

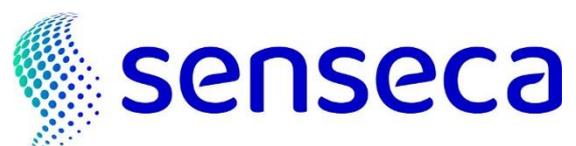
OPERATING MANUAL

LPSILICON-PYRA04

Pyranometer with
silicon photodiode



EN
V1.0



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1 Introduction

LPSILICON-PYRA04 pyranometer measures the **global irradiance** on a flat surface (W/m^2), sum of direct solar irradiance and diffuse irradiance.

The sensor consists of a silicon photodiode, suitable for measuring natural sunlight. In very cloudy conditions or for measuring reflected light, the use of a thermopile pyranometer is recommended.

Passive output in mV.

5 m fixed cable ended with open wires.

It can be optionally supplied already mounted on a base with bubble level:

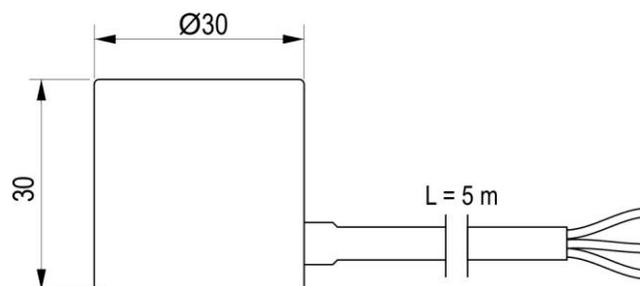
Model	Base with bubble level
LPSILICON-PYRA04	--
LPSILICON-PYRA04BL	√

The pyranometer is factory calibrated. The calibration is performed by comparison with a class B reference pyranometer, using a solar simulator with filters that reproduce the solar spectrum at A.M. 1.5 (air mass index 1.5).

2 Technical specifications

Sensor	Silicon photodiode
Typical sensitivity	20 $\mu\text{V}/\text{Wm}^{-2}$
Measuring range	0...2000 W/m^2
Spectral range	400...1100 nm
Response time	< 0.5 s
Non-linearity	< $ \pm 2 $ %
Long-term instability (1 year)	< $ \pm 2 $ %
Temperature response (-10...+40°C)	< $ \pm 3 $ %
Calibration uncertainty	< $ \pm 3 $ %
Spectral error	< $ \pm 4 $ %
Directional response @ 1000 W/m^2	< $ \pm 30 $ W/m^2
Output	Passive in mV
Power supply	No power required
Output impedance	< 50 Ω typical
Connection	5 m fixed cable ended with open wires
Operating temperature	-40...+70 °C
Protection degree	IP 67
Housing material	Anodized aluminium

Dimensions (mm)



3 Measuring principle

The LPSILICON-PYRA04 pyranometer sensor consists of a silicon photodiode.

The photocurrent generated by the photodiode exposed to light is converted into a difference of potential via an internal shunt resistor.

The special geometry and the diffuser provide a 180° viewing angle according to the cosine law. The following graph shows the difference between the theoretical response and the measured response.

