



SOLAR MEASUREMENTS



What is a Pyranometer?

According to the WMO '*Guide to Meteorological Instruments and Methods of Observation*', a pyranometer is a device for measuring global solar radiation from a solid angle of 2π sr into a plane surface and a spectral range from 300 to 3000 nm.

The term global solar radiation refers to the total amount of solar energy received by the earth's surface (expressed in W/m^2). This includes both direct radiation that passes directly through the atmosphere to the earth's surface and diffuse sky radiation that is scattered in the atmosphere.

Which Pyranometers do we produce?

Delta OHM pyranometers are the result of our own R&D department.

'High quality, high technology, high standard', a leading motto that in the years has been taken into consideration while developing the full range of our pyranometers.

The whole range complies with the requirements of ISO 9060:1990, with the International Standard set by WMO (World Meteorological Organization) and are traceable to the PMOD/WRC Institute in Davos, Switzerland.

Delta OHM has a wide range of Pyranometers: Secondary standard, First class and Second class are all covered.



LPPYRA10
Secondary Standard



LPPYRA02
First Class



LPPYRA03
Second Class

How does a pyranometer work?

The operating principle of a pyranometer is based on the temperature difference of two surfaces. The sensor is based on a thermopile protected by a glass dome. That allows the pyranometer to operate in any weather condition and to be placed anywhere, from the desert to the South Pole.



Where to use these devices?

Nowadays solar radiation has an enormous impact on our lives. Meteorology, climate research, hydrology, environmental analysis, agriculture, material testing. Directly or indirectly solar radiation on Earth's surface has an influence in all these application fields and collecting these data has become fundamental.

Furthermore, one of the most promising renewable energy is solar energy. The enormous market growth in photovoltaics during the 21 st century has revived the research and expansion in the solar industry, including the maintenance of existing plants. The utmost precision is required to get maximum yield from sun energy. Monitoring and maintenance are a key for ensuring the productivity of the photovoltaic system. The right pyranometer has to be chosen depending on the size of the plants.

What are the benefits of our pyranometers?

✓ Buy **experience:**

Delta OHM supplies Pyranometers to the market since over 20 years

✓ Buy **efficiency:**

our Pyranometers are easy to set up and quick to install

✓ Buy **accuracy:**

we supply each Pyranometer with an individual calibration report

✓ Buy **the best:**

our Pyranometers are the only ones on the market with 6 years warranty



Technical Specifications	LPPYRA10	LPPYRA02	LPPYRA03
WMO/ISO Classification	Secondary standard	First Class	Second Class
ISO 9060:2018*	Spectrally flat ***	Spectrally flat **	Spectrally flat *
Typical sensitivity	6 to 11 $\mu\text{V}/(\text{W}/\text{m}^2)$	6 to 12 $\mu\text{V}/(\text{W}/\text{m}^2)$	5 to 15 $\mu\text{V}/(\text{W}/\text{m}^2)$
Impedance	5 $\Omega \div 50 \Omega$	33 $\Omega \div 45 \Omega$	33 $\Omega \div 45 \Omega$
Measuring range	0-4000 W/m^2	0 $\div 2000 \text{W}/\text{m}^2$	0 $\div 2000 \text{W}/\text{m}^2$
Viewing field	2 π sr	2 π sr	2 π sr
Spectral range (50%)	283 nm ... 2800 nm	283 nm \div 2800 nm	300 nm \div 2800 nm
Operating and storage temperature range	-40 $^{\circ}\text{C} \div 80 ^{\circ}\text{C}$	-40 $^{\circ}\text{C} \div 80 ^{\circ}\text{C}$	-40 $^{\circ}\text{C} \div 80 ^{\circ}\text{C}$
Weight	0.90 kg	0.90 kg	0.45 kg
ISO 9060 Specifications			
Response time 95%	< 5 s	< 28 s	< 30 s
Zero Off-set	a) Response to thermal radiation (200 W/m^2)	<7 W/m^2	15 W/m^2
	b) Response to temperature change 5K/h	< ± 2 W/m^2	< ± 4 W/m^2
Non stability over 1 year	< ± 0.5 %	< ± 1.5 %	< ± 2.5 %
Non-linearity	< ± 0.2 %	< ± 1 %	< ± 2 %
Cosine response	< ± 10 W/m^2	< ± 18 W/m^2	< ± 22 W/m^2
Spectral selectivity	< ± 3 %	< ± 5 %	< ± 7 %
Temperature response (-10 $^{\circ}\text{C}$ to +40 $^{\circ}\text{C}$)	< 1 %	< 4 %	< 8 %
Tilt response	< ± 0.2 %	< ± 2 %	< ± 4 %
Humidity Range	0 to 100%	0 to 100%	0 to 100%
Mean Time Between Failures	> 10 years	> 10 years	> 10 years
Accuracy of bubble level	< 0.1 $^{\circ}$	< 0.1 $^{\circ}$	< 0.2 $^{\circ}$
Ingress Protection (IP) rating	67	67	67
Version with shadow ring	✓	✓	✓ (only for passive version)
Warranty	6 (registration required)	6 (registration required)	3
ISO 17025 Certification	on request	on request	on request

*Under approval

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LPPYRA10, LPPYRA13



LPPYRA10 - LPPYRA13 SECONDARY STANDARD PYRANOMETER

The pyranometers LPPYRA10 and LPPYRA13 measure the irradiance on a flat surface (W/m^2). The radiation measured is the sum of direct solar irradiance and diffuse irradiance (global radiation). LPPYRA13 is equipped with an adjustable shadow ring for the measurement of diffuse radiation only.

LPPYRA10 and LPPYRA13 are pyranometers classified as "Secondary Standards" in accordance with ISO 9060 and according to the publication "Guide to Meteorological Instruments and Methods of Observation", eighth edition of WMO

The pyranometers are available in five versions:

LPPYRA10	PASSIVE
LPPYRA10AC	ACTIVE with 4..20mA CURRENT output
LPPYRA10AV	ACTIVE with 0..1V, 0..5V, 0..10V VOLTAGE output, to specify at the time of ordering
LPPYRA10S	with serial RS485 MODBUS-RTU protocol output
LPPYRA10S12	with digital SDI-12 output
LPPYRA13	PASSIVE
LPPYRA13AC	ACTIVE with 4..20mA CURRENT output
LPPYRA13AV	ACTIVE with 0..1V, 0..5V, 0..10V VOLTAGE output, to specify at the time of ordering
LPPYRA13S	with serial RS485 MODBUS-RTU protocol output
LPPYRA13S12	with digital SDI-12 output

WORKING PRINCIPLE

The pyranometers LPPYRA10 and LPPYRA13 are based on a thermopile sensor which surface is covered by a matt black paint so to allow the instrument not to be selective at various wavelengths. The spectral range of the pyranometers is determined by the transmission of the two glass domes. The new sensor allows a response time less than the requirements of the ISO 9060 standard for classification of Secondary Standard pyranometers (response time is generally less than 5 seconds, where ISO 9060 standard requires a response time less than 15 seconds).

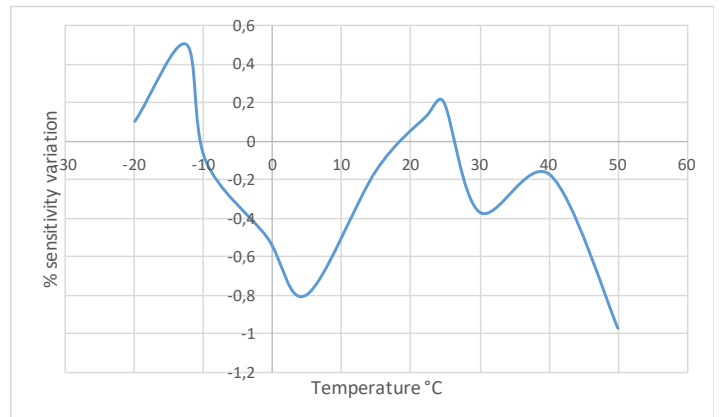
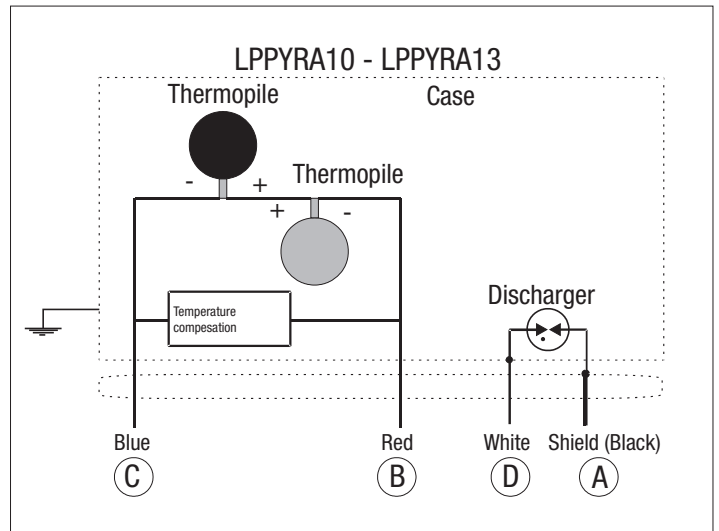
Radiant energy is absorbed/radiated from the surface of the blackened thermopile, creating a temperature difference between the centre of the thermopile (hot junction) and the body of pyranometer (cold junction). The temperature difference between hot and cold junction is converted into Potential Difference thanks to the Seebeck effect.

A second thermopile is mounted inside the instrument and not accessible by light. This second thermopile, connected anti-series with respect to the sensor exposed to light, reduces the signals of the pyranometers caused by sudden temperature changes (thermal shock).

In order to minimize variations of sensitivity according to the temperature, the LPPYRA10 and LPPYRA13 are equipped with a passive compensation circuit. The graph 1 shows the typical variation of sensitivity at different temperatures.

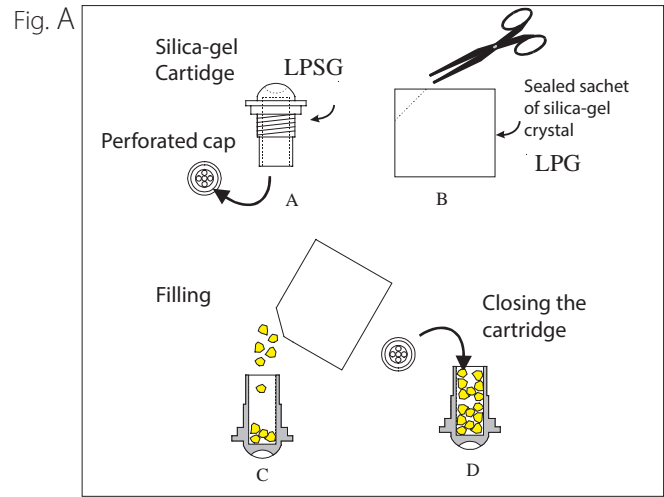
The deviations are calculated from the measured sensitivity at 20°C.

LPPYRA10 and LPPYRA13 have two concentric domes with external diameter of 50mm and 30mm respectively, this to ensure a thermal insulation of the thermopile by the wind and reduce the sensitivity to radiation heat. The domes protect the thermopile from dust settling on the blackened surface, which could affect the spectral sensitivity.



Graph 1: % change of the sensitivity of the pyranometer LPPYRA10 - LPPYRA13 compared to the sensitivity at 20°C in the temperature range between -20 and 50°C.

