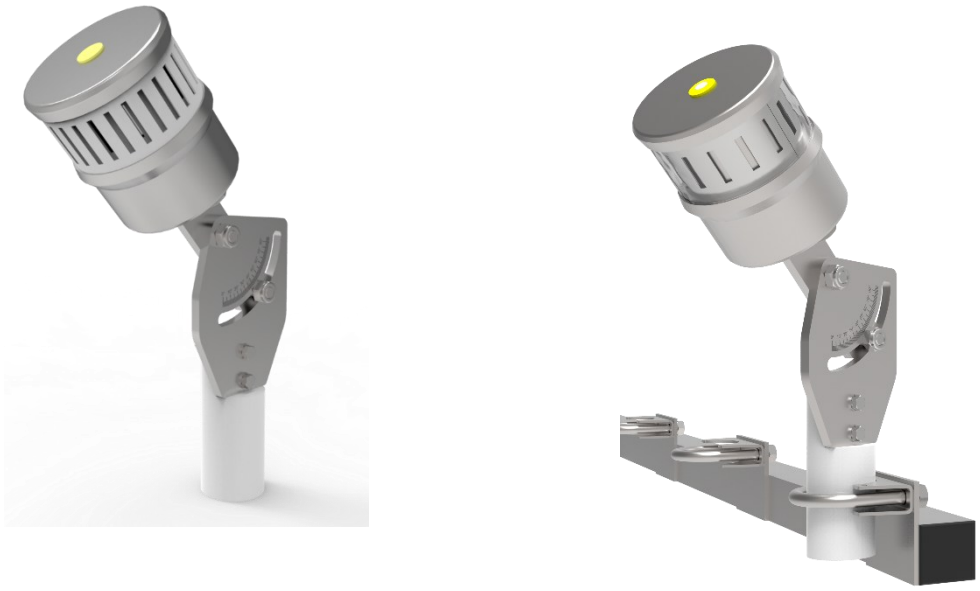


Fig. 4.2: support

The mount allows the sensor to be tilted up to 80° (with a graduated scale) from the vertical and rotated in the horizontal plane.

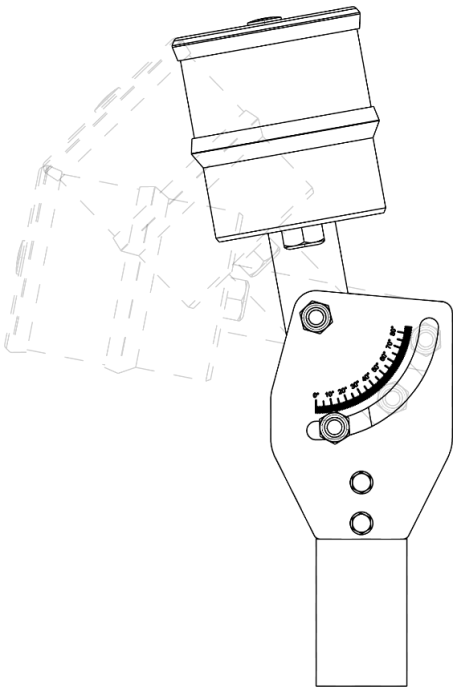


Fig. 4.3: orientation

Before adjusting the heliometer to its final position, place it vertically so that the spirit level at the top of the instrument is perfectly level.

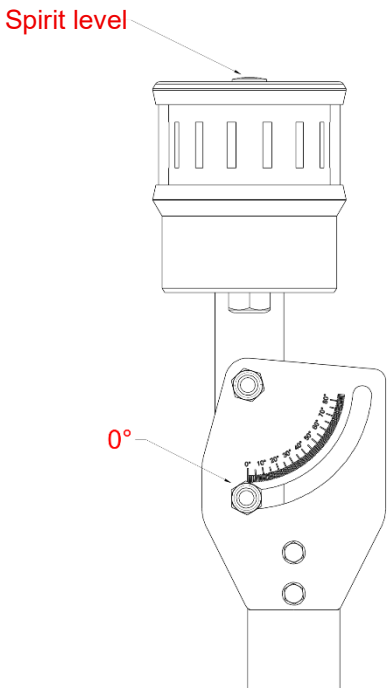


Fig. 4.4: leveling

Align the heliometer so that the pointer on the scale of the mount points to the value (90° - Latitude), with the top (where the spirit level is located) facing the North Pole if used in the Northern Hemisphere and facing the South Pole if used in the Southern Hemisphere.