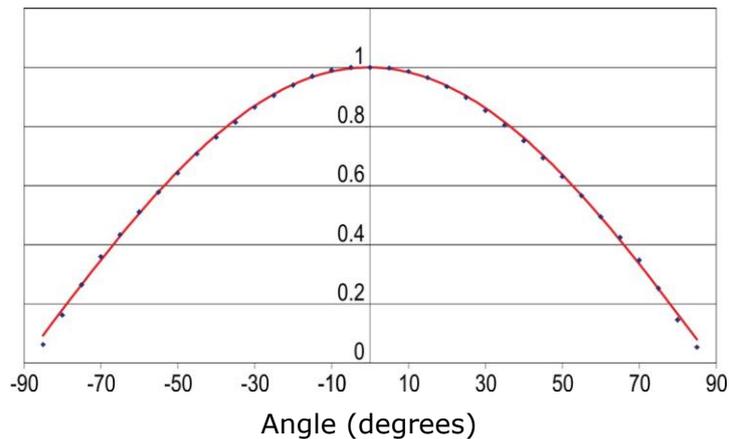


Fig. 3.1: normalized response according to cosine law

Most of the solar energy that reaches the Earth's atmosphere is in the 290...3000 nm spectral range (WMO). The ideal instrument for measuring solar radiation should have a flat response at least in this spectral range. The spectral characteristics of the LPSILICON-PYRA04 pyranometer are determined mainly by the photodiode and marginally by the diffuser. The following graph shows the spectral response curve of the LPSILICON-PYRA04 pyranometer together with a typical solar spectrum.

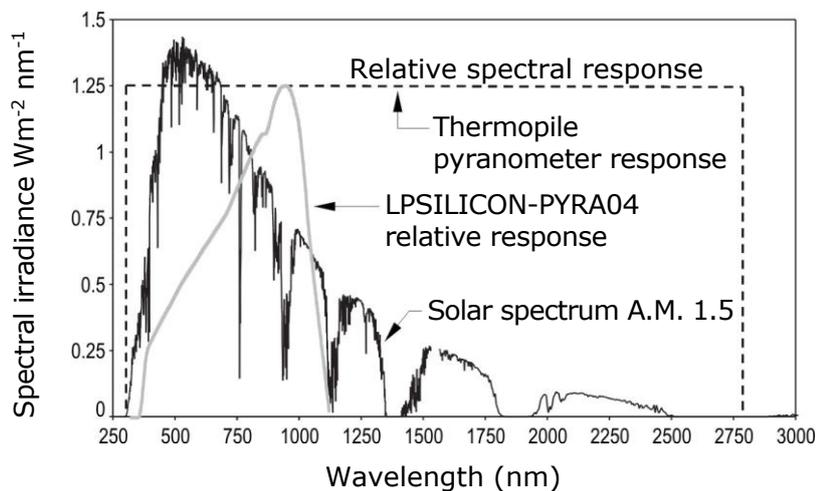


Fig. 3.2: spectral response

As can be seen, the spectral response of the LPSILICON-PYRA04 pyranometer is not constant and does not cover the entire solar spectrum. Reliable measurements can only be obtained if the pyranometer is calibrated with light whose spectrum is equal to that of the light to be measured.

Under clear sky conditions, the measured radiation has an uncertainty of less than 3%.

In cloudy conditions, at dawn or sunset, the solar spectrum is quite different from that with which the instrument was calibrated, and therefore the measurement error will be higher.

4 Installation

- The pyranometer must be mounted in an easy-to-reach location in order to clean the sensitive area regularly and carry out maintenance. At the same time, make sure that no buildings, constructions, trees or obstructions exceed the horizontal plane where the pyranometer lies. If this is not possible, select a site where obstructions in the path of the sun from sunrise to sunset do not exceed 5 degrees of elevation. **N.B.: The presence of obstructions on the horizon line affects significantly the measurement of direct irradiance.**
- The pyranometer must be located far from any kind of obstruction, which might reflect sunlight (or sun shadow) onto the pyranometer itself.
- The mast height does not exceed the pyranometer plane to avoid measurement errors caused by any reflection or shadow of the mast itself.
- In compliance with ISO TR9901 standard and WMO recommendations, the pyranometer must be positioned so that the cable gland is pointed to the North Pole, if the instrument is used in the Northern Hemisphere, and to the South Pole, if used in the Southern Hemisphere.
- For fixing, use the M4 holes in the lower part of the pyranometer (LPSILICON-PYRA04) or the $\varnothing 6,5$ mm through holes of the base with bubble level (LPSILICON-PYRA04BL). For an accurate horizontal positioning, a bubble level (integrated in LPSILICON-PYRA04BL) can be used.