Technical Specifications		
Typical sensitivity		
- LPPYRA10 - LPPYRA13	6 to 11 $\mu\text{V}/(\text{W}/\text{m}^2)$	
- LPPYRA10AC	4..20 mA (0..2000 W/m^2)	
- LPPYRA13AC	4..20mA (0..4000 W/m^2) on request	
- LPPYRA10AV	0..1,5,10V (0..2000 W/m^2)	
- LPPYRA13AV	0..1,5,10V (0..4000 W/m^2) on request	
Impedance	5 $\Omega \div 50 \Omega$	
Measuring range	0-4000 W/m^2	
Viewing field	2 π sr	
Spectral range (50%)	283 nm ... 2800 nm	
Operating and storage temperature range	-40 °C \div 80 °C	
Dimensions:	See figure B	
Weight	0.90 kg	
ISO 9060 Specifications		
Response time 95%	< 5 s.	
Zero Off-set	a) Response to thermal radiation (200 W/m^2)	<7 W/m^2
	b) Response to temperature change 5K/h	< ± 2 W/m^2
Non stability over 1 year	< ± 0.5 %	
Non-linearity	< ± 0.2 %	
Cosine response	< ± 10 W/m^2	
Spectral selectivity	< ± 3 %	
Temperature response (-10°C to +40°C)	<1 %	
Tilt response	< 0.2 %	
Humidity Range	0 to 100%	
Mean Time Between Failures	> 10 years	
Accuracy of bubble level	< 0.1°	
Ingress Protection (IP) rating	67	
Shadow ring for LPPYRA13		
Weight	5.90 kg	
Diameter	570 mm	
Height	54 mm	
Basis diameter	300 mm	



- The pyranometer should be located far from any kind of obstacle that can project the reflection of the sun (or shadow) on the pyranometer itself.
- When the pyranometer is used without the white screen should be positioned so that the cable comes out from the North pole side if you use it in the NORTH hemisphere, and from the SOUTHERN pole side if you use it in the SOUTH hemisphere, according to the ISO TR9901 standard and other WMO recommendations. In any case, it is preferable to comply with WMO/ISO recommendations also when the screen is used.
- For an accurate horizontal positioning, the pyranometer LPPYRA10 and LPPYRA13 are equipped with a spirit level, which adjustment is by two screws with lock nut that allows changing the pyranometer inclination. The fixing on a flat base can be performed by using two 6mm diam. holes and 65 mm wheelbase. In order to access the holes, remove the screen and re-place it back after mounting, see figure B
- In order to facilitate the installation of the pyranometer, Delta OHM provides on request a range of accessories. The installer must take care that the height of the mast does not exceed the plane of the pyranometer, not to introduce measurement errors caused by reflections and shadows caused by the pole.
- It is better to insulate the pyranometer from its support, while ensuring that there is a good electrical contact to earth.

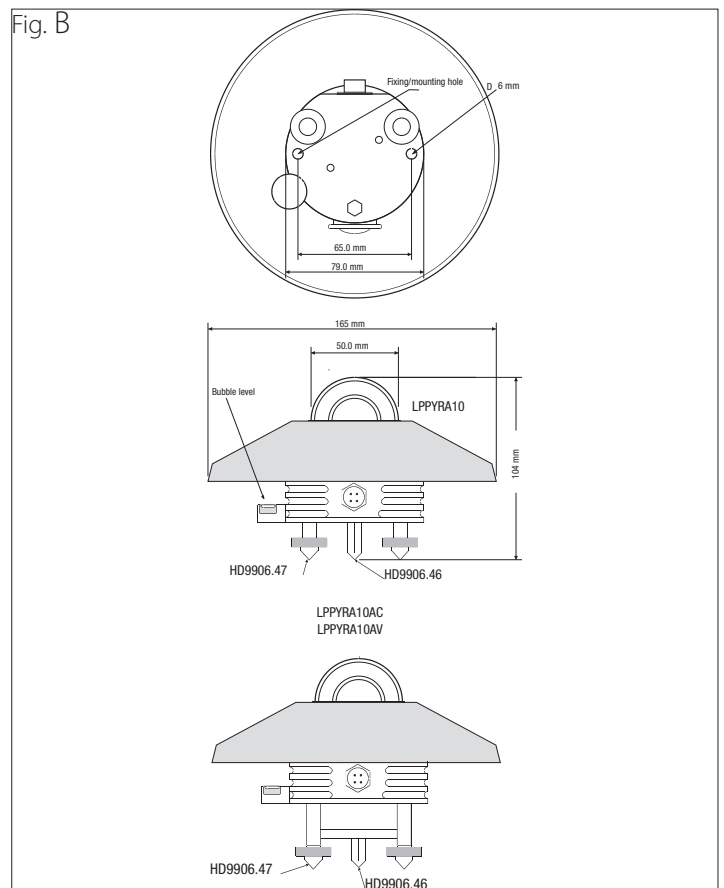
INSTALLATION AND MOUNTING OF THE PYRANOMETERS TO MEASURE GLOBAL RADIATION:

Before installing the pyranometers you need to load the cartridge containing silica gel crystals (see figure A). The silica gel has the function of absorbing the humidity in the dome chamber, which can lead to condensation on the inside of the dome walls, thus altering the measure. While loading silica gel crystals, avoid touching it with wet hands. The operations to perform (as much as possible) in a dry place are:

- 1- unscrew the three screws that fix the white screen
- 2- unscrew the Silica gel cartridge by using a coin
- 3- remove cartridge perforated cap
- 4- open the envelope (included with the pyranometer) containing the silica gel
- 5- fill the cartridge with silica-gel crystals
- 6- close the cartridge with his cap, making sure that the O-ring seal is positioned correctly
- 7- screw the cartridge into the body of the pyranometer with a coin
- 8- make sure that the cartridge is firmly screwed (if not the duration of the crystals of silica gel is reduced)
- 9- place the screen and screw it
- 10- the pyranometer is ready for use

- The LPPYRA10 and LPPYRA13 have to be installed in a location easily accessible for periodic cleaning of the silicon window. At the same time you should avoid buildings, trees or obstacles of any kind exceed the horizontal plane on which the pyranometer lies. In case this is not possible it is advisable to choose a location where the obstacles are lower than 5°.

N.B. the presence of obstructions on the horizontal line significantly affects the measurements of direct irradiance.



ELECTRICAL CONNECTIONS AND REQUIREMENTS FOR ELECTRONIC READING:

LPPYRA10 and LPPYRA13 are produced in five versions:

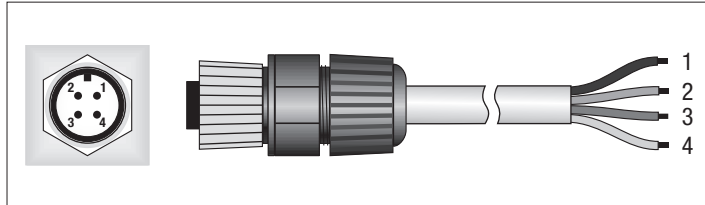
LPPYRA10, LPPYRA10AC, LPPYRA10AV, LPPYRA10S, LPPYRA10S12
LPPYRA13, LPPYRA13AC, LPPYRA13AV, LPPYR13S, LPPYRA13S12

- LPPYRA10 and LPPYRA13 are passive and do not need power.
- Versions LPPYRA10AC, AV, S, S12 and LPPYRA13AC, AV, S, S12 are active and need power.
The voltage required is:
10-30 Vdc for the versions AC and AV with 0..1V and 0..5 V output.
15-30 Vdc for the version AV with 0..10V output.
5-30 Vdc for the version S with RS485 output
7-30 Vdc for the version S12 with SDI-12 output

- Passive versions as well as versions AC and AV are equipped with 4-pin output connector. Versions S and S12 are equipped with 8-pin output connector.

- The (optional) cable, with M12 connector is made in PTFE resistant to UV and is provided with 3 wires plus shield, (4 wires plus shield in the S versions).

CONNECTION SCHEME FOR 4-PIN CONNECTOR



LPPYRA10 - LPPYRA13

Connector	Function	Color
1	Output positive (+Vout)	Red
2	Output negative (-Vout)	Blue
3	Housing	White
4	Cable shield	Black

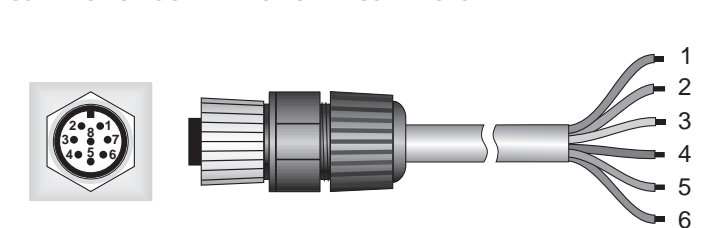
LPPYRA10AC - LPPYRA13AC

Connector	Function	Color
1	Positive (Current in)	Red
2	Negative (Current out)	Blue
3	Housing	White
4	Cable shield	Black

LPPYRA10AV - LPPYRA13AV

Connector	Function	Color
1	Output positive (+Vout)	Red
2	Output negative (-Vout) Power supply negative (GND)	Blue
3	Power supply positive(+Vdc)	White
4	Cable shield	Black

CONNECTION SCHEME FOR 8-PIN CONNECTOR



Fixed 8-pole M12 plug

Female 8-pole M12 connector

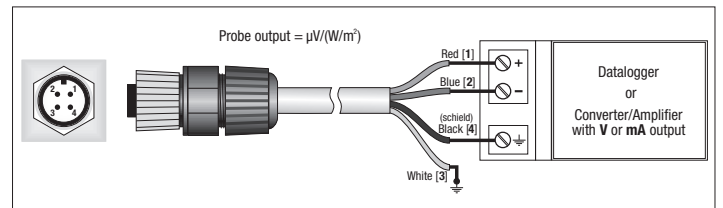
LPPYRA10S - LPPYRA13S

Connector	Function	Color
1	Power supply negative (GND)	Blue
2	Power supply positive (+Vdc)	Red
3	Not connected	
4	RS485 A/-	Brown
5	RS485 B/+	White
6	Housing	Shield (Black)
7	Not connected	
8	Not connected	

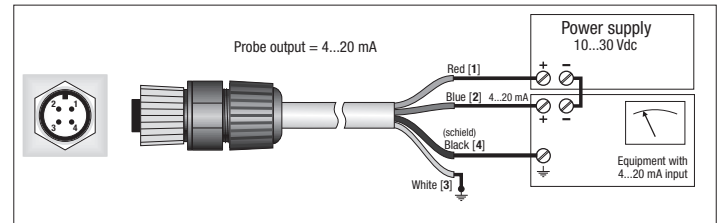
LPPYRA10S12 - LPPYRA13S12

Connector	Function	Color
1	Power supply negative (GND) SDI-12 output negative	Blue
2	Power supply positive (+Vdc)	Red
3	Not connected	
4	Not connected	
5	SDI-12 output positive	White
6	Housing	Shield (Black)
7	Not connected	
8	Not connected	

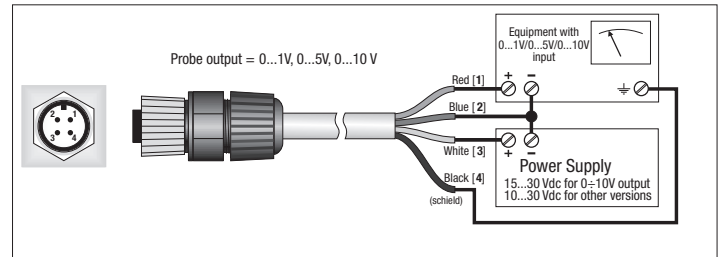
- LPPYRA10 and LPPYRA13 are connected to a millivoltmeter or to a data acquisition system. Typically, the signal from the pyranometer does not exceed 20 mV. In order to take full advantage of the pyranometer, the recommended resolution of the reading instrument is 1µV.



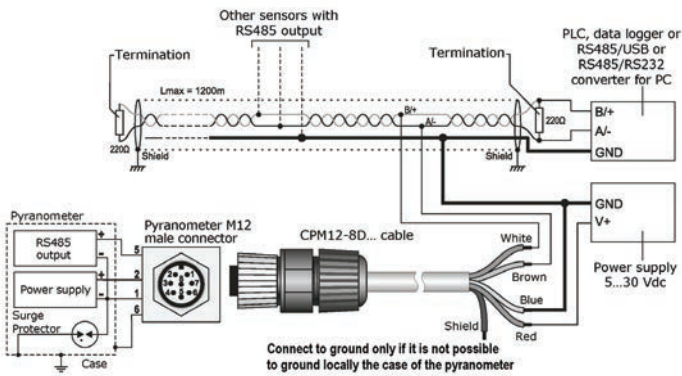
- LPPYRA10AC, LPPYRA13AC have to be connected to a power supply and a multimeter as shown below, resistance load for reading the signal must be ≤ 500 Ω:



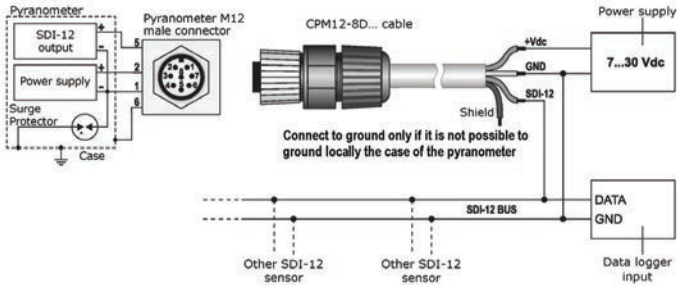
- LPPYRA10AV, LPPYRA13AV have to be connected to a power supply and a multimeter, as shown below, the load resistance for reading the signal must be ≥ 100 kΩ:



- LPPYRA...S has to be connected according to the following scheme:



- LPPYRA...S12 has to be connected according to the following scheme:



CALIBRATION AND MEASURES

LPPYRA10, LPPYRA13

The sensitivity of the pyranometer (or calibration factor) allows to determine the global irradiance by measuring a volt signal at the ends of the thermopile. The S factor is in $\mu\text{V}/(\text{Wm}^{-2})$.

