PIR – Thermopile piranometers – Technical Annex for installation (Rev.2 010316)

Working principle

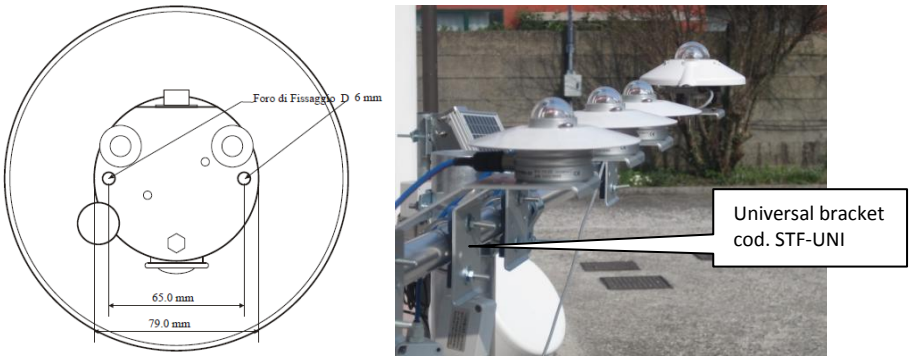
The pyranometer is based on a thermopile sensor.

The sensitive surface of the thermopile is covered with matt black paint which allows the pyranometer not to be selective at various wavelengths. The pyranometer spectral range is determined by the transmission of the glass domes type K5.

Radiant energy is absorbed by the thermopile black surface, creating in this way a temperature difference between the center of the thermopile (hot junction) and the pyranometer body (cold junction). The temperature difference between hot and cold junction is converted into a voltage signal by Seebeck effect.

Mounting

1. Load the cartridge containing the silica-gel crystals (only for PIR2S and PIR01 versions).
2. Install the pyranometer away from obstacles that can project the reflection of the sun (or their shadow) onto the sensor. The height of the pyranometer support must never exceed the plane of the pyranometer, so as not to introduce measurement errors caused by reflections and shadows generated by the support itself. In any case it is advisable to choose a position where the obstacles on the path of the sun from sunrise to sunset are less than 5 ° (the presence of obstacles on the horizon line sensitively influences the measure of direct radiation). Also avoid installing near headlights or lamps that are activated at night.
3. For accurate horizontal positioning (WMO weather and climate applications), the pyranometer is equipped with a bubble: the adjustment is made by means of the two screws with adjustment ring that allow to vary the inclination of the pyranometer. The fixing on a surface can be performed using the two 6mm diameter holes and the 65 mm center distance (only for PIR2S and PIR01 seePicture 1). To access the holes, remove the screen and replace it when assembly is complete.

