



日燭國際事業股份有限公司
JD Auspice Co., Ltd.

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Operating manual

Pyranometer **LPPYRA10**



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1 INTRODUCTION

LPPYRA10 pyranometer measures the irradiance on a flat surface (W/m^2). The measured irradiance (Global Irradiance) is the sum of direct solar irradiance and diffuse irradiance.

LPPYRA10 is a Spectrally Flat Class A (Secondary Standard) pyranometer in accordance with ISO 9060:2018 and with the criteria of the WMO "Guide to Meteorological Instruments and Methods of Observation".

The pyranometer is available in the following versions:

- **LPPYRA10:** PASSIVE
The passive version can be connected to the instruments D09847 and HD31 by using VP 472 SICRAM module.
- **LPPYRA10AC:** ACTIVE with 4..20 mA CURRENT output
- **LPPYRA10AV:** ACTIVE with 0..1 or 0..5 or 0..10 V VOLTAGE output to be defined when ordering.
- **LPPYRA10S:** With RS485 Modbus-RTU output.
- **LPPYRA10S12:** With SDI-12 output.

The pyranometer is supplied factory calibrated and with a calibration report. The calibration is carried out in accordance with the ISO 9847:1992 (type IIc) standard: "Calibration of field pyranometers by comparison to a reference pyranometer". The pyranometer is calibrated by comparison with the reference sample calibrated annually at WRC (World Radiation Center).

2 WORKING PRINCIPLE

LPPYRA10 pyranometer is based on a thermopile sensor. The thermopile sensitive surface is coated with a black matt paint, which allows the pyranometer not to be selective at different wavelengths.

In order to grant the thermopile a proper thermal insulation from the wind and reduce the sensitivity to thermal irradiance, LPPYRA10 is equipped with two concentric domes having 50 mm and 32 mm outer diameter. The domes protect the thermopile from the dust, which might change spectral sensitivity if it lies on the black surface,

The pyranometer spectral range is determined by the transmission of the two glass domes. Thanks to the use of a new material for the manufacturing of the domes, the spectral range has been further extended to short wavelengths starting from 283 nm.

Considering a standard solar spectrum, the portion of solar irradiation measured by the pyranometer is greater than 99.8%. Figure 2.1 shows the relative spectral sensitivity of the LPPYRA10 pyranometer and a standard solar spectrum.

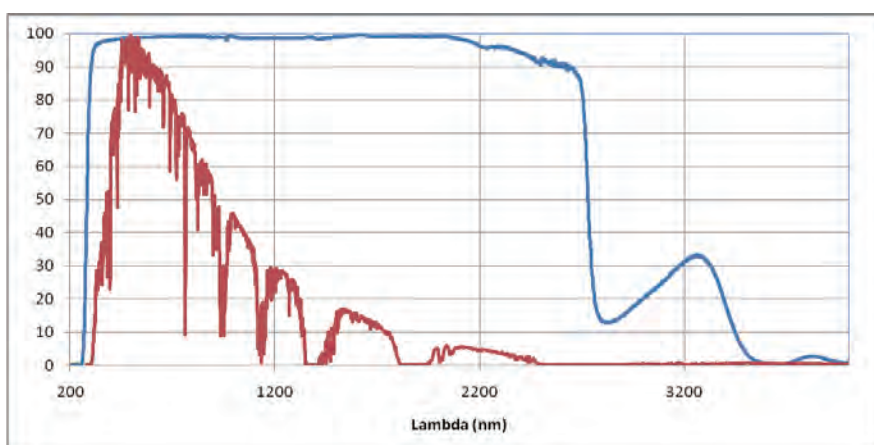


Fig. 2.1: LPPYRA10 pyranometer relative spectral sensitivity (blue line) compared with a standard solar spectrum (red line)

Radiant energy is absorbed by the thermopile black surface, thus creating a difference of temperature between the center of the thermopile (hot junction) and the pyranometer body (cold junction). Thanks to the Seebeck effect, the difference of temperature between hot and cold junction is converted into a Difference of Potential.

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

In order to minimize sensitivity changes with temperature, LPPYRA10 is equipped with a passive compensation circuit. The graph in figure 2.2 shows the typical variation of sensitivity at different temperatures. The deviations are calculated from the sensitivity measured at 20 °C.

