Member of GHM GROUP

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

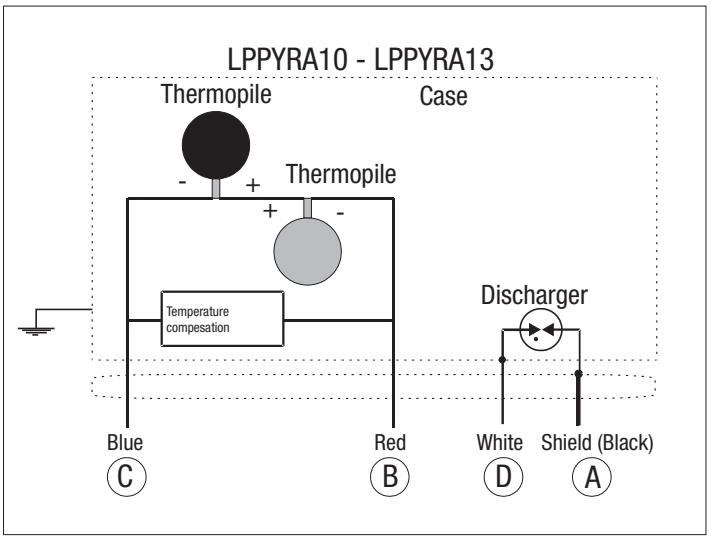
WORKING PRINCIPLE

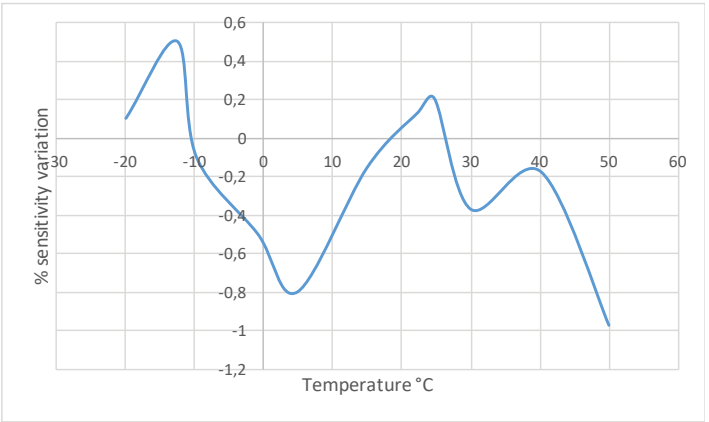
The pyranometers LPPYRA10 and LPPYRA13 are based on a thermopile sensor which surface is covered by a matt black paint so to allow the instrument not to be selective at various wavelengths. The spectral range of the pyranometers is determined by the transmission of the two glass domes. The new sensor 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.

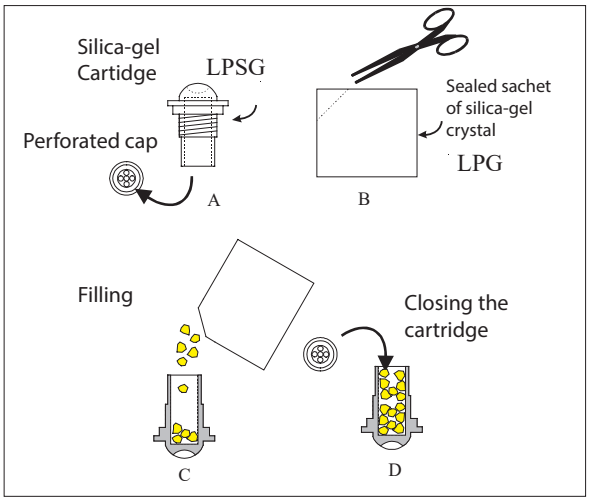




Graph 1: % change of the sensitivity of the pyranometer LPPYRA10 - LPPYRA13 compared to the sensitivity at 20°C in the temperature range between -20 and 50°C.