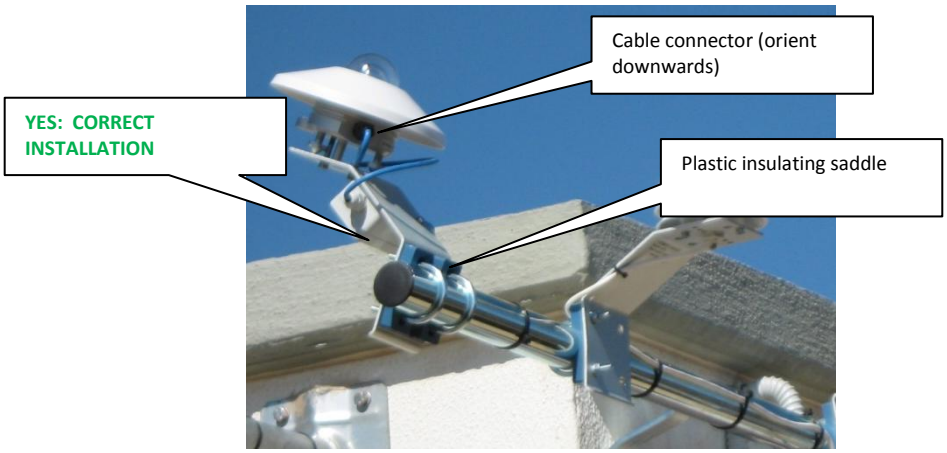


Picture 1

4. When the pyranometer is used without the white screen it must be positioned so that the electric cable exits from the part of the NORTH pole if used in the NORTH hemisphere (on the opposite side if installed in the SOUTH hemisphere), in accordance with ISO TR9901 and the WMO recommendations. In any case it is preferable to follow this recommendation even when the screen is used (see Picture 1). **Important note**: For applications in the photovoltaic field where the pyranometer must be tilted with the same angle as the solar panels, the assembly must be carried out so that the connector coming out of **the sensor faces downwards** (see Picture 2) avoiding possible infiltrations of rainwater in the cable.

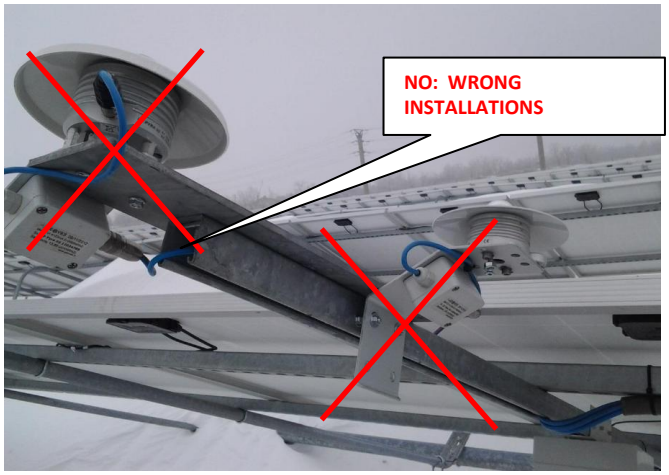
Geoves Snc
Via Magg.Piovesana, 155/a 31015 Conegliano (TV) - Italy
C.F. e P.IVA: 04433390269
tel.: +39 0438 22099 fax: +39 0438 420668
E-mail: info@geoves.it http://www.geoves.it

5. For a correct installation of the pyranometer, use the universal bracket cod. STF-UNI (see Picture 1) supplied with each pyranometer, which allows mounting on vertical, horizontal and oblique poles (ø25 ... 43mm) (the latter for example to allow installation at the same angle as photovoltaic panels for electricity production). The use of the STF-UNI bracket also allows the **thermally pyranometer insulation** from the adjacent structures to which it is attached: this greatly improves the response of the instrument and avoids errors on the measurement.



Picture 2 – Pyranometer correct mounting in photovoltaic applications

6. Do not connect the pyranometer support bracket directly on metal structures like solar panels (see Picture 3) where actuators or other electromechanical equipment are connected as disturbances or ripples can be induced in the pyranometer thermopile (not protected by Faraday cage), enter the conversion circuit and close on the shunt becoming a fixed and continuous signal always present.

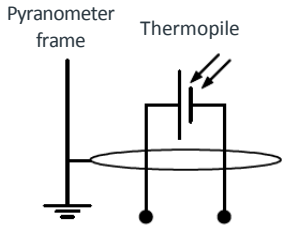


Picture 3 – Wrong installations

7. The second-class pyranometers (PIR02), unlike the first-class and secondary-standard ones (PIR01 and PIR2S), are not equipped with raised feet that separate the ballast (mechanical carcass where the cold-joint thermopiles act) from the mass thermal of a structure therefore, when the pyranometer support is connected directly to the metal structure, a considerable thermal mass is added (see Picture 3). This mass not only acts as a receptor of disturbances that are conveyed in the pyranometer, but also considerably changes the cold joint as a thermal weight, thus slowing down both the uphill and the downward response of the instrument. If it is not possible to install it correctly, use the blue plastic plate (see Picture 2) supplied with the Geoves bracket that can act as an electrical and thermo-mechanical isolator.
8. The distance from the ground of the pyranometer must never fall below 150 cm (ref. Annex n.8 WMO), since the infrared present in the solar rays is systematically reflected according to the type of paving overheating the compensation ballast (cold joint). For this reason it is advisable to install the pyranometer above a mowed lawn surface.