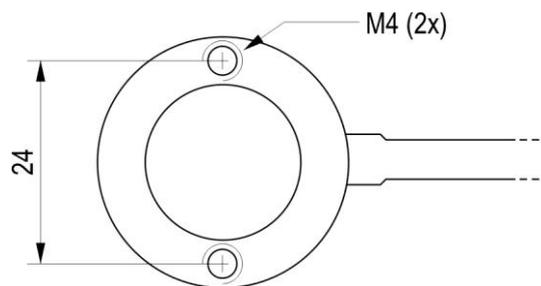


Fig. 4.1: LPSILICON-PYRA04 position of fixing holes

4.1 Electrical connections

Warning!

To protect the pyranometer against electrostatic discharges, the metallic housing of the pyranometer should be grounded (earthed) locally, via the support mast. The cable shield is **not** connected to the housing.

Cable color coding:

Wire color	Function
White / Red	+Vout
Blue / Brown	-Vout
Black	Cable shield

To reduce signal noise, connect the black wire (shield) to the blue/brown wire (-Vout).

5 Measurement

Each pyranometer is distinguished by its own sensitivity (or calibration factor) **S** expressed in $\mu\text{V}/(\text{Wm}^{-2})$, shown in the label on the pyranometer (and in the optional calibration report).

The irradiance **E_e** is obtained by measuring with a multimeter the difference of potential **DDP** at the ends of the sensor and applying the following formula:

$$E_e = DDP / S$$

where:

E_e is the irradiance expressed in W/m^2 ;

DDP is the difference of potential expressed in μV measured by the multimeter;

S is the sensitivity of the pyranometer expressed in $\mu\text{V}/(\text{Wm}^{-2})$.

The output signal typically does not exceed a few tens of mV. The recommended resolution of the reading instrument is $1 \mu\text{V}$.

6 Maintenance

In order to grant measurements accuracy, it is important to keep the pyranometer diffuser clean. The more the diffuser will be kept clean, the more measurements will be accurate.

You can wash it using water and standard papers for lens. If necessary, use pure ETHYL alcohol. After using alcohol, clean again the diffuser with water only.

To exploit all the pyranometer features, it is highly recommended that the calibration be checked annually.

7 Safety instructions

The pyranometer proper operation and operating safety can be ensured only in the climatic conditions specified in this manual and if all standard safety measures as well as the specific measures described in this manual are followed.

Do not use the instruments in places where there are:

- Corrosive or flammable gases.
- Direct vibrations or shocks to the instrument.
- High-intensity electromagnetic fields, static electricity.

User obligations

The instrument operator shall follow the directives and regulations below that refer to the treatment of dangerous materials:

- EU directives on workplace safety.
- National law regulations on workplace safety.
- Accident prevention regulations.

Notes

WARRANTY

The manufacturer is required to respond to the "factory warranty" only in those cases provided by Legislative Decree 6 September 2005 - n. 206. Each instrument is sold after rigorous inspections; if any manufacturing defect is found, it is necessary to contact the distributor where the instrument was purchased from. During the warranty period (24 months from the date of invoice) any manufacturing defects found will be repaired free of charge. Misuse, wear, neglect, lack or inefficient maintenance as well as theft and damage during transport are excluded. Warranty does not apply if changes, tampering or unauthorized repairs are made on the product. Solutions, probes, electrodes and microphones are not guaranteed as the improper use, even for a few minutes, may cause irreparable damages.

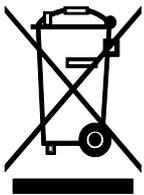
The manufacturer repairs the products that show defects of construction in accordance with the terms and conditions of warranty included in the manual of the product. For any dispute, the competent court is the Court of Padua. The Italian law and the "Convention on Contracts for the International Sales of Goods" apply.

TECHNICAL INFORMATION

The quality level of our instruments is the result of the continuous product development. This may lead to differences between the information reported in the manual and the instrument you have purchased.

We reserve the right to change technical specifications and dimensions to fit the product requirements without prior notice.

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.



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