Technical Specifications		
Typical sensitivity		
- LPPYRA10 - LPPYRA13		6 to 11 µV/(W/m²)
- LPPYRA10AC - LPPYRA13AC		4..20 mA (0...2000 W/m²) 4...20mA (0...4000W/m²) on request
- LPPYRA10AV - LPPYRA13AV		0..1,5,10V (0...2000 W/m²) 0...1,5,10V (0...4000W/m²) on request
Impedance		5 Ω ÷ 50 Ω
Measuring range		0-4000 W/m²
Viewing field		2π sr
Spectral range (50%()		283 nm ... 2800 nm
Operating and storage temperature range		-40 °C ÷ 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 (200Wm⁻²)	<7 W/m²
Zero Off.-set	b) Response to temperature change 5K/h	<|±2|W/m²
Non stability over 1 year		<|±0.5| %
Non-linearity		<|±0.2| %
Cosine response		< |±10| W/m²
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

Fig. A



- 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:

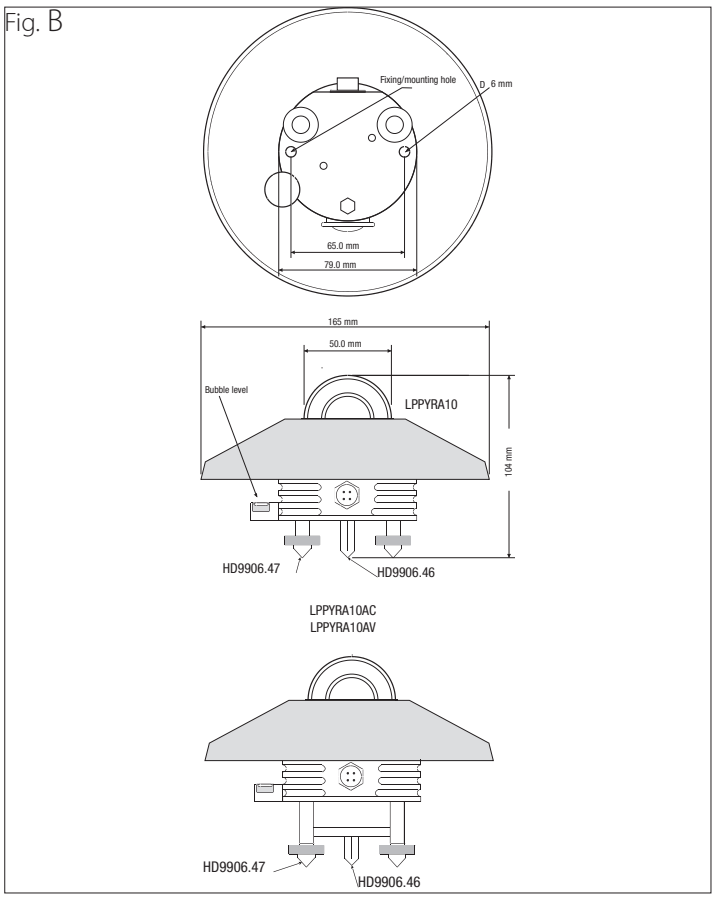
Before installing the pyranometers you need to load the cartridge containing silica gel crystals (see figure A). The silica gel has the function of absorbing the humidity in the dome chamber, which can lead to condensation on the inside of the dome walls, thus altering the measure. While loading silica 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.

Fig. B



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

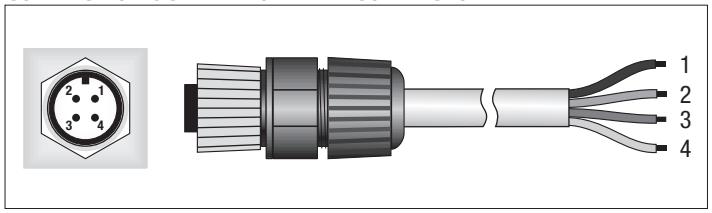
- LPPYRA10 and LPPYRA13 are passive and do not need power.