Once measured the potential difference (DDP) at the ends of the thermopile, the radiation E_e is obtained by the following formula:

$$E_e = \text{DDP}/S$$

where;

E_e : is the Radiation expressed in W/m^2 ,

DDP: is the difference of potential expressed in μV measure by a multimeter,

S: is the sensitivity

LPPYRA10AC, LPPYRA13AC

The sensitivity of the pyranometer is factory adjusted so that $4.20 \text{ mA} = 0.2000 \text{ W}/\text{m}^2$ (on request $0.4000 \text{ W}/\text{m}^2$). To get the value of radiation once the current (I_{out}) absorbed by the instrument is known, following formula has to be applied:

$$E_e = 125 \cdot (I_{\text{out}} - 4\text{mA})$$

where;

E_e : is the Radiation expressed in W/m^2 ,

I_{out} : is the current in mA absorbed by the instrument

LPPYRA10AV, LPPYRA13AV

The sensitivity of the pyranometer is factory adjusted, so as to have, depending on the version that has been chosen:

$0.1 \text{ V} = 0.2000 \text{ W}/\text{m}^2$ (on request $0.4000 \text{ W}/\text{m}^2$)

$0.5 \text{ V} = 0.2000 \text{ W}/\text{m}^2$ (on request $0.4000 \text{ W}/\text{m}^2$)

$0.10 \text{ V} = 0.2000 \text{ W}/\text{m}^2$ (on request $0.4000 \text{ W}/\text{m}^2$)

To obtain the value of irradiation, once the output voltage (V_{out}) of the instrument is known, following formula has to be applied:

$$E_e = 2000 \left[(\text{W}/\text{m}^2)/\text{V} \right] \times V_{\text{out}} [\text{V}] \text{ for the version } 0.1\text{V} (0.2000 \text{ W}/\text{m}^2)$$

$$E_e = 400 \left[(\text{W}/\text{m}^2)/\text{V} \right] \times V_{\text{out}} [\text{V}] \text{ for the version } 0.5\text{V} (0.2000 \text{ W}/\text{m}^2)$$

$$E_e = 200 \left[(\text{W}/\text{m}^2)/\text{V} \right] \times V_{\text{out}} [\text{V}] \text{ for the version } 0.10\text{V} (0.2000 \text{ W}/\text{m}^2)$$

where;

E_e : is the Radiation expressed in W/m^2 ,

V_{out} : is the output voltage (in Volts) measured with the voltmeter

Each pyranometer is individually factory calibrated and is distinguished by its calibration factor. To take full advantage of the LPPYRA10 and LPPYRA13 features, we recommend performing the calibration annually. The instruments present in the metrology laboratory of Photo-Radiometry at Delta OHM srl allows the calibration of the pyranometer according to the requirements of WMO, and ensures the traceability of measurements to international standards.

ORDERING CODES:

LPPYRA10: Pyranometer Secondary Standard according to ISO 9060.

Supplied with shade disk, cartridge with silica-gel crystals, 2 spare sachets, levelling device, connector and ISO 9001 Calibration Report. The connection cable CPM12AA4... has to be ordered separately.

LPPYRA10AC: Pyranometer Secondary Standard according to ISO 9060.

Supplied with shade disk, cartridge with silica-gel crystals, 2 spare sachets, levelling device, connector and ISO 9001 Calibration Report. The connection cable CPM12AA4... has to be ordered separately. 4.20 mA current output signal ($0.2000 \text{ W}/\text{m}^2$). 4.20 mA ($0.4000 \text{ W}/\text{m}^2$) on request.

LPPYRA10AV: Pyranometer Secondary Standard according to ISO 9060.

Supplied with shade disk, cartridge with silica-gel crystals, 2 spare sachets, levelling device, connector and ISO 9001 Calibration Report. The connection cable CPM12AA4... has to be ordered separately. Voltage 0.1 Vdc , 0.5 Vdc , 0.10 Vdc output signal, to define when ordering ($0.2000 \text{ W}/\text{m}^2$). 0.1 V , 0.5 V , 0.10 V ($0.4000 \text{ W}/\text{m}^2$) on request.

LPPYRA10S: Pyranometer Secondary Standard according to ISO 9060.

Supplied with shade disk, cartridge with silica-gel crystals, 2 spare sachets, levelling device, connector and ISO 9001 Calibration Report. The connection cable CPM12-8D... has to be ordered separately. Serial output RS485 MODBUS-RTU. Power supply: $5 \dots 30 \text{ Vdc}$.

LPPYRA10S12: Pyranometer Secondary Standard according according to ISO 9060.

Supplied with shade disk, cartridge with silica-gel crystals, 2 spare sachets, levelling device, connector and ISO 9001 Calibration Report. SDI-12 output. Power supply $7 \dots 30 \text{ Vdc}$. The cable CPM12-8D... has to be ordered separately.

LPPYRA13: Pyranometer Secondary Standard according to ISO 9060.

Equipped with protection, shadow ring for diffuse radiation, silica-gel crystals cartridge, 2 recharges, levelling device, connector and ISO 9001 Calibration Report. The cable CPM12AA4... has to be ordered separately.

LPPYRA13AC: Pyranometer Secondary Standard according to ISO 9060.

Equipped with protection, shadow ring for diffuse radiation, silica-gel crystals cartridge, 2 recharges, levelling device, connector and ISO 9001 Calibration Report. The cable CPM12AA4... has to be ordered separately. 4.20 mA current output signal ($0.2000 \text{ W}/\text{m}^2$). 4.20 mA ($0.4000 \text{ W}/\text{m}^2$) on request.

LPPYRA13AV: Pyranometer Secondary Standard according to ISO 9060.

Equipped with protection, shadow ring for diffuse radiation, silica-gel crystals cartridge, 2 recharges, levelling device, connector and ISO 9001 Calibration Report. The cable CPM12AA4... has to be ordered separately. Voltage 0.1 Vdc , 0.5 Vdc , 0.10 Vdc output signal, to define when ordering ($0.2000 \text{ W}/\text{m}^2$). 0.1 V , 0.5 V , 0.10 V ($0.4000 \text{ W}/\text{m}^2$) on request.

LPPYRA13S: Pyranometer Secondary Standard according to ISO 9060.

Equipped with protection, shadow ring for diffuse radiation, silica-gel crystals cartridge, 2 recharges, levelling device, connector and ISO 9001 Calibration Report. The cable CPM12-8D... has to be ordered separately. Serial output RS485 MODBUS-RTU. Power supply: $5 \dots 30 \text{ Vdc}$.

LPPYRA13S12: Pyranometer Secondary Standard according according to ISO 9060.

Equipped with protection, shadow ring for diffuse radiation, silica-gel crystals cartridge, 2 recharges, levelling device, connector and ISO 9001 Calibration Report. The cable CPM12-8D... has to be ordered separately. SDI-12 output. Power supply $7 \dots 30 \text{ Vdc}$.

For connecting cables and mounting accessories see page 21

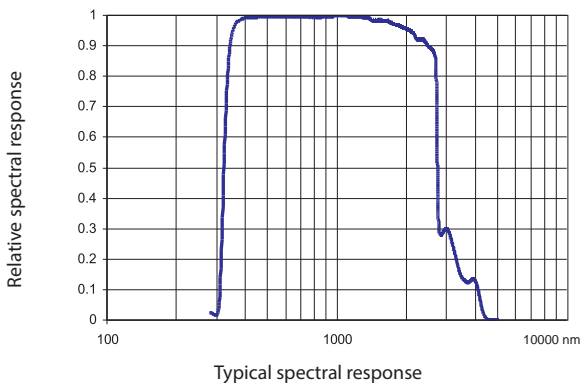
LPPYRA02, LPPYRA03, LPPYRA12



LPPYRA02 - LPPYRA03 - LPPYRA12 FIRST CLASS AND SECOND CLASS PYRANOMETERS

Delta OHM manufactures First Class LPPYRA02 and LPPYRA12 and Second Class LPPYRA03 pyranometers which fully comply with ISO 9060 standards, and meet the requirements defined by the World Meteorological Organization (WMO). These are strong and reliable instruments, especially designed to be used under all weather conditions. They are suitable for installation on the field.

Recommended use: atmospheric research, weather stations, climatology, energy saving research, productive efficiency test of photovoltaic plants, etc...



Pyranometers LPPYRA02 and LPPYRA03 are well suited for the measurement of incoming global solar radiation (GHI - Global Horizontal Irradiance). LPPYRA12 (pyranometer with shadow ring) is designed to shield the instrument sensor from direct radiation; by that, an exact measurement of the diffuse sky radiation is possible (DHI - Diffuse Horizontal Irradiance).

- LPPYRAxx with direct, unamplified output, no external power supply required
- LPPYRAxxAC with 4..20 mA current output- 2-wire connection, requires external power supply
- LPPYRAxxAV with 0..1Vdc, 0..5Vdc or 0..10 Vdc voltage output, requires external power supply
- LPPYRAxxS with serial RS485 and MODBUS-RTU protocol, requires external power supply
- LPPYRAxxS12 with digital SDI-12 output, requires external power supply

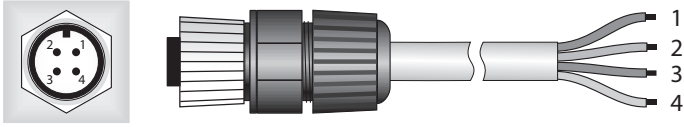
The pyranometers with unamplified output have a typical sensitivity of:

$$10 \frac{\text{mV}}{\text{kW} \cdot \text{m}^2}$$

Every pyranometer is calibrated separately and is supplied standard with a WRR (World Radiometric Reference) Report of Calibration.

Technical Specifications	LPPYRA02 / LPPYRA12	LPPYRA03
Typical sensitivity	6 to 12 $\mu\text{V}/(\text{W}/\text{m}^2)$	5 to 15 $\mu\text{V}/(\text{W}/\text{m}^2)$
Impedance	$33 \Omega \div 45 \Omega$	$33 \Omega \div 45 \Omega$
Measuring range	$0 \div 2000 \text{ W}/\text{m}^2$	$0 \div 2000 \text{ W}/\text{m}^2$
Viewing field	$2\pi \text{ sr}$	$2\pi \text{ sr}$
Spectral range (50%)	283 nm \div 2800 nm	300 nm \div 2800 nm
Operating and storage temperature range	$-40^\circ\text{C} \div 80^\circ\text{C}$	$-40^\circ\text{C} \div 80^\circ\text{C}$
Weight	0.90 kg	0.45 kg
ISO 9060 Specifications		
Response time 95%	< 28 s	< 30 s
Zero Off-set		
Zero Off-set	a) Response to thermal radiation ($200 \text{ W}/\text{m}^2$)	15 W/m^2
	b) Response to temperature change 5K/h	< $ \pm 4 \text{ W}/\text{m}^2$
Non stability over 1 year	< $ \pm 1.5 \%$	< $ \pm 2.5 \%$
Non-linearity	< $ \pm 1 \%$	< $ \pm 2 \%$
Cosine response	< $ \pm 18 \text{ W}/\text{m}^2$	< $ \pm 22 \text{ W}/\text{m}^2$
Spectral selectivity	< $ \pm 5 \%$	< $ \pm 7 \%$
Temperature response (-10°C to $+40^\circ\text{C}$)	< 4 %	< 8 %
Tilt response	< $ \pm 2 \%$	< $ \pm 4 \%$
Humidity Range	0 to 100%	0 to 100%
MTBF	> 10 years	> 10 years
Accuracy of bubble level	< 0.1°	< 0.2°
Ingress Protection (IP) rating	67	67
Shadow ring for LPPYRA12		
Weight	5.90 kg	
Diameter	570 mm	
Height	54 mm	
Basis diameter	300 mm	