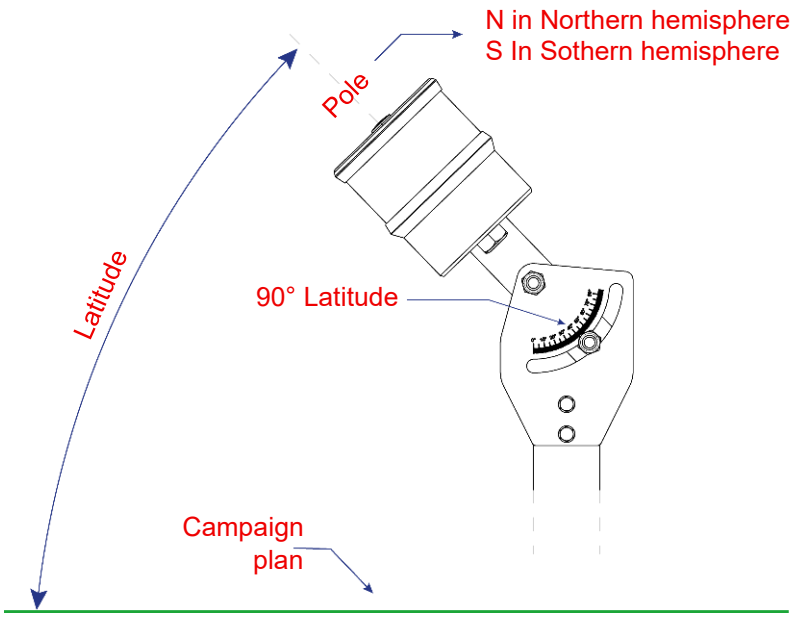


Fig. 4.5: orientation of the sunshine duration sensor

The angle that instrument axis should make with respect to the ground is equal to the latitude of the installation site, this way the axis of the instrument will be parallel to the earth axis North-South.