- 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

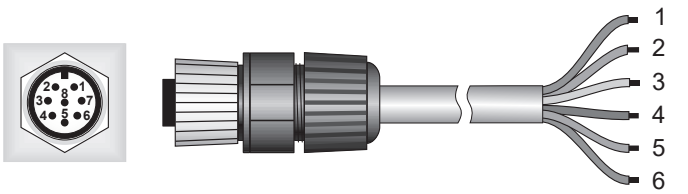
LPPYRA10AC - LPPYRA13AC

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

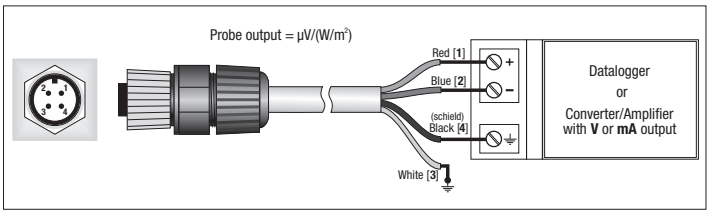
LPPYRA10S - LPPYRA13S

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	

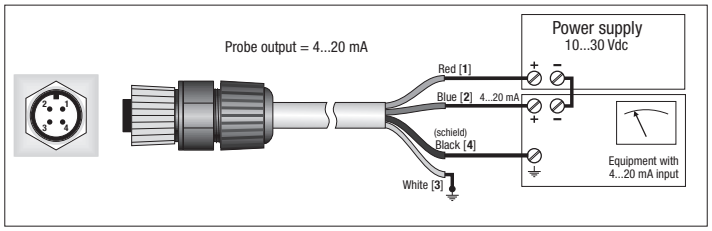
LPPYRA10S12 - LPPYRA13S12

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	

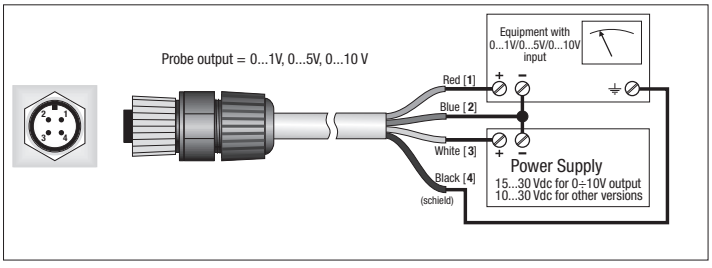
- LPPYRA10 and LPPYRA13 are connected to a millivoltmeter or to a data acquisition system. Typically, the signal from the pyranometer does not exceed 20 mV. In order to take full advantage of the pyranometer, the recommended resolution of the reading instrument is 1µV.



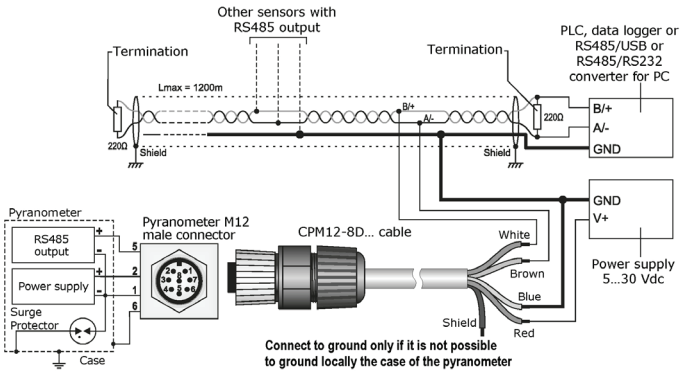
- LPPYRA10AC, LPPYRA13AC have to be connected to a power supply and a multimeter as shown below, resistance load for reading the signal must be ≤ 500 Ω:



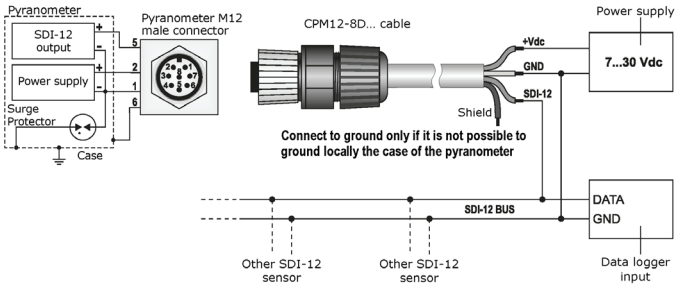
- LPPYRA10AV, LPPYRA13AV have to be connected to a power supply and a multimeter, as shown below, the load resistance for reading the signal must be ≥ 100 kΩ:



• 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 μV/(Wm^{-2}).
Once measured the potential difference (DDP) at the ends of the thermopile, the radiation E_e is obtained by the following formula:

$$E_e = DDP/S$$

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 mA = 0.. 2000 W/m^2 (on request 0…4000 W/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:

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

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 V = 0.. 2000 W/m^2 (on request 0...4000 W/m^2)
0..5 V = 0.. 2000 W/m^2 (on request 0...4000 W/m^2)
0..10 V = 0.. 2000 W/m^2 (on request 0...4000 W/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:

$E_e = 2000\ [(W/m^2)/V] \times V_{out}\ [V]$ for the version 0…1V (0…2000 W/m^2)

$E_e = 400\ [(W/m^2)/V] \times V_{out}\ [V]$ for the version 0…5V (0…2000 W/m^2)

$E_e = 200\ [(W/m^2)/V] \times V_{out}\ [V]$ for the version 0…10V (0…2000 W/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...20mA current output signal (0...2000W/m^2). 4...20mA (0...4000W/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..1Vdc, 0..5Vdc, 0..10Vdc output signal, to define when ordering (0...2000W/m^2). 0..1V, 0...5V, 0...10V (0...4000W/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…30Vdc.