Geoves Snc
Via Magg.Piovesana, 155/a 31015 Conegliano (TV) - Italy
C.F. e P.IVA: 04433390269
tel.: +39 0438 22099 fax: +39 0438 420668
E-mail: info@geoves.it http://www.geoves.it

9. It is strongly recommended to thermally isolate the pyranometer from its support, at the same time make sure that there is a good electrical contact to ground.



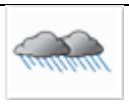
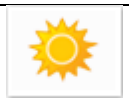
10. Check that the metal structure where the pyranometers are mounted is always connected to a good ground (optimal value on the ground <5 Ohm)
11. If the sensor-datalogger cable is longer than 30m, it is advisable to use a galvanic isolator on the acquisition side that isolates the masses and the power supply between pyranometer and PLC / datalogger.
12. For versions of pyranometers with natural thermopile output, the typical output of the sensor does not exceed 20mV. The recommended resolution of the reading acquisition device, in order to take full advantage of the pyranometer characteristics, must be at least 1µV.

Maintenance

In order to ensure high precision of the measurements it is necessary that the external dome of the pyranometer is always kept clean, therefore the greater the frequency of cleaning of the dome the better the precision of the measurements.
Cleaning can be performed with normal maps for cleaning photographic objectives and with water, if it were not sufficient to use pure ETHYL alcohol. After cleaning with alcohol it is necessary to clean the dome again with water only. Due to the high temperature changes between day and night it is possible that condensation forms on the pyranometer domes, in this case the reading is strongly overestimated. To minimize the formation of condensation, a special cartridge with Silica-gel absorbent material is inserted inside the pyranometer (only for PIR2S and PIR01 versions). The efficiency of Silica-gel crystals decreases over time with the absorption of moisture. When the silica-gel crystals are efficient the color is **yellow**, while as they lose their efficiency the color turns **blue**. Typically, the duration of the silica gel varies from 2 to 6 months depending on the environmental conditions in which the pyranometer operates.

Other useful information on pyranometer measurements

Typical values of solar radiation

		
Cloudy	**Partly cloudy**	**Sunny**
>40 ... 120 W/m²	**120 ... 450 W/m²**	**450 ... 1100 W/m²**

Maximum solar radiation values

Due to the reflection of some types of clouds, global radiation at sea level can rise above the direct extraterrestrial radiation of 1367 W/m² (solar constant) in the upper part of the atmosphere (WMO 1982): this phenomenon can occur sporadically, for a few minutes and at particular sites on Earth.

Negative values of solar radiation

This effect normally occurs when the temperature inside the dome is different from the cold junctions of the sensor (instrument casing). This phenomenon occurs mainly at night with clear skies when the earth's surface emits a long wave of infrared radiation upwards, generating a flow of heat carried by the wind that is emitted by conduction from the pyranometer casing towards the domes. This heat flow is opposite to the normal daytime heat flow when the thermopile absorbs solar radiation, therefore the pyranometer detects a negative value. This phenomenon, also known as "Type A Zero Offset", can also occur during daylight hours with a clear sky, but it is hidden inside the solar radiation measurement.
To reduce the “Zero Offset type A” phenomenon and improve the response of the pyranometer, we recommend using the PIR-RISC ventilation unit (applicable only to the PIR01 and PIR2S pyranometers) which ensures good ventilation of the domes and of the sensor casing, minimizing offsets and increasing stability on the measurements.