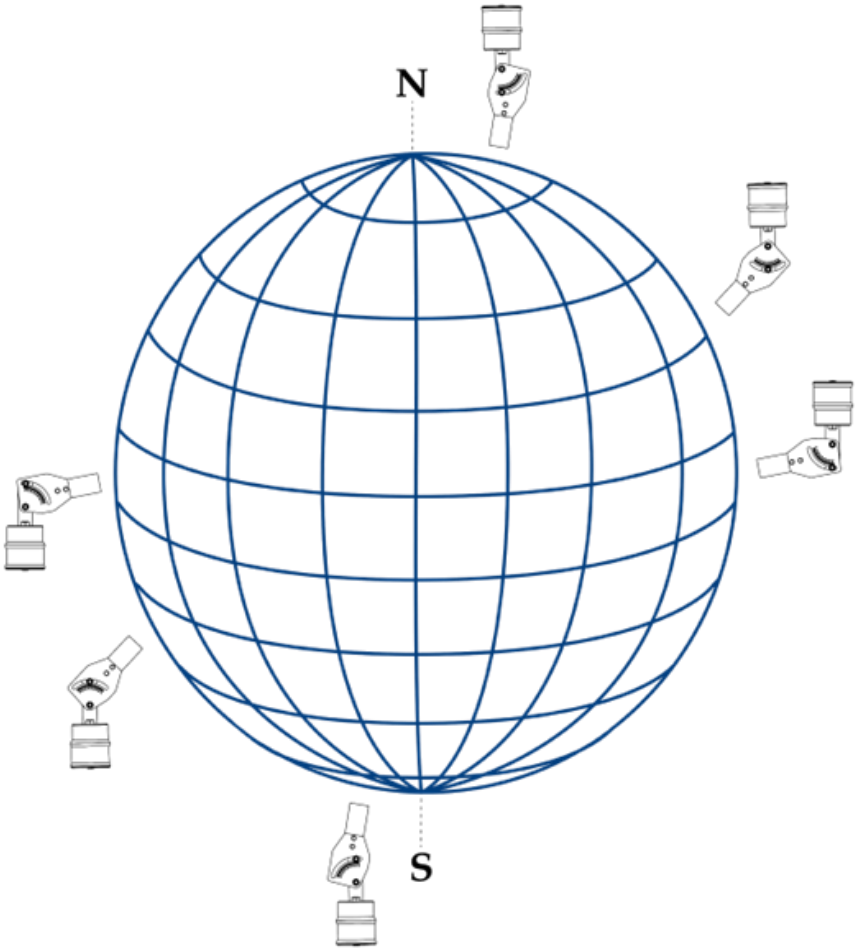
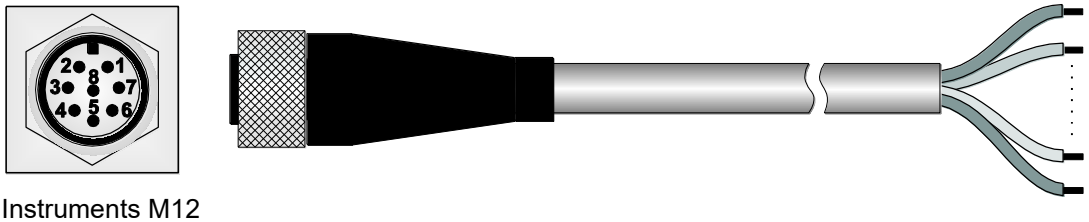


Fig. 4.6: sunshine duration sensor parallel to the earth axis

5 Electrical connections

The heliometer has an 8-pin connector and uses cables with an 8-pin connector on one end and bare wires on the other.



Instruments M12
male connector

Fig. 5.1: connections

Connector pin number	Function	wire N°/colour
T057-TSD[R]		
1	Power supply negative	12/Black + 7/Violet + 6/Pink (**)
2	Power supply positive	1/Red + 2/Blue + 4/Grey-Pink (**)
3	Heating (*)	3/Yellow
4	RS485 A/-	9/White
5	RS485 B/+	5/Red-Blue
6	Volt-free contact output	8/Grey
7	Heating (*)	10/Brown
8	Volt-free contact output	11/Green

(*) The heating connection is not polarized; the two wires can be reversed.

(**) Wires shorted to the connector pin.