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…30 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...20mA current output signal (0...2000W/m^2). 4...20mA (0...4000W/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..1Vdc, 0..5Vdc, 0..10Vdc output signal, to define when ordering (0...2000W/m^2). 0..1V, 0...5V, 0...10V (0...4000W/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…30Vdc.

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…30 Vdc.

For connecting cables and mounting accessories see page 21

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 lenghts 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).

LPSG: 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.

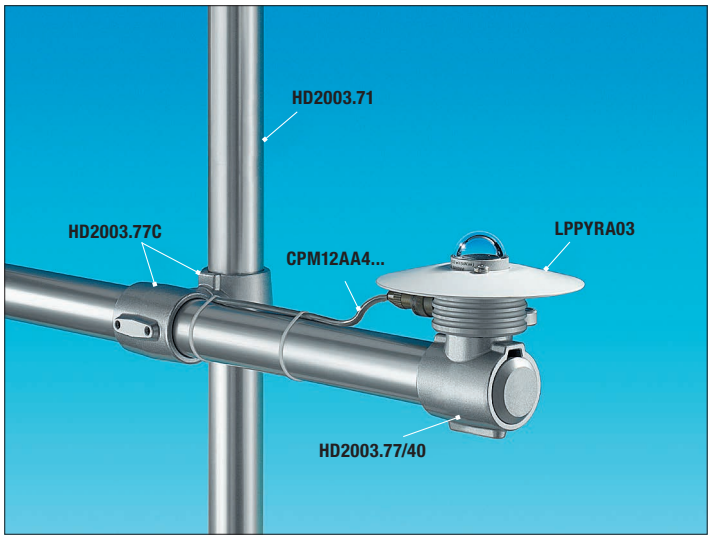
LPRING12: Ring base for measuring the diffused radiation, for LPPYRA02 and LPPYRA10 pyranometers.

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

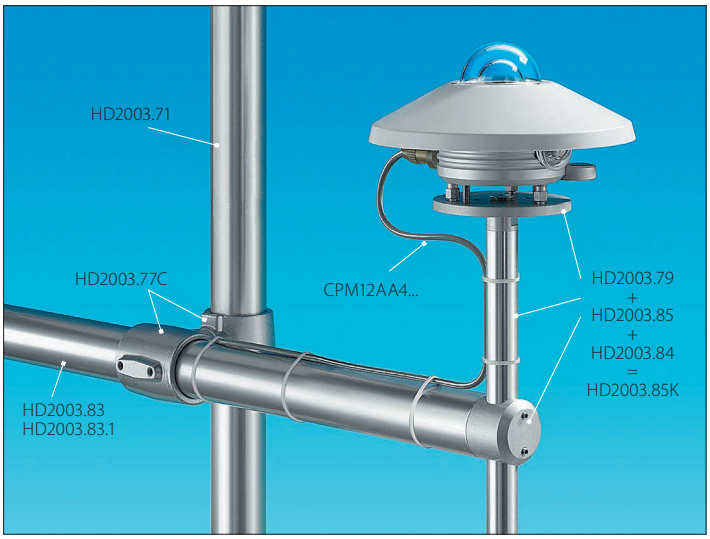
HD2003.85K: Mounting kit with adjustable height for the installation of the pyranometer on pole with diameter Ø 40 mm (HD2003.84 + HD2003.85 + HD2003.79). Not suitable for LPPYRA03 series.