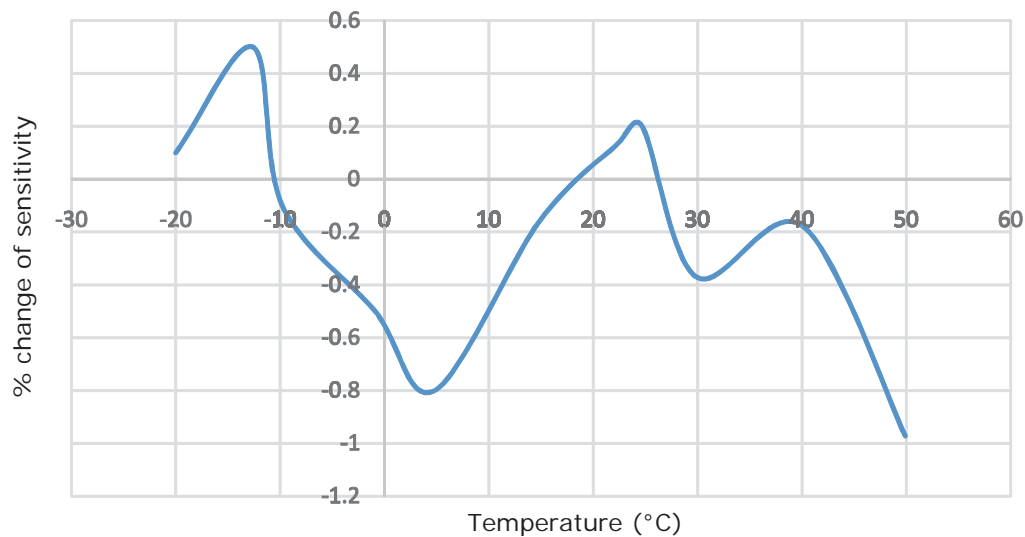


Fig. 2.2: : percentage change of LPPYRA10 pyranometer sensitivity in the temperature range -20...50 °C compared to the sensitivity at 20 °C

To prevent internal condensation forming on the internal side of the dome under certain climatic conditions, silica gel tablets are inserted inside the pyranometer to absorb humidity.

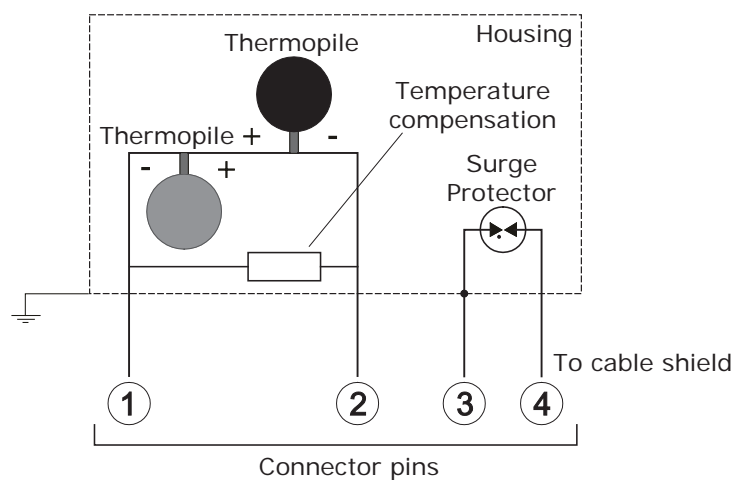


Fig. 2.3: scheme of principle LPPYRA10 (version with mV output)

3 INSTALLATION

Before installing the pyranometer, refill the cartridge containing silica-gel crystals. Silica gel absorbs humidity in the dome chamber and prevents, in particular climatic conditions, condensation on the internal walls of the domes and measurement alteration.

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

1. Loosen the three screws that fix the white shade disk.
2. Unscrew the silica gel cartridge using a coin.
3. Remove the cartridge perforated cap.
4. Open the sachet containing silica gel (supplied with the pyranometer).
5. Fill the cartridge with the silica gel crystals.
6. Close the cartridge with its own cap, paying attention that the sealing O-ring be properly positioned.
7. Screw the cartridge to the pyranometer body using a coin.
8. Check that the cartridge is screwed tightly (if not, silica gel life will be reduced).
9. Position the shade disk and screw it with the screws.
10. The pyranometer is ready for use.