Geoves Snc
Via Magg.Piovesana, 155/a 31015 Conegliano (TV) - Italy
C.F. e P.IVA: 04433390269
tel.: +39 0438 22099 fax: +39 0438 420668
E-mail: info@geoves.it http://www.geoves.it

RISC-PIR – Ventilation and heating unit for pyranometers mod. PIR2S and PIR01- Technical annex for installation

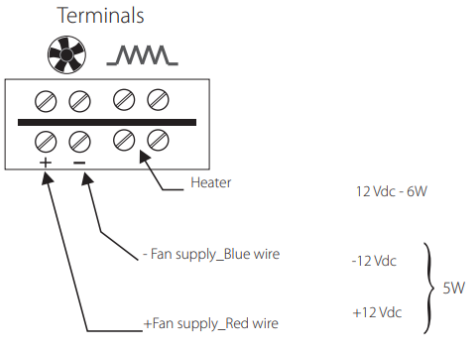
Description

The RISC-RIP ventilation and heating unit can be applied to pyranometers Vers. PIR2S (Secondary Standard Class) and PIR01 (First Class) and can be used outdoors in any weather condition. Ventilation of instruments increases the measurements accuracy making uniform the temperature of the pyranometer, in particular avoids the deposition of dew and frost on the optical parts of the sensors; besides this solution reduces the offset type A (found in pyranometers and pyrgeometers) due to the cooling of the dome respect to the instrument body.

It's possible to use the heating in extreme environmental conditions to prevent ice forming on the dome of the pyranometer (when the heating is switched on, it must be considered that the type A offset could therefore increase is recommended to use the heating for the necessary time to ice or snow removal formed on instruments).

Electrical wiring

The electrical connections of the RISC-PIR unit are made via the terminal block located under the base and the cable supplied.
In the terminal box there are two pairs of terminals. One pair for ventilation and one pair for heating.
The polarity of the fan must be respected otherwise the air flow is in the opposite direction to that expected (from bottom to top) while for the heater the polarity can also be reversed as a simple resistance is fed. The following figure shows the correspondences between terminals, cable and functionality:



Technical features:

- Power supply: 12Vdc Ventilation (5W)
- Heating 12Vdc (6W)
- Working temperature: -30 ... 70 ° C

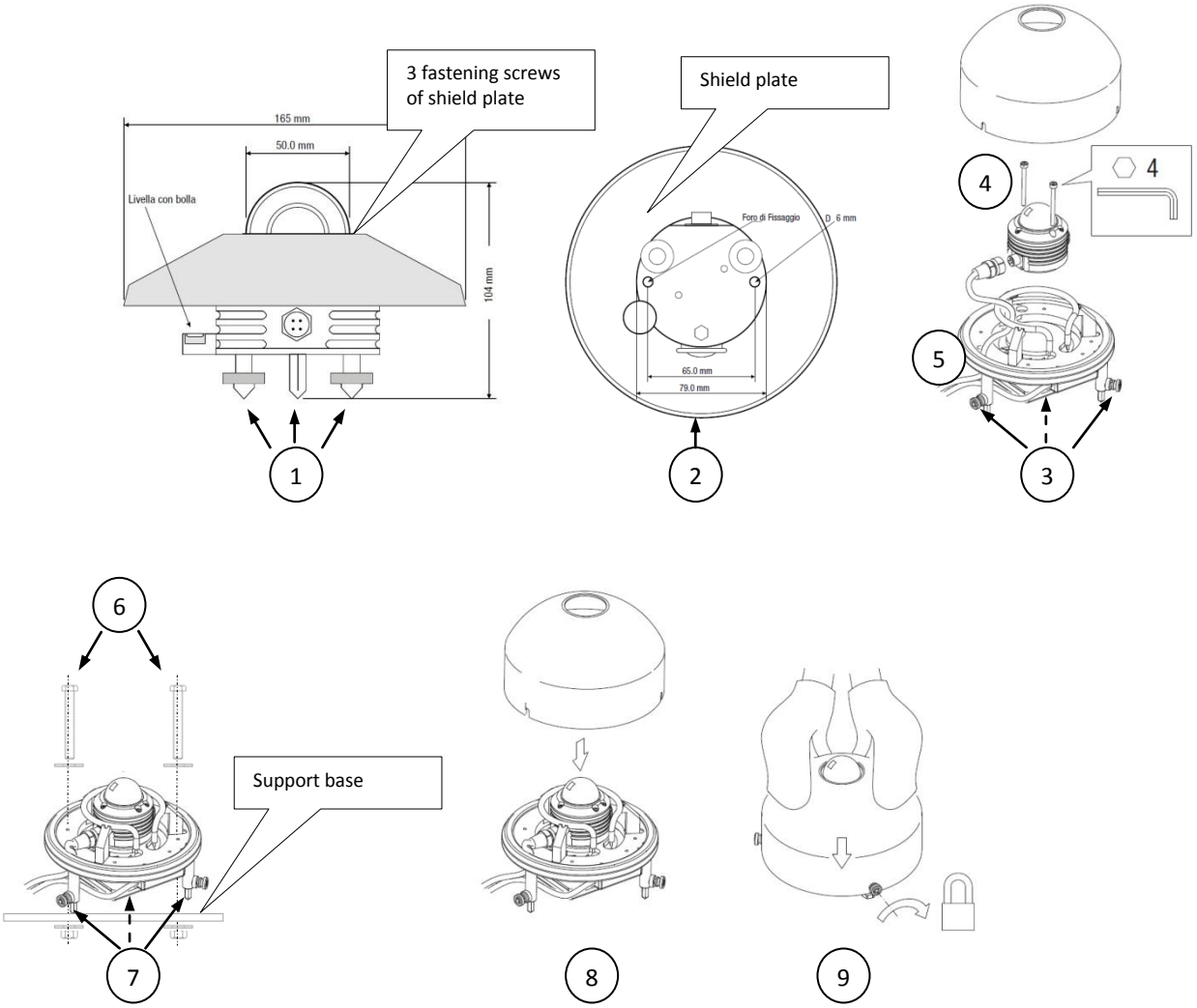
Installation and assembly of the ventilation / heating unit