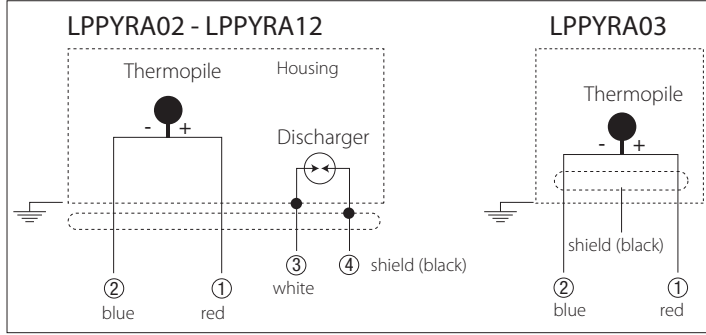
CONNECTION SCHEME FOR 4-PIN CONNECTOR



Fixed 4-pole M12 plug Female 4-pole M12 connector

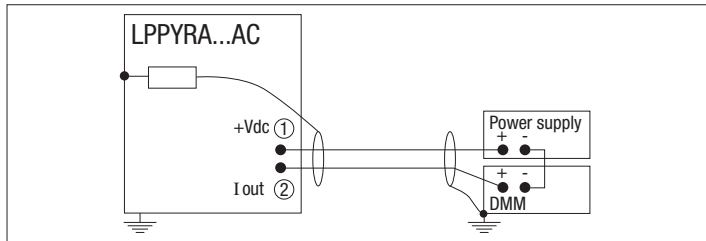
LPPYRA02 - LPPYRA03 - LPPYRA12

Connector	Function	Color
1	Output positive (+Vout)	Red
2	Output negative (-Vout)	Blue
3	Housing	White
4	Cable shield	Black



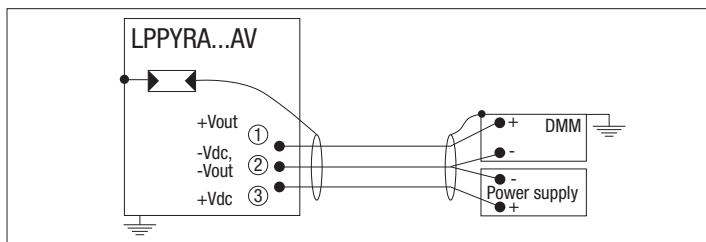
LPPYRA02AC - LPPYRA03AC - LPPYRA12AC

Connector	Function	Color
1	Positive (Current in)	Red
2	Negative (Current out)	Blue
3	Housing	White
4	Cable shield	Black

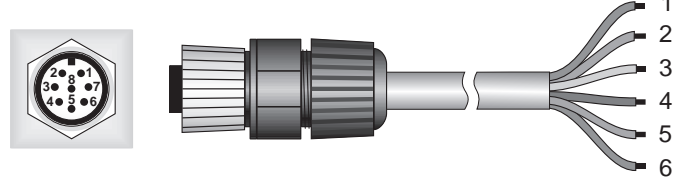


LPPYRA02AV - LPPYRA03AV - LPPYRA12AV

Connector	Function	Color
1	Output positive (+Vout)	Red
2	Output negative (-Vout) Power supply negative (GND)	Blue
3	Power supply positive (+Vdc)	White
4	Cable shield	Black



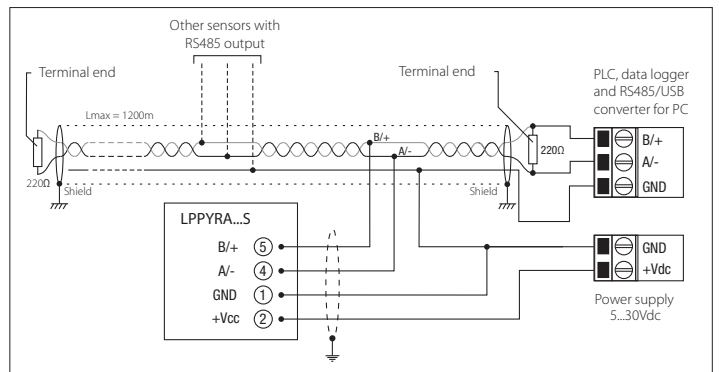
CONNECTION SCHEME FOR 8-PIN CONNECTOR



Fixed 8-pole M12 plug Female 8-pole M12 connector

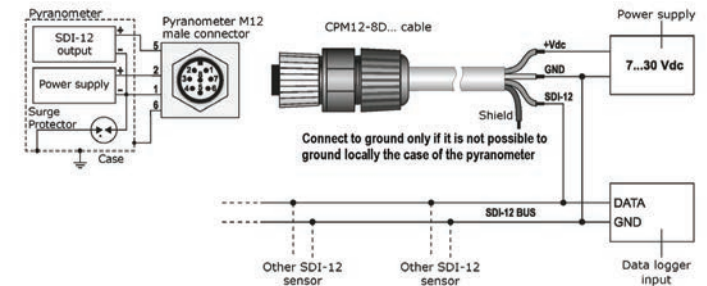
LPPYRA02S - LPPYRA03S - LPPYRA12S

Connector	Function	Color
1	Power supply negative (GND)	Blue
2	Power supply positive (+Vdc)	Red
3	Not connected	
4	RS485 A/-	Brown
5	RS485 B/+	White
6	Housing	Shield (Black)
7	Not connected	
8	Not connected	



LPPYRA02S12 - LPPYRA03S12 - LPPYRA12S12

Connector	Function	Color
1	Power supply negative (GND) SDI-12 output negative	Blue
2	Power supply positive (+Vdc)	Red
3	Not connected	
4	Not connected	
5	SDI-12 output positive	White
6	Housing	Shield (Black)
7	Not connected	
8	Not connected	



ORDERING CODES:

LPPYRA02: First Class Pyranometer according to ISO 9060. Supplied with shade disk, cartridge with silica-gel crystals, 2 spare sachets, levelling device, connector and ISO 9001 Calibration Report. The connection cable CPM12AA4... has to be ordered separately. Typical sensitivity 6 to 12 $\mu\text{V}/(\text{W}/\text{m}^2)$.

LPPYRA02AC: First Class Pyranometer according to ISO 9060. Supplied with shade disk, cartridge with silica-gel crystals, 2 spare sachets, levelling device, connector and ISO 9001 Calibration Report. The connection cable CPM12AA4... has to be ordered separately. Current output 4...20mA. 4mA = 0W/m², 20mA = 2000W/m². Power supply: 10...30Vdc.

LPPYRA02AV: First Class Pyranometer according to ISO 9060. Supplied with shade disk, cartridge with silica-gel crystals, 2 spare sachets, levelling device, connector and ISO 9001 Calibration Report. The connection cable CPM12AA4... has to be ordered separately. Voltage output 0...1Vdc, 0...5Vdc, 0...10Vdc. 0V = 0W/m², 1/5/10Vdc = 2000W/m². Power supply: 10...30Vdc (15...30Vdc for models with output 0...10Vdc).

LPPYRA02S: First Class Pyranometer according to ISO 9060. Supplied with shade disk, cartridge with silica-gel crystals, 2 spare sachets, levelling device, connector and ISO 9001 Calibration Report. The connection cable CPM12-8D... has to be ordered separately. Serial output RS485 MODBUS-RTU. Power supply: 5...30Vdc.

LPPYRA02S12: First Class Pyranometer according to ISO 9060. Supplied with shade disk, cartridge with silica-gel crystals, 2 spare sachets, levelling device, connector and ISO 9001 Calibration Report. The connection cable CPM12-8D... has to be ordered separately. SDI-12 output. Power supply 7...30 Vdc.

LPPYRA03: Second Class Pyranometer according to ISO 9060. Complete with levelling device, connector and ISO 9001 Calibration Report. Typical sensitivity 5 to 15 $\mu\text{V}/(\text{W}/\text{m}^2)$. The connection cable CPM12AA4... has to be ordered separately.

LPPYRA03AC: Second Class Pyranometer according to ISO 9060. Complete with levelling device, connector and ISO 9001 Calibration Report. The shade disk and the connection cable CPM12AA4... have to be ordered separately. Current output 4...20mA. 4mA = 0W/m², 20mA = 2000W/m². Power supply: 10...30Vdc.

LPPYRA03AV: Second Class Pyranometer according to ISO 9060. Complete with levelling device, connector and ISO 9001 Calibration Report. The shade disk and the connection cable CPM12AA4... have to be ordered separately. Voltage output 0...1Vdc, 0...5Vdc, 0...10Vdc. 0V = 0W/m², 1/5/10Vdc = 2000W/m². Power supply: 10...30Vdc (15...30Vdc for models with output 0...10Vdc).

LPPYRA03S: Second Class Pyranometer according to ISO 9060. Complete with levelling device, connector and ISO 9001 Calibration Report. The shade disk and the connection cable CPM12-8D... have to be ordered separately. Serial output RS485 MODBUS-RTU. Power supply: 5...30Vdc.

LPPYRA03S12: Second Class Pyranometer according to ISO 9060. Complete with levelling device, connector and ISO 9001 Calibration Report. SDI-12 output. Power supply 7...30 Vdc. The shade disk and the connection cable CPM12-8D... have to be ordered separately.

LPPYRA12: First Class pyranometer according to ISO 9060, with shadow ring for measuring the diffuse radiation only. Equipped with protection, silica-gel crystals cartridge, 2 recharges, levelling device, connector and ISO 9001 Calibration Report. The cable CPM12AA4... has to be ordered separately. Typical sensitivity 6 to 12 $\mu\text{V}/(\text{W}/\text{m}^2)$.

LPPYRA12AC: First Class pyranometer according to ISO 9060, with shadow ring for measuring the diffuse radiation only. Equipped with protection, silica-gel crystals cartridge, 2 recharges, levelling device, connector and ISO 9001 Calibration Report. The cable CPM12AA4... has to be ordered separately. Current output 4...20mA. 4mA = 0W/m², 20mA = 2000W/m². Power supply: 10...30Vdc.

LPPYRA12AV: First Class pyranometer according to ISO 9060, with shadow ring for measuring the diffuse radiation only. Equipped with protection, silica-gel crystals cartridge, 2 recharges, levelling device, connector and ISO 9001 Calibration Report. The cable CPM12AA4... has to be ordered separately. Voltage output 0...1Vdc, 0...5Vdc, 0...10Vdc. 0V = 0W/m², 1/5/10Vdc = 2000W/m². Power supply: 10...30Vdc (15...30Vdc for models with output 0...10Vdc).

LPPYRA12S: First Class pyranometer according to ISO 9060, with shadow ring for measuring the diffuse radiation only. Equipped with protection, silica-gel crystals cartridge, 2 recharges, levelling device, connector and ISO 9001 Calibration Report. The cable CPM12-8D... has to be ordered separately. Serial output RS485 MODBUS-RTU. Power supply: 5...30Vdc.

LPPYRA12S12: First Class pyranometer according to ISO 9060, with shadow ring for measuring the diffuse radiation only. Equipped with protection, silica-gel crystals cartridge, 2 recharges, levelling device, connector and ISO 9001 Calibration Report. The cable CPM12-8D... has to be ordered separately. SDI-12 output. Power supply 7...30 Vdc.

For connecting cables and mounting accessories see page 21



LPPYRA08



LPPYRA08 - LPPYRA08AC - LPPYRA08AV PYRANOMETERS

DeltaOHM manufactures, according to ISO 9060 and the recommendations of the WMO, the range of Second Class Pyranometers LPPYRA08. These instruments are robust and reliable, provided to withstand adverse climatic conditions and suitable for installation in the field.

The pyranometer LPPYRA08 measures the radiation on a flat surface (W/m^2). The radiation measured is the sum of direct solar irradiance and diffuse irradiance (global radiation).

The LPPYRA08 sensors have mV output and do not need to be powered, their typical sensitivity is $10\text{ mV}/(kW/m^2)$.

The pyranometers are also available with an amplified and converted $4\text{...}20\text{mA}$ current (LPPYRA08AC) or $0\text{...}10\text{Vdc}$ voltage signal (LPPYRA08AV)

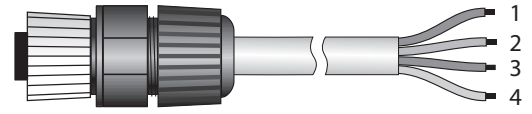
Each pyranometer is calibrated individually with reference to the WWR (World Radiometric Reference in Davos CH) and accompanied by calibration report.