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

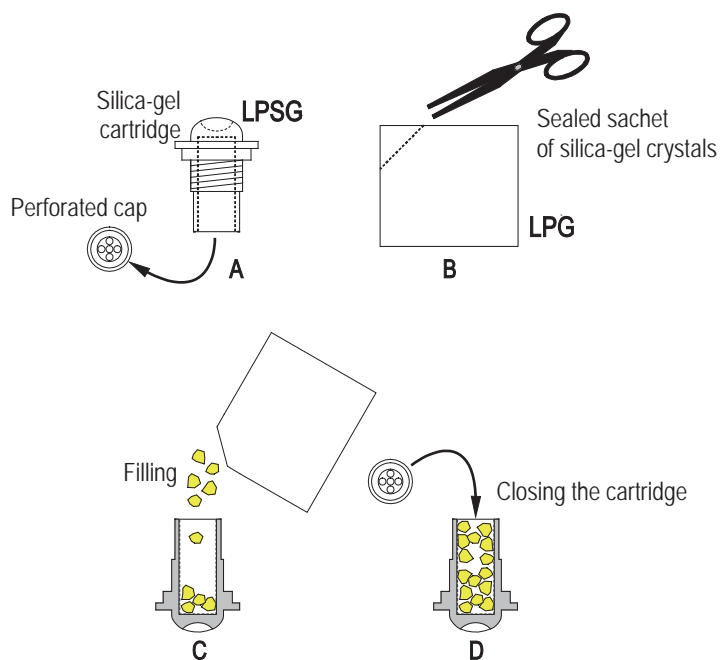


Fig. 3.1: filling the silica-gel cartridge

- The pyranometer must be mounted in an easy-to-reach location in order to clean the dome regularly and carry out maintenance. At the same time, make sure that no buildings, constructions, trees or obstructions exceed the horizontal plane where the pyranometer lies. If this is not possible, select a site where obstructions in the path of the sun from sunrise to sunset do not exceed 5 degrees of elevation. **N.B.: The presence of obstructions on the horizon line affects significantly the measurement of direct irradiance.**
- The pyranometer must be located far from any kind of obstruction, which might reflect sunlight (or sun shadow) onto the pyranometer itself.
- In compliance with ISO TR9901 standard and WMO recommendations, when the pyranometer is used without the white shade disk, it must be positioned so that its connector is pointed to the North Pole, if the instrument is used in the Northern Hemisphere, and to the South Pole, if used in the Southern Hemisphere. In any case, it is better to follow this suggestion even when the shade disk is applied.
- For fixing, use the holes on the pyranometer body (remove the shade disk to access the holes and reposition it after mounting) or the suitable accessories (see the figures below). In order to allow an accurate horizontal positioning, the pyranometer is equipped with a levelling device: the adjustment is made by means of the two levelling screws that allow adjusting the pyranometer inclination. The mast height does not exceed the pyranometer plane to avoid measurement errors caused by any reflection or shadow of the mast itself.
- It is preferably to thermally insulate the pyranometer from its mounting bracket ensuring, at the same time, a good electrical contact to ground.