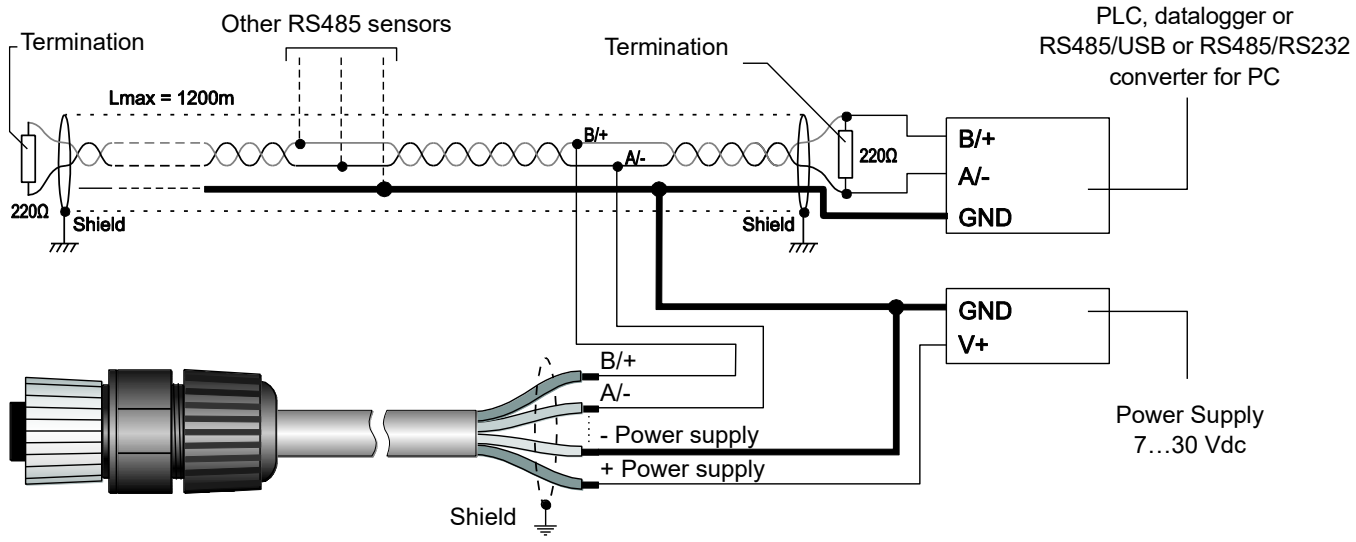


Fig. 5.2: RS485 connection

6 RS485 Modbus-RTU output

The t057-TSD features an RS485 Modbus-RTU output.

The Modbus-RTU protocol becomes active 5 seconds after power-up.

Before connecting the sensor to the RS485 network, you must assign it an address and configure its communication parameters, if they differ from the factory defaults**.**

6.1 Configuring Communication Parameters

Connect the sensor to the PC using the optional 8-pin M12 flying lead and an RS485/USB or RS485/RS232 converter. If you are using an RS485/USB converter, you must install the appropriate USB drivers on the PC.

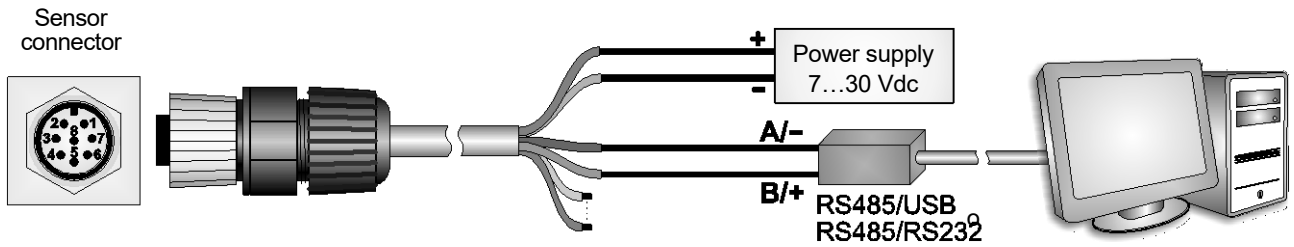


Fig. 6.1: connection to PC

Procedure:

1. Start with the sensor not powered.
2. In the PC, start a serial communication program. Set the Baud Rate to 57600 and set the communication parameters as follows (the sensor is connected to a COM type port):

   Data Bits: 8

   Parity: None

   Stop Bits: 2

In the program, set the COM port number to which the sensor will be connected.

3. Switch the sensor on.
4. Wait until the sensor transmits the **&** character, then send (within 5 seconds from the sensor power on) the **@** command and press **Enter**.

Note: if the sensor does not receive the **@** command within 5 seconds from power on, the RS485 MODBUS mode is automatically activated. In such a case, it is necessary to switch off and on again the sensor.

5. Send the command **CAL USER ON**.

Note: the command CAL USER ON is disabled after 5 minutes of inactivity.