Thanks to a new sensor LPPYRA08 has a response time of less than 8 seconds and is used when it is necessary to record changes in short and very short-term irradiation.

WIRING DIAGRAMS:



Fixed 4-pole M12 plug



Female 4-pole M12 connector

LPPYRA08, LPPYRA08BL, LPPYRA08BLAC

Connector	Function	Color
1	Output positive (+Vout)	Red
2	Output negative (-Vout)	Blue
3	Not connected	White
4	Cable shield	Black

LPPYRA08BLAC

Connector	Function	Color
1	Positive (Current in)	Red
2	Negative (Current out)	Blue
3	Not connected	White
4	Cable shield	Black

LPPYRA08BLAV

Connector	Function	Color
1	Output positive (+Vout)	Red
2	Output negative (-Vout) Power supply negative (GND)	Blue
3	Power supply positive(+Vdc)	White
4	Cable shield	Black

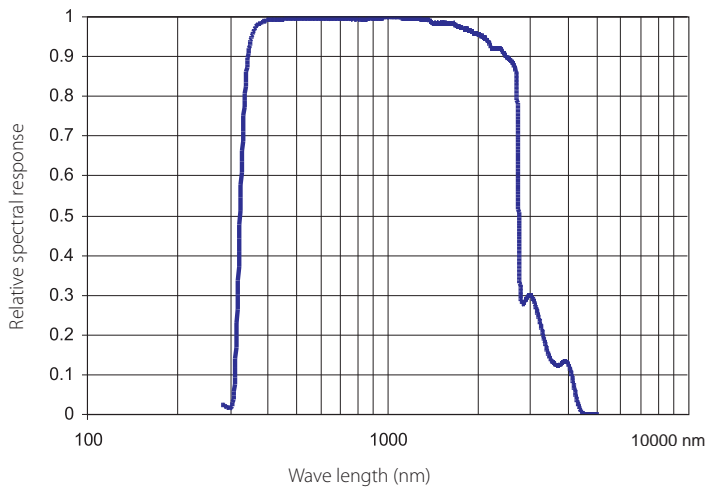


Figure A - Typical spectral response of the pyranometers.

Technical specifications		LPPYRA08
Typical sensitivity		10 mV (kW/m ²)
Impedance		5Ω-50Ω
Measuring range		2000 W/m ²
Viewing field		2πsr
Spectral field		305 nm– 2800 nm (50%) (figure A)
Working temperature		-40 °C – 80 °C
Specifications according to ISO 9060		
Response time (95%)		<8 s
Zero Off-set		25 W/m ²
Zero Off-set	a) Response to thermal radiation (200W/m ²)	<25W/m ²
	b) Response to a change of temperature 5K/h	< ±6 W/m ²
Long-term instability (1 year)		< ±2 %
Non linearity		< ±22 W/m ²
Response according to cosine		< ±7 W/m ²
Spectral selectivity		<8%
Tilt response		< ±4 %

ORDERING CODES:

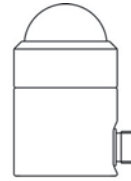
LPPYRA08: Second Class Pyranometer according to ISO 9060, fast response sensor. Supplied with Calibration Report. Different configurations available. Male M12 connector. The cable with the female connector has to be ordered separately. Uses CPM12AA4... cables (2, 5 or 10 meter length).

LPPYRA08

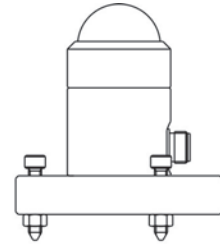


Blank = typical output 10 μV / (W/m²)
 BL = typical output 10 μV / (W/m²), with base with bubble level
 BLAC = output 4 ÷ 20 mA, with base with bubble level
 BLAV = output 0 ÷ 10 Vdc with base with bubble level

For connecting cables and mounting accessories see page 21



LP PYRA 08



LP PYRA 08BL...



HD9906.51



HD9906.51 HEATING AND VENTILATION UNIT

The heating and ventilation unit HD9906.51 is meant to be used with solar radiation sensors (pyranometer, pyrgeometer and radiometer) and can be used outdoor under any weather conditions.

The ventilation of the instruments increases the precision of the measures by making the pyranometer's temperature uniform, in particular it avoids the deposit of dew and frost on the optical parts of the sensors and reduces the off-set of type A (present in pyranometers and pyrgeometers) caused by the cooling of the dome with respect to the instrument's body. It is possible to use the heating under extreme environmental conditions so to prevent ice formation on the dome of the pyranometer (when the heating is on, you should consider that the off-set of type A may increase, therefore we suggest the use of the heating only for the time necessary to remove snow or ice formed on the instrument's surface).

The HD9906.51 unit can be used with LPPYRA02 and LPPYRA10, with the pyrgeometer LPPIRG01 and the radiometers LPPHOT02, LPUVA02 and LPUVB02.

Installation and assembly of the ventilation unit

In order to install the pyranometer on the ventilation unit, it is necessary to work under the following procedure:

1. Loosen the three nuts that hold the bell
2. Remove the HD9906.51 bell
3. Remove the white screen by the pyranometer
4. Remove the adjusting screws from the body of the pyranometer (if necessary, leveling will be performed by adjusting the screws on the HD9906.51.)
5. Fix the pyranometer to the ventilation unit by using the two M5 screws

6. Make sure that the cable of the pyranometer has been properly connected
 7. Reassemble the HD9906.51 bell into place and tighten the screws.
- The pyranometer is fixed to ventilation unit by 2 screws M5x50. To allow an accurate reading of ground solar radiation it is necessary to place the HD9906.51 parallel to the ground, this can be done using the bubble on the ventilation unit.

The electrical connections of the HD9906.5 are done via the terminals located under the base.

There are two pairs of terminals. A pair for ventilation and a pair for heating. The polarity of the fan must be respected, otherwise the flow of air is in the opposite direction to that expected (from bottom to top).

Figure A shows the correspondence between terminals and features:

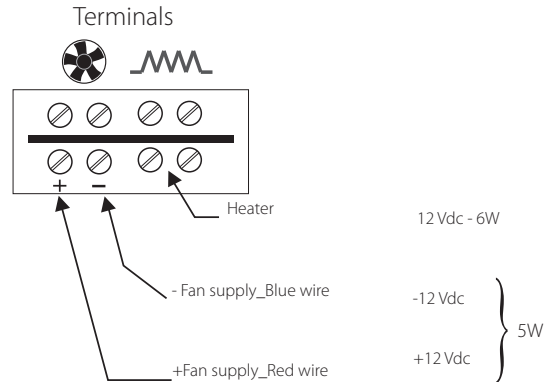


Figure A

The supplies required are:

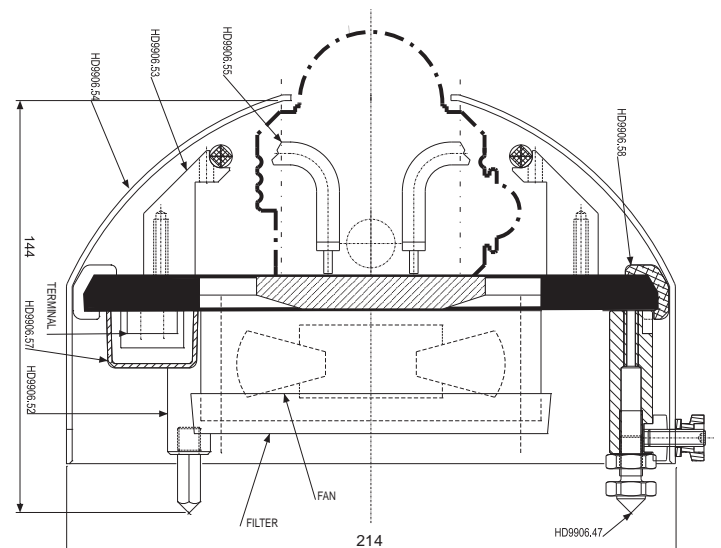
For heating is required 12V DC (6W)

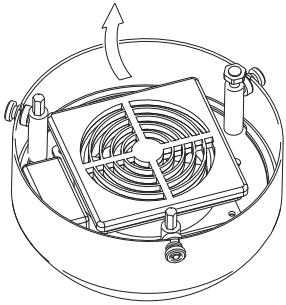
For the fan is required 12V DC (5W)

The fan model is: EBMPAPST 4312V (IP 54 protection and capacity of 170m³/h), equipped with a filter (EBMPAPST: PMFA 12OT) that must be periodically checked and replaced if dirty.

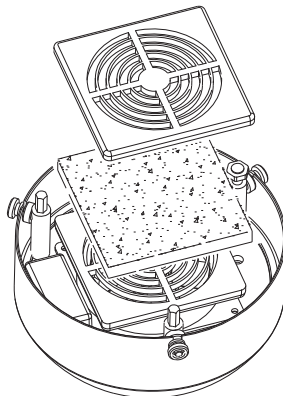
Specifications:

Power supply :	fan	12V DC (5W)
	heating	12V DC (6W)
Working temperature:	-30 °C ÷ 70 °C	

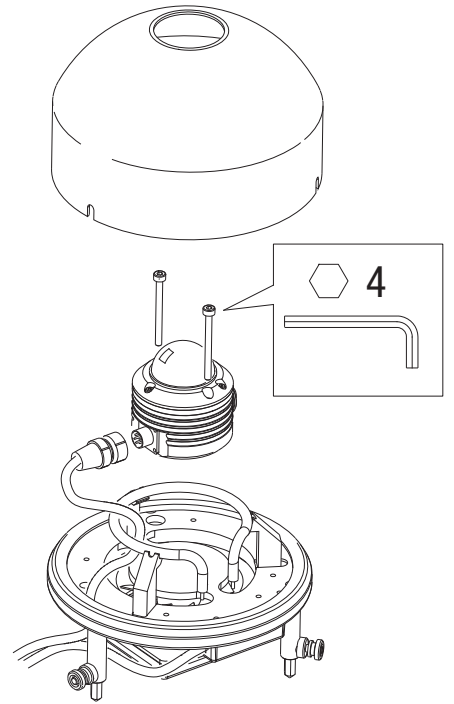




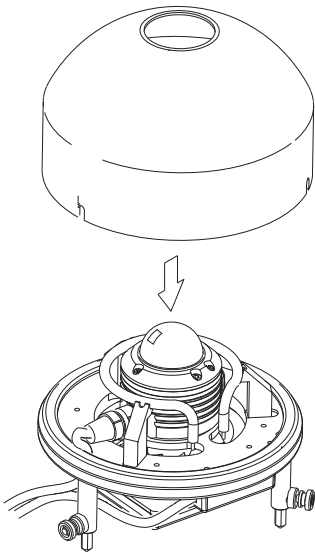
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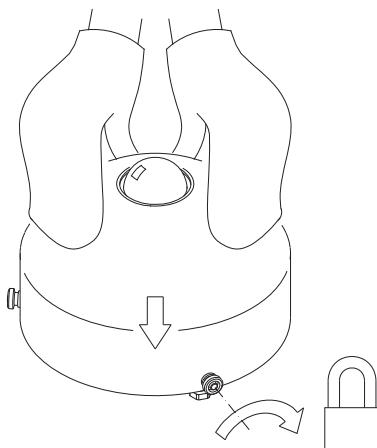
2