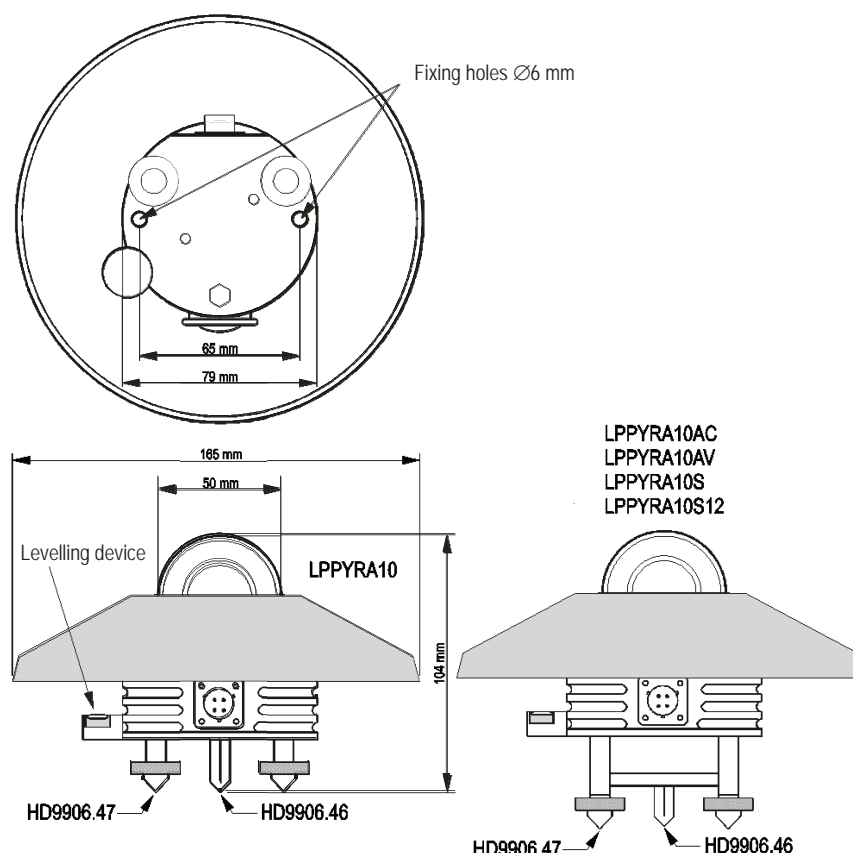


Fig. 3.2: fixing holes and levelling device

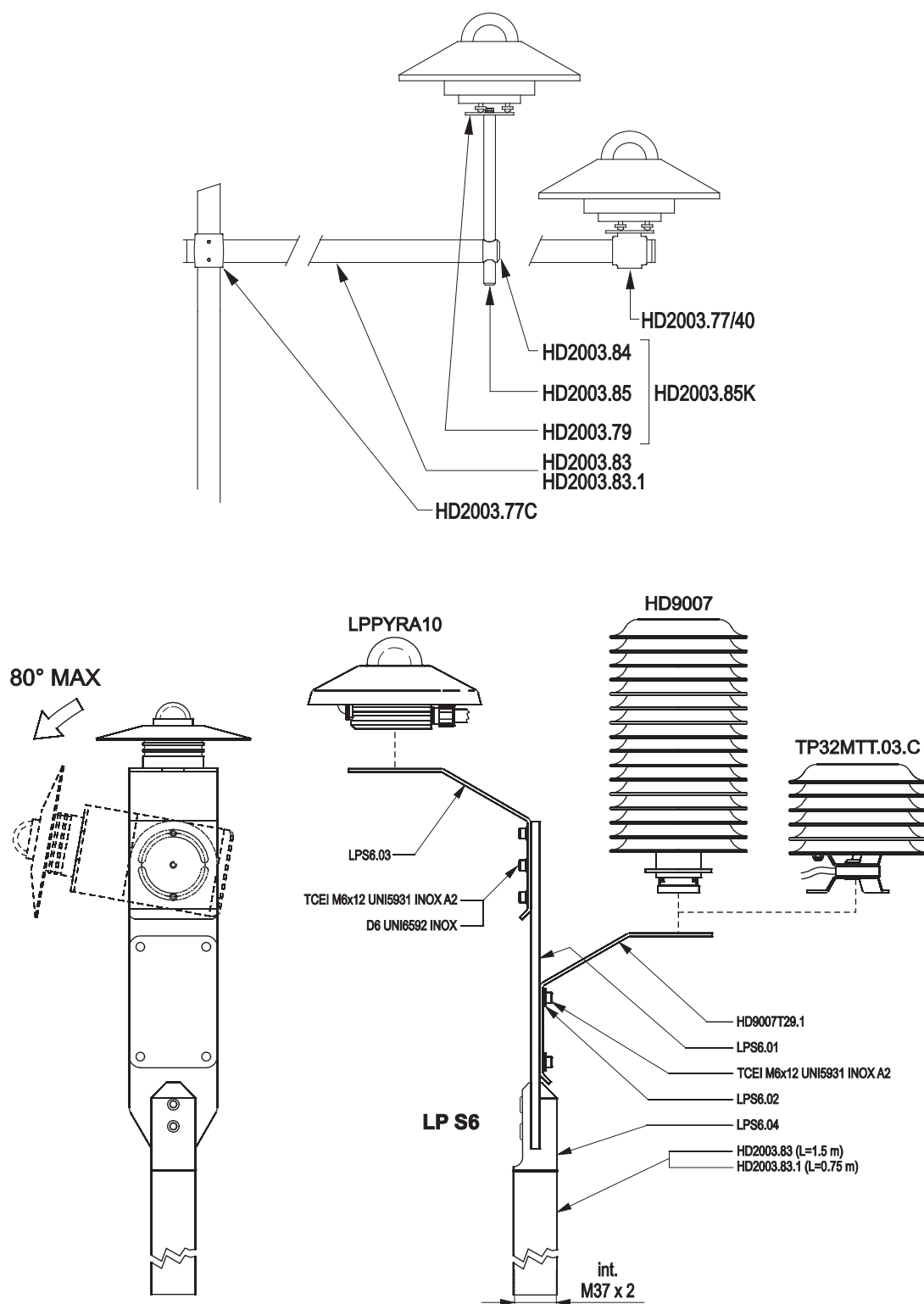


Fig. 3.3: fixing accessories

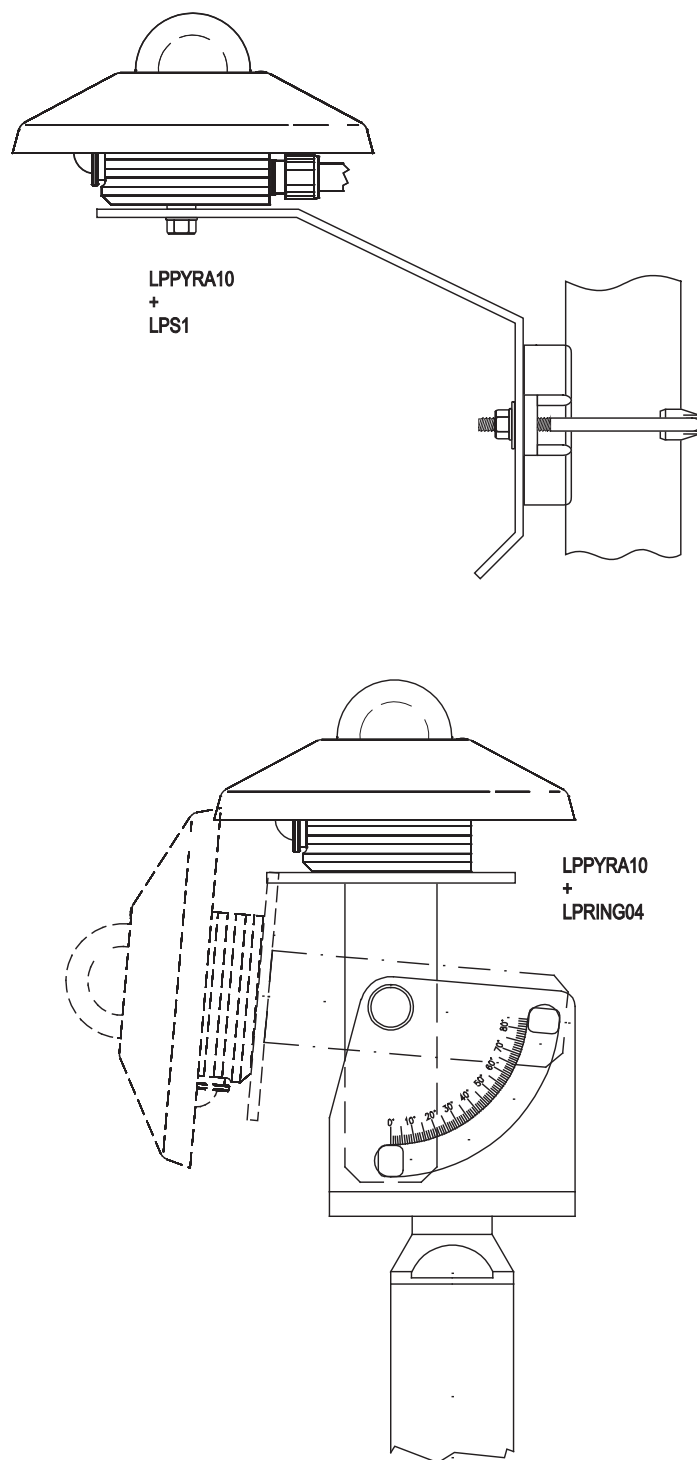


Fig. 3.4: fixing accessories



4 ELECTRICAL CONNECTIONS

LPPYRA10, **LPPYRA10AC** and **LPPYRA10AV** have a 4-pole connector and use the **CPM12AA4... optional** cables in UV resistant PTFE, with 4-pole connector on one side and open wires on the other side.