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

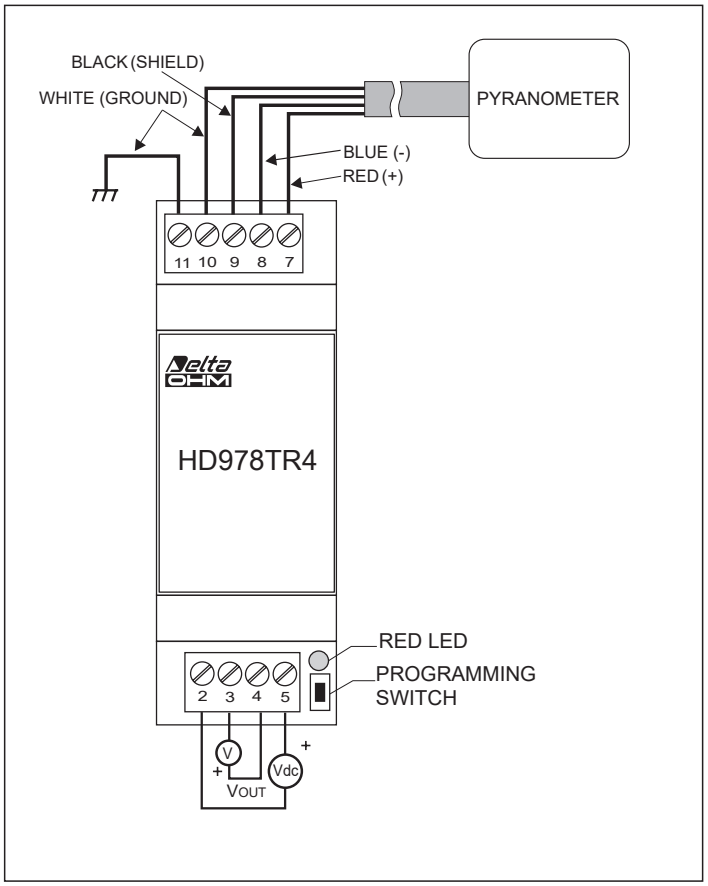
HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input range -10 ..+60mVdc. Standard configuration 0÷20mVdc. Minimum measuring range 2mVdc. For DIN rail 35mm. Configurable with HD778 TCAL.

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.

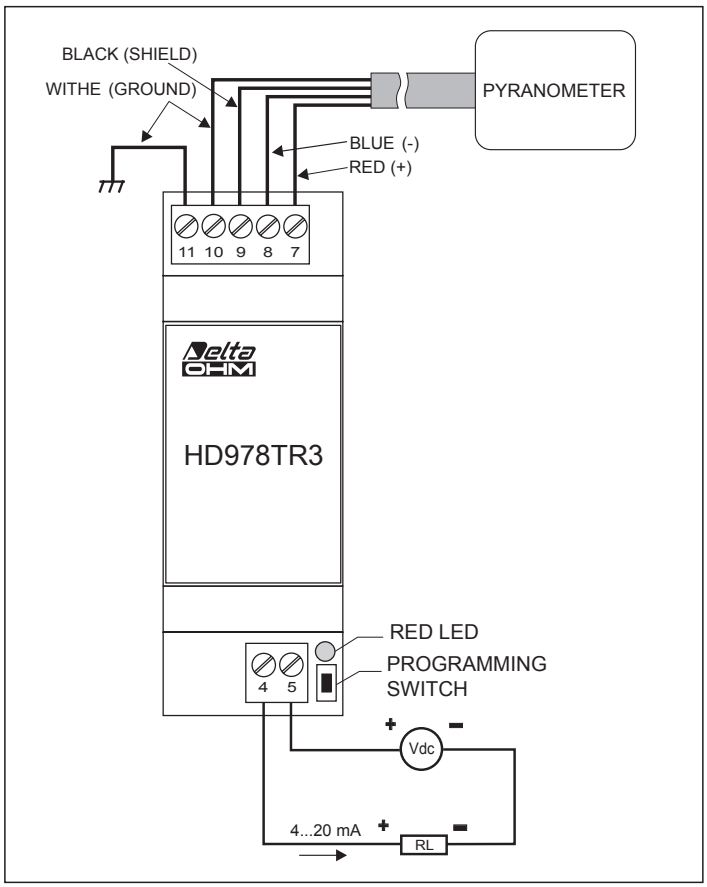
HD978TR4: Configurable signal converter amplifier with 0÷10Vdc (10÷0Vdc) output. Input range -10 ..+60mVdc. Standard configuration 0÷20mVdc. Minimum measuring range 2mVdc. For DIN rail 35mm. Configurable with HD778 TCAL

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.