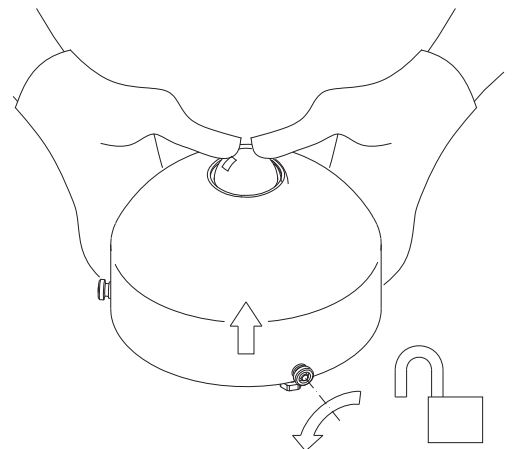
3



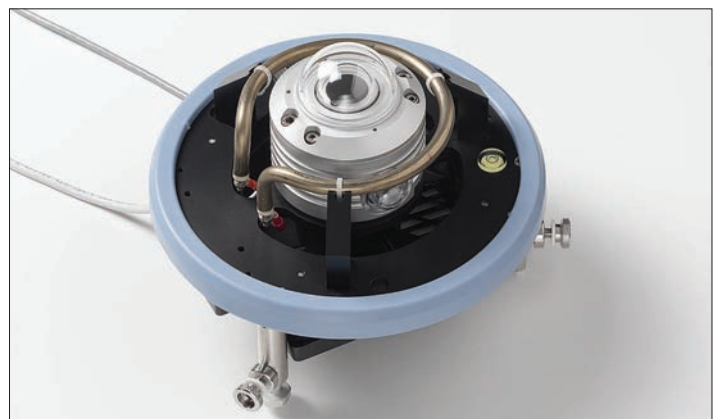
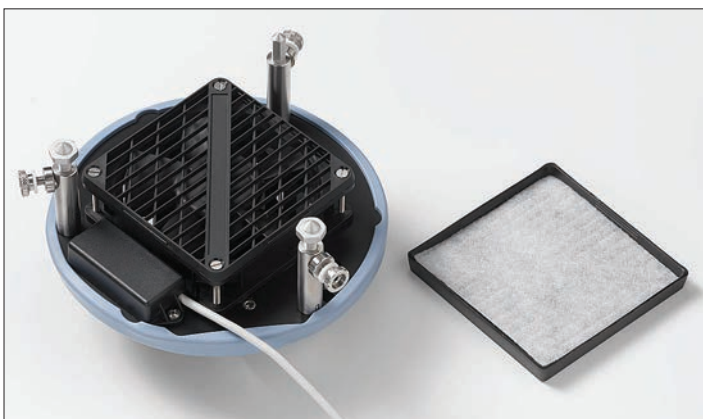
4



5



6



LPPYRA11, LPPYRA05, LPPYRA06,

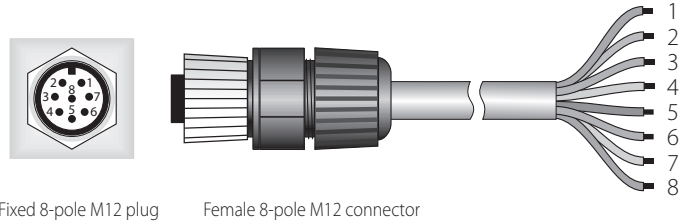


Every pyranometer composing the albedometer is calibrated separately as per the WRR (World Radiometric Reference) standard and is supplied with the relevant Report of Calibration.

These are strong and reliable ground-based instruments, especially designed to be used under all weather conditions. They are suitable for installation of the field.

Recommended use: climatological research, weather stations, road weather stations, agriculture stations, etc...

WIRING DIAGRAM LPPYRA11, LPPYRA05 - LPPYRA06



Fixed 8-pole M12 plug Female 8-pole M12 connector

Connector	Function	Colour
1	Output positive (+Vout) of upper detector(↓)	Red
2	Output negative (-Vout) of upper detector(↓)	Blue
3	Not connected	
4	Not connected	
5	Output negative (-Vout) of lower detector (↑)	Brown
6	Housing (↗) (LPPYRA05/LPPYRA11) Not connected (LPPYRA06)	White
7	Cable shield (±)	Black
8	Output positive (+Vout) of lower detector (↑)	Green

**LPPYRA11 - LPPYRA05 - LPPYRA06
ALBEDOMETERS**

Delta OHM manufactures three different models of albedometers:
 - LPPYRA11 is constructed starting from two Secondary Standard Pyranometers
 - LPPYRA05 is constructed starting from two First Class Pyranometers
 - LPPYRA06 is constructing starting from two Second Class Pyranometers

All pyranometers are according to ISO 9060 standards and to specifications published by the World Meteorological Organization). An albedometer basically consists of two pyranometers, mounted back-to-back, one looking upward (sky) and one downward (earth). The upward pyranometer measures the incident global radiation (direct radiation + diffuse radiation) striking the ground, while the downward one, measures the global radiation reflected from the ground. The outputs of the two pyranometers electric signals can be directly sent to a data logger or to an automatic data processor. The two pyranometers which made up the LPPYRA05 and LPPYRA11 are coupled in order to have the same sensitivity. Albedo is the fraction of solar radiation that is reflected from the ground, with respect to incident radiation:

$$ALBEDO = \frac{\text{Reflected Global Radiation}}{\text{Incident Global Radiation}}$$

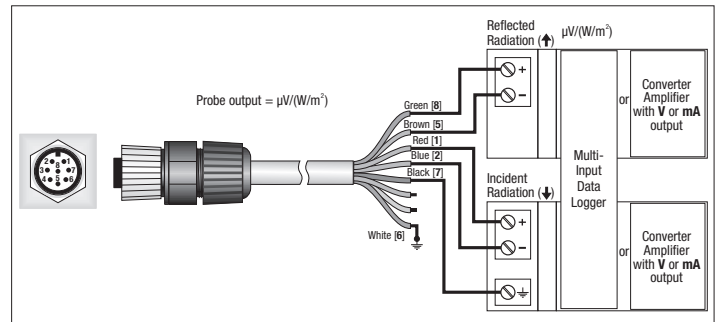
By using albedometers, we can calculate the net radiation obtained through the difference between incident global radiation and reflected global radiation.

Delta OHM albedometers operate within 0.3 μm ÷ 3 μm spectral range. No power supply is needed. as the two pyranometers generate a voltage which is usually equal to:

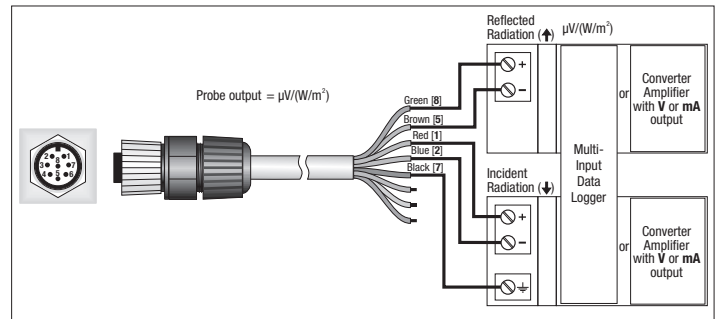
$$10 \frac{\text{mV}}{\text{kW} \cdot \text{m}^{-2}}$$

CONNECTION DIAGRAMS

LPPYRA11 / LPPYRA05



LPPYRA06



Technical Specifications	LPPYRA11*	LPPYRA05*	LPPYRA06*
Typical sensitivity	6 to 11 $\mu\text{V}/(\text{W}/\text{m}^2)$	6 to 12 $\mu\text{V}/(\text{W}/\text{m}^2)$	5 to 15 $\mu\text{V}/(\text{W}/\text{m}^2)$
Impedance	$5 \Omega \div 50 \Omega$	$33 \Omega \div 45 \Omega$	$33 \Omega \div 45 \Omega$
Measuring range	$0 \div 4000 \text{ W}/\text{m}^2$	$0 \div 2000 \text{ W}/\text{m}^2$	$0 \div 2000 \text{ W}/\text{m}^2$
Viewing field	$2\pi \text{ sr}$	$2\pi \text{ sr}$	$2\pi \text{ sr}$
Spectral range (50%)	283 nm \div 2800 nm	283 nm \div 2800 nm	300 nm \div 2800 nm
Operating and storage temperature range	$-40 \text{ }^\circ\text{C} \div 80 \text{ }^\circ\text{C}$	$-40 \text{ }^\circ\text{C} \div 80 \text{ }^\circ\text{C}$	$-40 \text{ }^\circ\text{C} \div 80 \text{ }^\circ\text{C}$
Weight	1.35 kg	1.35 kg	1.1 kg
ISO 9060 Specifications			
Response time 95%	<5 s	< 28 s	< 30 s
Zero Off-set	a) Response to thermal radiation (200Wm ⁻²)	<7 W/m ²	15 W/m ²
	b) Response to temperature change 5K/h	< \pm 2 W/m ²	< \pm 4 W/m ²
Non stability over 1 year	< \pm 0.5 %	< \pm 1.5 %	< \pm 2.5 %
Non-linearity	< \pm 0.2 %	< \pm 1 %	< \pm 2 %
Cosine response	< \pm 10 W/m ²	< \pm 18 W/m ²	< \pm 22 W/m ²
Spectral selectivity	< \pm 3 %	< \pm 5 %	< \pm 7 %
Temperature response (-10°C to +40°C)	< 1 %	< 4 %	< 8 %
Tilt response	< \pm 0.2 %	< \pm 2 %	< \pm 4 %
Humidity Range	0 to 100%	0 to 100%	0 to 100%
Mean Time Between Failures	> 10 years	> 10 years	> 10 years
Accuracy of bubble level	<0.1°	<0.1°	<0.2°
Ingress Protection (IP) rating	67	67	67

* All technical data, excluding weight, are referred to one of the two pyranometers composing the albedometer.

ORDERING CODES:

LPPYRA11: Albedometer made up of two Secondary Standard Pyranometers, according to ISO 9060. Complete with: top shade disk and bottom shade disk, drying cartridge with silicagel crystals, 2 silica gel cartridges, levelling device, \varnothing 16x500 rod for attachment to a mast, M12 8-pole connector and ISO 9001 Calibration Report. Typical sensitivity 6 to 11 $\mu\text{V}/(\text{W}/\text{m}^2)$. The connection cable CPM12AA8... has to be ordered separately.

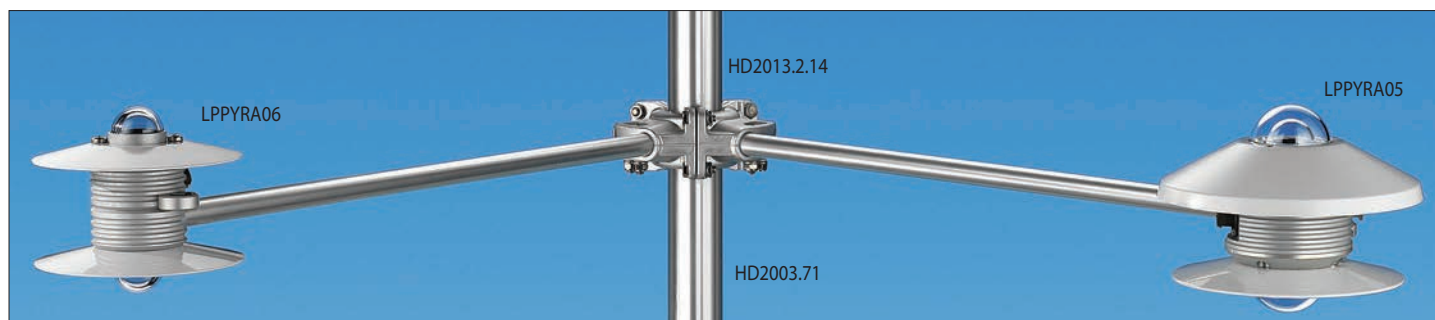
LPPYRA05: Albedometer made up of two First Class Pyranometers, according to ISO 9060. Complete with: top shade disk and bottom shade disk, drying cartridge with silicagel crystals, 2 silica gel cartridges, levelling device, \varnothing 16x500 rod for attachment to a mast, M12 8-pole connector and ISO 9001 Calibration Report. Typical sensitivity 6 to 12 $\mu\text{V}/(\text{W}/\text{m}^2)$. The connection cable CPM12AA8... has to be ordered separately.

LPPYRA06: Albedometer made up of two Second Class Pyranometers, according to ISO 9060. Complete with: top shade disk and bottom shade disk, levelling device, \varnothing 16x500 rod for attachment to a mast, M12 8-pole connector and ISO 9001 Calibration Report. Typical sensitivity 5 to 15 $\mu\text{V}/(\text{W}/\text{m}^2)$. The connection cable CPM12AA8... has to be ordered separately.



LPPYRA06

For connecting cables and mounting accessories see page 21



HD2013.2.14 + LPPYRA05 + LPPYRA06

**LP471PYRA02.5, LP471PYRA02.10,
LP471PYRA03.5, LP471PYRA03.10,
LP471PYRA10.5, LP471PYRA10.10,
LP471Silicon-PYRA**



LP471PYRA02.5 - LP471PYRA02.10 - LP471PYRA03.5
LP471PYRA03.10 - LP471PYRA10.5 - LP471PYRA10.10
LP471SILICON-PYRA

PROBES TO CONNECT WITH PORTABLE INSTRUMENTS

Portable instruments are used by professionals to perform regular problem-solving.