LPPYRA10S and **LPPYRA10S12** have a 8-pole connector and use the **CPM12-8D... optional** cables in UV resistant PTFE, with 8-pole connector on one side and open wires on the other side.



The metallic housing of the pyranometer should preferably be grounded (\perp) locally. In this case, do not connect the wire of the cable corresponding to the housing to prevent ground loops.

Only if it is not possible to ground locally the metallic case of the pyranometer, connect the wire of the cable corresponding to the housing to ground (\perp).

The wire of the cable corresponding to the housing depends on the model: white wire in LPPYRA10 and LPPYRA10AC, black wire (cable shield) in LPPYRA10S and LPPYRA10S12. In LPPYRA10AV the housing is not connected directly to the connector.

4.1 LPPYRA10 CONNECTIONS

The pyranometer LPPYRA10 is passive and does not require power supply. It is to be connected either to a millivoltmeter or to a data acquisition system. Typically, the pyranometer output signal does not exceed 20 mV. In order to better exploit the pyranometer features, the readout instrument should have 1 μ V resolution.

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

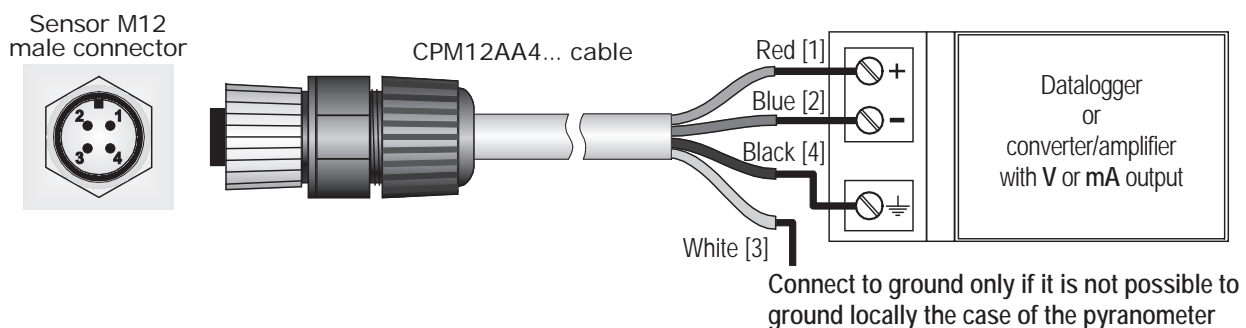


Fig. 4.1: LPPYRA10 connections



4.2 LPPYRA10AC CONNECTIONS

The pyranometer LPPYRA10AC has **4...20 mA** output and requires **10...30 Vdc** external power supply. It is to be connected to a power supply and an instrument with 4...20 mA input as shown in fig. 4.2. The load resistance of the instrument reading the signal must be $\leq 500 \Omega$.