6. Send the serial commands given in the following table to set the RS485 Modbus parameters:

Command	Response	Description
CMAnnn	&|	Set address to nnn Ranging from 1 to 247 Preset on 1
CMBn	&|	Set Baud Rate n=0 ⇒ 9600 n=1 ⇒ 19200 Preset on 1 ⇒ 19200
CMPn	&|	Set parity and stop bits n=0 ⇒ 8N1 (no parity, 1 stop bit) n=1 ⇒ 8N2 (no parity, 2 stop bits) n=2 ⇒ 8E1 (even parity, 1 stop bit) n=3 ⇒ 8E2 (even parity, 2 stop bits) n=4 ⇒ 8O1 (odd parity, 1 stop bit) n=5 ⇒ 8O2 (odd parity, 2 stop bits) Preset on 2 ⇒ 8E1
CMWn	&|	Set waiting time after transmission n=0 ⇒ Immediate reception (violates protocol) n=1 ⇒ Waiting 3.5 characters (respects protocol) Preset on 1 ⇒ Waiting 3.5 characters

7. You can verify the parameter settings by sending the following commands:

Command	Response	Description
RMA	*Address*	Read address
RMB	*Baud Rate* (0,1)	Read Baud Rate 0 ⇒ 9600 1 ⇒ 19200
RMP	*Tx Mode* (0,1,2,3,4,5)	Read parity and stop bits 0 ⇒ 8N1 1 ⇒ 8N2 2 ⇒ 8E1 3 ⇒ 8E2 4 ⇒ 8O1 5 ⇒ 8O2
RMW	*Rx Mode* (0,1)	Read waiting time after transmission 0 ⇒ Immediate reception (violates protocol) 1 ⇒ Waiting 3.5 characters (respects protocol)

Note: Reading the settings does not require sending the CAL USER ON command.

6.2 Reading the measures with the Modbus-RTU protocol

Below is a list of the registers.

Input Registers

Address	Datum	Format
0	Indoor temperature °C [x10]	16-bit integer
1	Indoor temperature °F [x10]	16-bit integer
2	Direct solar radiation (SRD, "Direct Sunshine") in W/m²	16-bit integer
3	Status Register Bit 0 = 1 ⇒ Radiation measurement error Bit 1 = 1 ⇒ Temperature measurement error Bit 2 = 1 ⇒ Data memory error Bit 3 = 1 ⇒ Program memory error	16-bit integer
4	Number of seconds in the last minute with radiation exceeding 120 W/m² (a number between 0 and 60)	16-bit integer
5	Number of 10-second intervals in the last 10 minutes with radiation ⇒ 120 W/m² (number ranging from 0 to 60: for each 10-second interval in the last 10 minutes, a value of 1 is counted if SRD ⇒ 120 W/m² for at least 5 seconds) For higher resolution, use register number 5.	16-bit integer
6	Sunlight presence/absence contact status 0 = SRD < 120 W/m² (contact open) 1 = SRD ≥ 120 W/m² (contact closed)	16-bit integer
7	Heating status: 0 = off, 1 = on	16-bit integer
8	Temperature in °C [x10] below which the heating turns on	16-bit integer
9	Circular counter ranging from 0 to 32,767, tracking the number of measurement cycles. It is incremented after each measurement.	16-bit integer
10	Radiation detected by sensor #1 in W/m² [x10]	16-bit integer
11	Radiation detected by sensor #2 in W/m² [x10]	16-bit integer
12	Radiation detected by sensor #3 in W/m² [x10]	16-bit integer
13	Radiation detected by sensor #4 in W/m² [x10]	16-bit integer
14	Radiation detected by sensor #5 in W/m² [x10]	16-bit integer
15	Radiation detected by sensor #6 in W/m² [x10]	16-bit integer
16	Radiation detected by sensor #7 in W/m² [x10]	16-bit integer
17	Radiation detected by sensor #8 in W/m² [x10]	16-bit integer
18	Radiation detected by sensor #9 in W/m² [x10]	16-bit integer
19	Radiation detected by sensor #10 in W/m² [x10]	16-bit integer
20	Radiation detected by sensor #11 in W/m² [x10]	16-bit integer
21	Radiation detected by sensor #12 in W/m² [x10]	16-bit integer
22	Radiation detected by sensor #13 in W/m² [x10]	16-bit integer
23	Radiation detected by sensor #14 in W/m² [x10]	16-bit integer
24	Radiation detected by sensor #15 in W/m² [x10]	16-bit integer
25	Radiation detected by sensor #16 in W/m² [x10]	16-bit integer