While operating, it may happen that some of the modules can compromise the performance of the entire PV system. When the efficiency of the system is lower than expected, it is important to solve the problem in order to remove the inefficiency. The portable instrumentation allows this analysis to be done directly on the field. In case of malfunctions, it is important to act promptly, without losing the kWh produced, which are the main

responsible for the success of the investment. In fact, the payback period will be respected if the plant produces within the expected time.

The LP471PYRA... probes consist of a LPPYRA03, LPPYRA02 or LPPYRA10 pyranometer and a SICRAM module with a 5 or 10-meter cable that connects the pyranometer to the portable instruments HD31, DO 9847, HD2102.2, HD2102.1 HD2302.0, thus allowing to have the reading in W/m² directly on the instrument's display.

The Pyranometer LPPYRA03 is a second class, LPPYRA02 is a first class, and the LPPYRA10 is a Secondary Standard pyranometer according to ISO 9060. The instruments are supplied with calibration report and M12 4-pole output connector. The manuals of the pyranometers LPPYRA02, 03, 10 are available at the Delta OHM website.

The SICRAM module of the LP471PYRA .. shows the same serial number than the pyranometer and its setting takes into account the sensitivity shown on the calibration report of the pyranometer, therefore it is not possible to use the same module to perform measurements with different pyranometers.

ORDERING CODES:

(For the technical specifications of the pyranometers, please refer to the previous pages)

LPPYRA10.5: The probe consists of a Secondary Standard pyranometer LPPYRA10, 5 meter cable and SICRAM module. It includes the ISO 9001 calibration report of the pyranometer connected to cable and SICRAM module.

The probe can be connected to the instruments HD31, HD2302.0, HD2102.1, HD2102.2 and DO9847.

LPPYRA10.10: The probe consists of a Secondary Standard pyranometer LPPYRA10, 10 meter cable and SICRAM module. It includes the ISO 9001 calibration report of the pyranometer connected to cable and SICRAM module.

The probe can be connected to the instruments HD31, HD2302.0, HD2102.1, HD2102.2 and DO9847.

LP471PYRA02.5: The probe consists of a first class pyranometer LPPYRA02, 5 meter cable and SICRAM module. It includes the ISO 9001 calibration report of the pyranometer connected to cable and SICRAM module.

The probe can be connected to the instruments HD31, HD2302.0, HD2102.1, HD2102.2 and DO9847.

LP471PYRA02.10: The probe consists of a first class pyranometer LPPYRA02, 10 meter cable and SICRAM module. It includes the ISO 9001 calibration report of the pyranometer connected to cable and SICRAM module.

The probe can be connected to the instruments HD31, HD2302.0, HD2102.1, HD2102.2 and DO9847.



LP471PYRA03.5: The probe consists of a second class pyranometer LPPYRA03, 5 meter cable and SICRAM module. It includes the ISO 9001 calibration report of the pyranometer connected to cable and SICRAM module.

The probe can be connected to the instruments HD31, HD2302.0, HD2102.1, HD2102.2 and DO9847.

LP471PYRA03.10: The probe consists of a second class pyranometer LPPYRA03,10 meter cable and SICRAM module. It includes the ISO 9001 calibration report of the pyranometer connected to cable and SICRAM module.

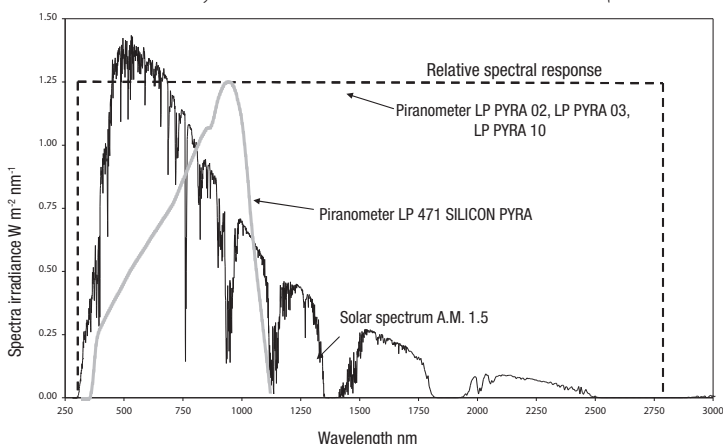
The probe can be connected to the instruments HD31, HD2302.0, HD2102.1, HD2102.2 and DO9847.

LP471Silicon-PYRA: Pyranometer with silicon photodiode with 5m cable and SICRAM module. The probe can be connected to the instruments HD31, HD2302.0, HD2102.1, HD2102.2 and DO9847.



VP472: SICRAM module for the connection of pyranometers (e.g. "secondary- standard" LP PYRA 10, first class LP PYRA 02 and second class LP PYRA 03) or albedometers (e.g. Secondary Standard LPPYRA11, First Class LPPYRA05 and Second Class LPPYRA06).

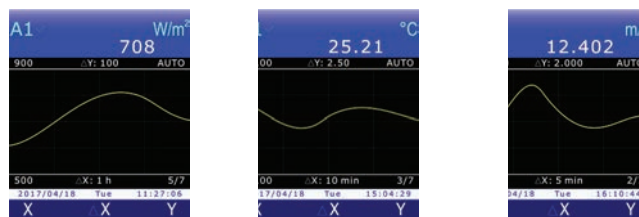
Measuring range	-25...+25 mV
Resolution	1 W/m ² , 1 μV
Accuracy	±1 W/m ² , ±3 μV
Sensitivity	selectable from 5 to 30 μV/Wm ²



Typical response curve of LP471PYRAxx probes



HD31: Three-channel multifunction data logger for probes complete with SICRAM module. Color graphic LCD display. Sampling speed one per second each channel. Records directly to SD memory card. Functions: CLOCK, HOLD, RELATIVE, DIFFERENCE, MINIMUM, MAXIMUM, AVERAGE. Simultaneous display of three measurements. Calibration of the individual probes with permanent storage of the calibration data inside the probe: probes can be changed without losing the calibration. The instrument allows the input of various types of probe of different physical magnitudes. Display of the graph of a measured quantity in real time. Power supply: lithium-ion rechargeable battery (lifetime about 18 hours), external power supply SWD05 (optional, to be connected to the USB port of the instrument via the CP31 cable) or powered by the USB port (at least 500 mA) of the PC. Includes DeltaLog 9 software downloadable from Delta OHM website. Supplied with: lithium-ion rechargeable battery, SD card, protective rubber shell with magnet, instruction manual and carrying case. The modules, the probes, the USB and serial connection cables and the power supply have to be ordered separately.



DO9847: Three-channel multifunction data logger for probes complete with SICRAM module. Sampling speed one per second each channel. Storage capacity 32,000 samples per channel. Functions: CLOCK, HOLD, RELATIVE, MINIMUM, MAXIMUM, AVERAGE. Simultaneous display of the measurements on three channels or two channels plus the difference between two channels. Calibration of the individual probes with permanent storage of the calibration data inside the probe: probes can be changed without losing the calibration. The instrument allows the input of various types of probe of different physical magnitudes. The firmware can be updated via RS232C, to implement new physical quantities. Power supply: 4 alkaline AA batteries, lifetime about 100 hours, socket for external power supply 9...16 Vdc. Includes DeltaLog 3 software downloadable from Delta OHM website. The Kit is composed of the instrument DO9847, 4 alkaline batteries, instruction manual and carrying case.

The modules, the probes and the cables for data download have to be ordered separately.

HD2302.0: Device for measuring illuminance, luminance, PAR, irradiance. Storage of maximum, minimum, average value. Functions: REL, HOLD and auto power off which can be disabled, IP 67 protection degree. Supplied with carrying case, instruction manual, 3 batteries. LP471 series probes with SICRAM module are suitable. The probes have to be ordered separately.

HD2102.1: Device for measuring illuminance, luminance, PAR, irradiance. Storage of maximum, minimum, average value and integral Q(t). RS232C output for data transfer in real time to a PC or printer. Functions: REL, HOLD and auto power off which can be disabled, IP 66 protection degree. Includes DeltaLog 9 software downloadable from Delta OHM website. Supplied with carrying case, instruction manual, 4 batteries. LP471.. series probes with SICRAM module are suitable. The probes and cables for data download have to be ordered separately.

HD2102.2: Device for measuring illuminance, luminance, PAR, irradiance. Datalogger which stores the maximum, minimum, average value and the integral Q(t), it can store up to 80,000 samples. USB output for data transfer in real time to a PC. Functions: REL, HOLD and auto power off which can be disabled, IP 66 protection degree. Includes DeltaLog 9 software downloadable from Delta OHM website. Supplied with carrying case, instruction manual, 4 batteries, USB cable CP23. LP471.. series probes with SICRAM module are suitable. The probes have to be ordered separately.

Accessories for Pyranometers

Connecting Cables

CPM12AA4.2: 4-pole UV resistant cable. Length 2m. 4-pole M12 connector on one end, open wires on the other side

CPM12AA4.5: 4-pole UV resistant cable. Length 5m. 4-pole M12 connector on one end, open wires on the other side

CPM12AA4.10: 4-pole UV resistant cable. Length 10m. 4-pole M12 connector on one end, open wires on the other side

CPM12AA8.2: 8-pole UV resistant cable. Length 2m. 8-pole M12 connector on one end, open wires on the other side For LPPYRA11 - LPPYRA05 - LPPYRA06.

CPM12AA8.5: 8-pole UV resistant cable. Length 5m. 8-pole M12 connector on one end, open wires on the other side For LPPYRA11 - LPPYRA05 - LPPYRA06.

CPM12AA8.10: 8-pole UV resistant cable. Length 10m. 8-pole M12 connector on one end, open wires on the other side For LPPYRA11 - LPPYRA05 - LPPYRA06.

CPM12-8D.2: 8-pole cable. Length 2m. 8-pole M12 connector on one end, open wires on the other side (**only for LPPYRA...S and S12**)

CPM12-8D.5: 8-pole cable. Length 5m. 8-pole M12 connector on one end, open wires on the other side (**only for LPPYRA...S and S12**)

CPM12-8D.10: 8-pole cable. Length 10m. 8-pole M12 connector on one end, open wires on the other side (**only for LPPYRA...S and S12**).

Other lengths available on request

CP24: PC connecting cable for the RS485 MODBUS parameters configuration of the LPPYRA...S pyranometers. With built-in RS485/USB converter. 8-pole M12 connector on instrument side and A-type USB connector on PC side.

Spare parts

LPSP1: UV resistant shade disk for pyranometers LPPYRA02, LPPYRA05 (top pyranometer), LPPYRA10, LPPYRA11 (top pyranometer), LPPYRA12.

LPSP2: Shade disk for pyranometers LPPYRA03, LPPYRA 06.

LPSP3: Bottom shade disk for albedometer LPPYRA05 (downward pyranometer).

LPSPG: Drying cartridge with silicagel crystals, complete with O-ring.

LPG: Pack of 5 cartridges of silicagel.

Mounting accessories

LPSP4: Flange for fixing the pyranometers on a flat surface.

LPS1: Only attachment bracket for pyranometers of the LPPYRA02 and LPPYRA10 series, suitable for mast with diameter 40 ±50 mm. Installation on horizontal or vertical mast, including fasteners and screws.

LPS2: Base to fix with Ø 16 x 500 mm mast to install the LPPYRA03 pyranometer. It easily allows to fix and set, in combination with the HD2013.2.14 flange, the pyranometer LPPYRA03.

LPS3: Only attachment bracket for LPPYRA03 serie, suitable for mast with Ø 40 ± 50 mm. Installation on horizontal or vertical mast.

LPS6: Kit for the installation of LPPYRA10, LPPYRA02 and LPPYRA03 pyranometers. The kit includes: 750 mm mast (HD2003.83.1), base fitting (LPS6.04), graduated support plate (LPS6.01), bracket for pyranometers (LPS6.03). On request, HD9007T29.1 bracket for HD9007 or HD32MTT.03.C

LPRING02: Base with levelling device and adjustable holder for mounting the LPPYRA02 and LPPYRA10 series pyranometers in an inclined position. (Specify upon ordering on which pyranometer model has to be mounted)

LPRING04: Adjustable holder for mounting the LPPYRA10, LPPYRA02, LPPYRA03 series pyranometers in an inclined position on Ø 40 mm mast with internal thread.