Operate as follows to install the pyranometer in the ventilation unit:

1. Remove the 3 adjustment screws from the pyranometer body (leveling if necessary will be performed with the adjustment screws present in the RISC-PIR ventilation unit)
2. Remove the white pyranometer screen by unscrewing the 3 screws on the top
3. Unscrew the 3 ring nuts that fix the bell-shaped white metal casing of the ventilation unit then remove it
4. Fix the pyranometer to the ventilation unit using two M5x55 screws supplied
5. Connect the pyranometer cable by passing it under the rubber gasket and in the special slot
6. Fix the ventilation unit to the support surface / plate where it will be installed, using the 2 M8 bolts

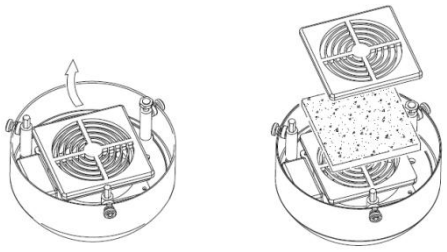
Geoves Snc
Via Magg.Piovesana, 155/a 31015 Conegliano (TV) - Italy
C.F. e P.IVA: 04433390269
tel.: +39 0438 22099 fax: +39 0438 420668
E-mail: info@geoves.it http://www.geoves.it

7. Before finally tightening the 2 M8 bolts, adjust the 3 feet so that the RISC-PIR unit and consequently the pyranometer are perfectly level (in this way a correct and more precise measurement of the solar radiation is ensured with respect to the ground). At this point tighten the 2 M8 bolts to ensure a good mechanical coupling between the ventilation unit and the existing support surface.
8. Reassemble the bell enclosure of the ventilation unit in its seat
9. Tighten the 3 fixing rings.



Maintenance of ventilation system

The ventilation system, that uses the fan mod. EBMPAPST 4312V (with IP 54 protection degree and capacity of 170m^3/h), is with the filter mod. EBMPAPST: PMFA 12OT which must be periodically controlled and replaced if dirty or clogged up (see next picture).



Geoves Snc
Via Magg.Piovesana, 155/a 31015 Conegliano (TV) - Italy
C.F. e P.IVA: 04433390269
tel.: +39 0438 22099 fax: +39 0438 420668
E-mail: info@geoves.it http://www.geoves.it