For sensor numbering, see the figure below. To identify the sensors, look for the square notch located at the top when the sensor is installed.

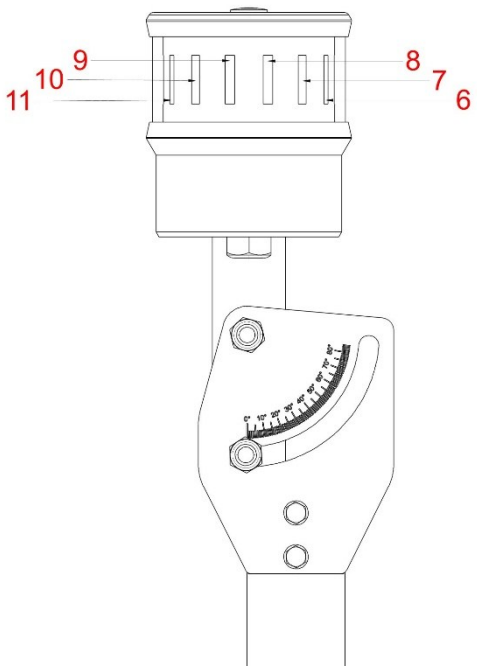


Fig. 6.2: sensor numbering

6.3 Changing the heating activation temperature

You can change the temperature at which the heating turns on by writing the value to the Holding Register at address 2. The value must be set in tenths of a degree within the range from -450 (-45.0 °C) to 700 (+70.0 °C).

Modifying the Holding Register at address 2 only changes the value in RAM; therefore, the change is lost if power to the instrument is interrupted. To make the change permanent, write the hexadecimal value FF00 to the Coil register at address 2.

To verify that the permanent storage operation was completed successfully, check that the Holding Register at address 1 contains 0.

Coils

Address	Datum
2	Permanent storage of the heating activation temperature.

Holding Registers

Address	Datum	Format
0	Indicator showing whether the last Modbus command sent was interpreted correctly. If 0, the command was executed successfully.	16-bit integer

	If 1, errors occurred during the execution of the command.	
1	Indicator showing whether the heating activation temperature has been successfully saved. If 0, the temperature has been saved successfully. If 1, errors occurred during saving.	16-bit integer
2	Heating activation temperature in °C [x10].	16-bit integer

CHECK OF THE CORRECT INTERPRETATION OF THE MODBUS COMMANDS: in order to check if the last Modbus command sent to the instrument has been interpreted correctly, verify that the Holding Register with address 0 contains the value 0.

7 Maintenance

In order to grant measurements high accuracy, it is important to keep the protective glass clean.

You can wash it using water and microfiber cloths for lens. If necessary, use pure ETHYL alcohol. After using alcohol, clean again the protective glass with water only and dry it thoroughly.

In order to minimize the condensation, the sensor is provided with a heating element and a cartridge containing dessicant material (silica-gel). The efficiency of the silica-gel crystals decreases over time while absorbing humidity. Silica-gel crystals are efficient when their color is **yellow**, while they turn **white/translucent** as soon as they lose their efficiency. Read instructions on chapter Errore. L'origine riferimento non è stata trovata. about how to replace the silica-gel crystals. Silica-gel typical lifetime goes from 2 to 6 months depending on the environment where the sensors works.