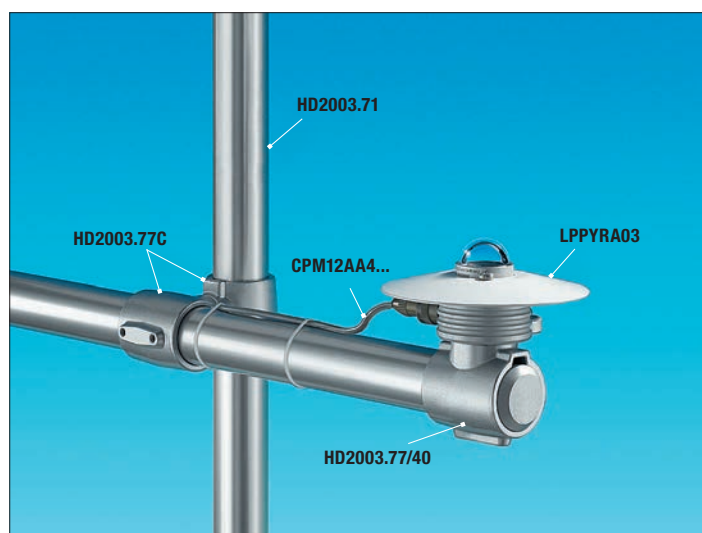
LPRING12: Ring base for measuring the diffused radiation, for LPPYRA02 and LPPYRA10 pyranometers.

LPRING13: Ring base for measuring the diffused radiation, for LPPYRA03 pyranometer.

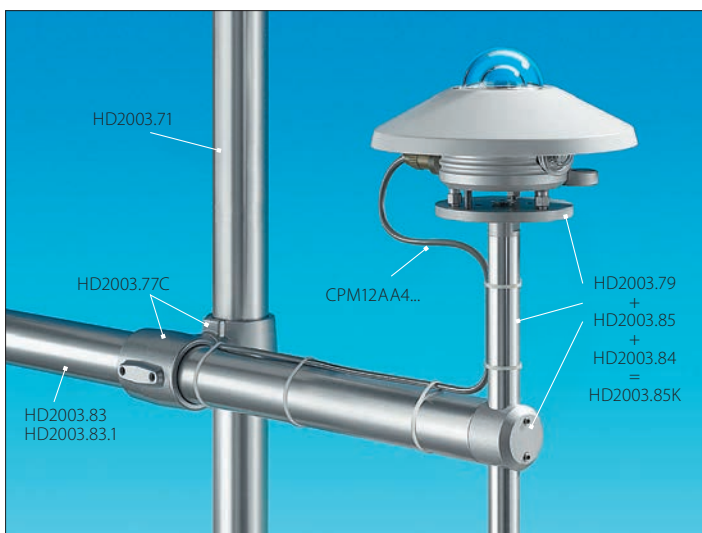
HD2003.85K: Mounting kit with adjustable height for the installation of the pyranometer on pole with diameter Ø 40 mm (HD2003.84 + HD2003.85 + HD2003.79). Not suitable for LPPYRA03 series.

HD2003.79K: Kit to mount pyranometers on clamping Ø 40 mm (HD2003.77/40, HD2003.79). To install the LPPYRA10, LPPYRA02 and LPPYRA03 pyranometers on the transverse mast.

HD2003.77/40: Clamping for mast Ø 40mm.



Example of mounting



Example of mounting

Configurable signal converter

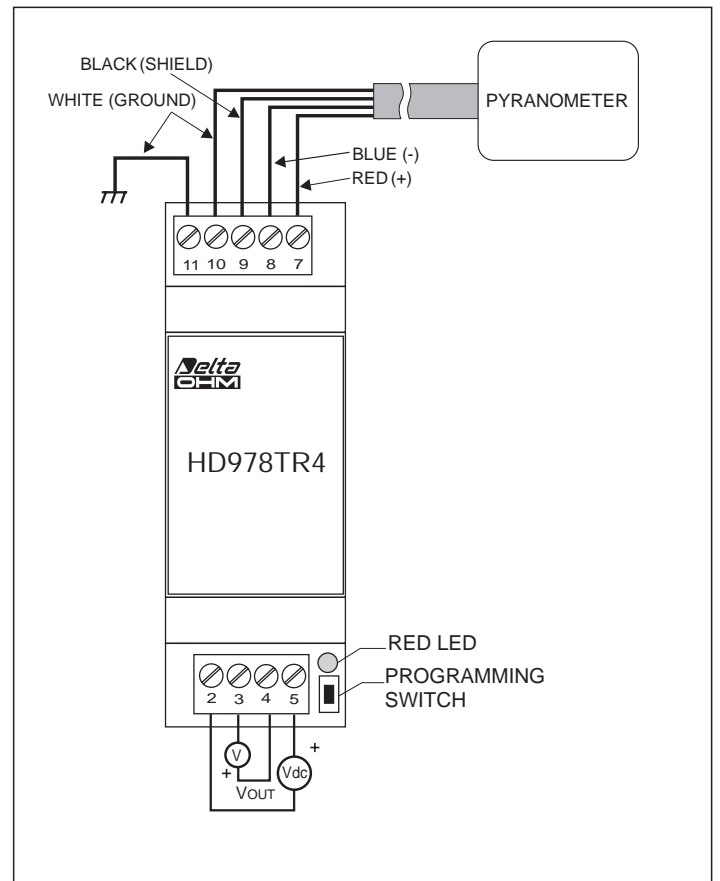
HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input range -10 ..+60mVdc. Standard configuration 0÷20mVdc. Minimum measuring range 2mVdc. For DIN rail 35mm. Configurable with HD778 TCAL.

HD978TR5: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input range -10 ..+60mVdc. Standard configuration 0÷20mVdc. Minimum measuring range 2mVdc. Configurable with HD778 TCAL. Container for WallMount installation.

HD978TR4: Configurable signal converter amplifier with 0÷10Vdc (10÷0Vdc) output. Input range -10 ..+60mVdc. Standard configuration 0÷20mVdc. Minimum measuring range 2mVdc. For DIN rail 35mm. Configurable with HD778 TCAL

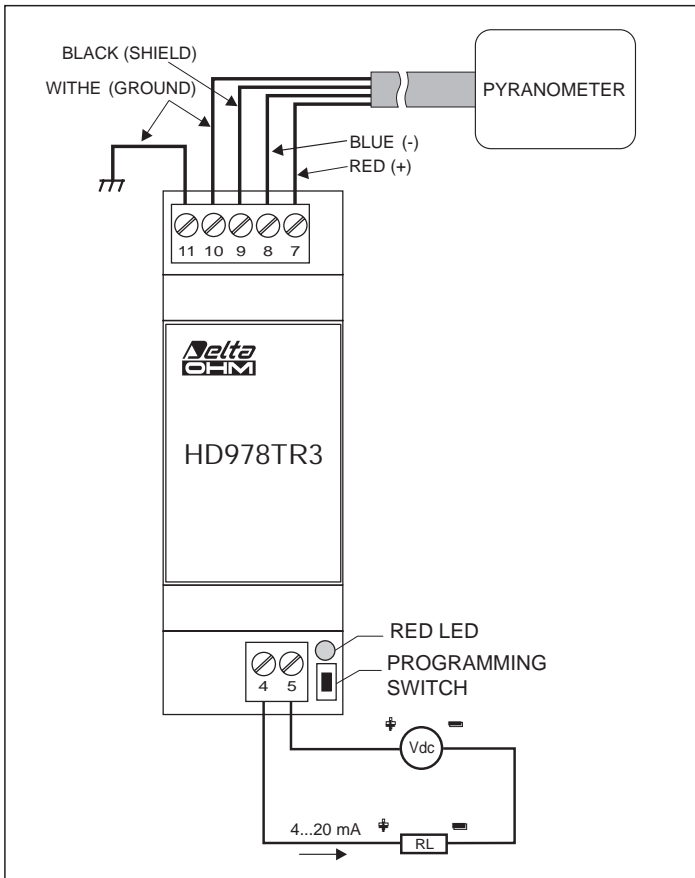
HD978TR6: Configurable signal converter amplifier with 0÷10Vdc (10÷0Vdc) output. Input range -10 ..+60mVdc. Standard configuration 0÷20mVdc. Minimum measuring range 2mVdc. Configurable with HD778 TCAL. Container for Wall Mount installation.

HD778TCAL: Voltage generator in the range -60mVdc...+60mVdc, controlled by PC through the RS232C serial port, DELTALOG-7 software for setting K, J, T, N thermocouple transmitters and HD 978TR3, HD 978TR4 converters.



Connection diagram of the HD978TR4 to pyranometer.

Connection diagram of the HD978TR3 to a pyranometer.





contact us



Headquarter

GHM Messtechnik GmbH
GHM GROUP CORPORATE
Tenter Weg 2-8
42897 Remscheid | GERMANY
Phone +49 2191 9672-0
info@ghm-group.de
www.ghm-group.de

Centers of Competences

GHM Messtechnik GmbH
GHM GROUP – Greisinger
Hans-Sachs-Straße 26
93128 Regenstauf | GERMANY
Phone +49 9402 9383-0
info@greisinger.de | www.greisinger.de

GHM Messtechnik GmbH
GHM GROUP – Honsberg
Tenter Weg 2-8
42897 Remscheid | GERMANY

GHM Messtechnik GmbH
GHM GROUP – Martens
Kiebitzhörn 18
22885 Barsbüttel | GERMANY

GHM Messtechnik GmbH
GHM GROUP – Imtron
Carl-Benz-Straße 11
88696 Owingen | GERMANY

Delta OHM S.r.l. a socio unico
GHM GROUP – Delta OHM
Via Marconi 5
35030 Caselle di Selvazzano
Padova (PD) | ITALY
Phone +39 049 8977150
info@deltaohm.com
www.deltaohm.com

Valco srl
GHM GROUP – VAL.CO
Via Rovereto 9/11
20014 S. Ilario di Nerviano
Milano (MI) | ITALY
Phone +39 0331 53 59 20
valco@valco.it
www.valco.it

GHM GROUP International

Austria
GHM Messtechnik GmbH
Office Austria
Breitenseer Str. 76/1/36
1140 Vienna | AUSTRIA
Phone +43 660 7335603
a.froestl@ghm-messtechnik.de

Brazil & Latin America
GHM Messtechnik do Brasil Ltda
Av. José de Souza Campos, 1073, cj 06
Campinas, SP
13025 320 | BRAZIL
Phone +55 19 3304 3408
info@grupoghm.com.br

Czech Republic/Slovakia
GHM Greisinger s.r.o.
Ovci hajek 2/2153
158 00 Prague 5
Nove Butovice | CZECH REPUBLIC
Phone +420 251 613828
Fax +420 251 612607
info@greisinger.cz | www.greisinger.cz

Denmark
GHM Maaleteknik ApS
Maarslet Byvej 2
8320 Maarslet | DENMARK
Phone +45 646492-00
Fax +45 646492-01
info@ghm.dk | www.ghm.dk

France
GHM GROUP France SAS
Parc des Pivoilles
9 Rue de Catalogne
69150 Décines-Charpieu (Lyon) | FRANCE
Phone +33 4 72 37 45 30
ajouanillou@ghm-group.fr

India
GHM Messtechnik India Pvt Ltd.
209 | Udyog Bhavan | Sonowala Road
Gregaon (E) | Mumbai - 400 063
INDIA
Phone +91 22 40236235
info@ghmgroup.in | www.ghmgroup.in

Italy for Greisinger & Delta OHM
GHM GROUP – Delta OHM
Via Marconi 5
35030 Caselle di Selvazzano
Padova (PD) | ITALY
Phone +39 049 8977150
a.casati@ghm-messtechnik.de

Italy for Honsberg, Martens, Val.co
GHM GROUP – Val.co
Via Rovereto 9/11
20014 S. Ilario di Nerviano
Milano (MI) | ITALY
Phone +39 0331 53 59 20
alessandro.perego@valco.it

Netherlands
GHM Meettechniek BV
Zeeltweg 30
3755 KA Eemnes | NETHERLANDS
Phone +31 35 53805-40
Fax +31 35 53805-41
info@ghm-nl.com | www.ghm-nl.com

South Africa
GHM Messtechnik SA (Pty) Ltd
16 Olivier Street
Verwoerdpark, Alberton 1453
SOUTH AFRICA
Phone +27 74 4590040
j.grobler@ghm-sa.co.za

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