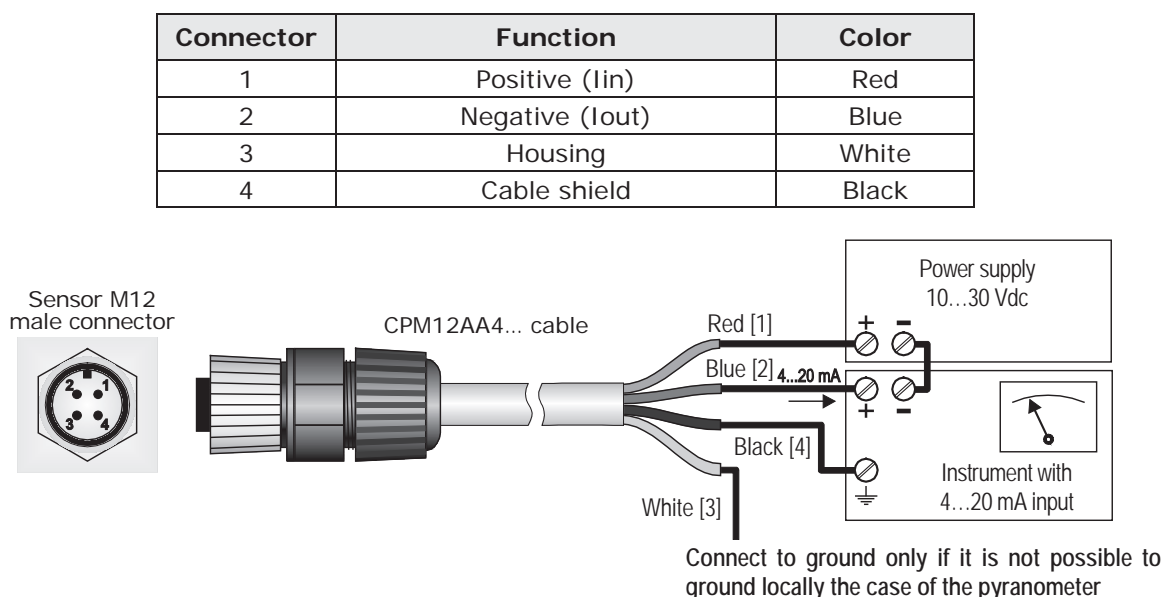


Fig. 4.2: LPPYRA10AC connections

4.3 LPPYRA10AV CONNECTIONS

The pyranometer LPPYRA10AV has **0...1 V**, **0...5 V** or **0...10 V** output (depending on the ordered output) and requires external power supply: **10...30 Vdc** for 0...1 V and 0...5 V outputs, **15...30 Vdc** for 0...10 V output. It is to be connected to a power supply and an instrument with voltage input as shown in fig. 4.3. The load resistance of the instrument reading the signal must be $\geq 100 \text{ k}\Omega$.

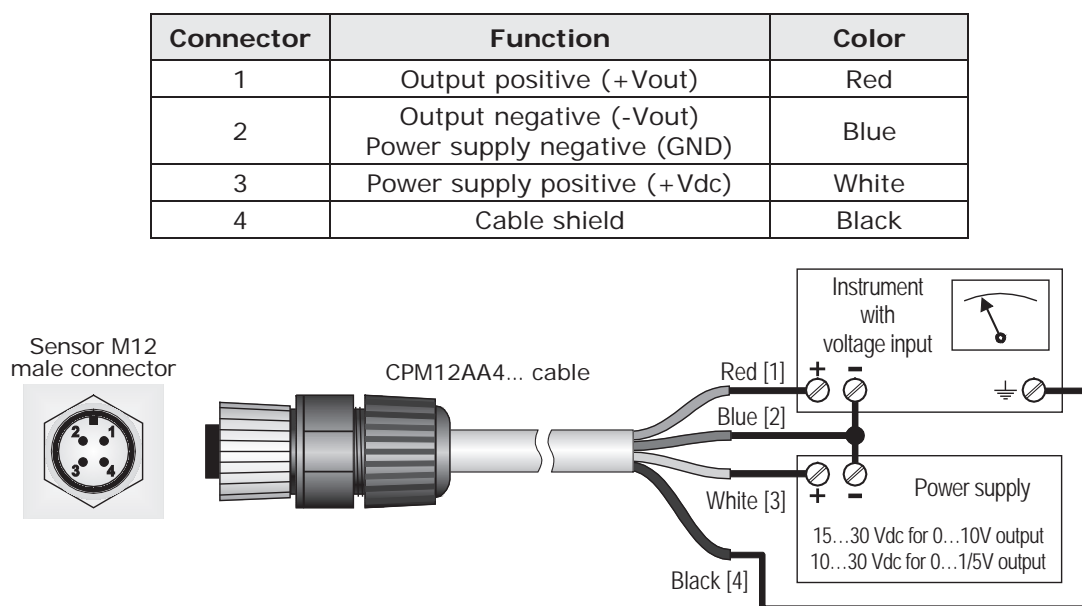


Fig. 4.3: LPPYRA10AV connections

4.4 LPPYRA10S CONNECTIONS

The pyranometer LPPYRA10S has **RS485 Modbus-RTU** output and requires **5...30 Vdc** external power supply. It is to be connected to a power supply and to a PLC, a data logger or a RS485/USB or RS485/RS232 converter for PC as shown in fig. 4.4. The RS485 output is not isolated.

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	

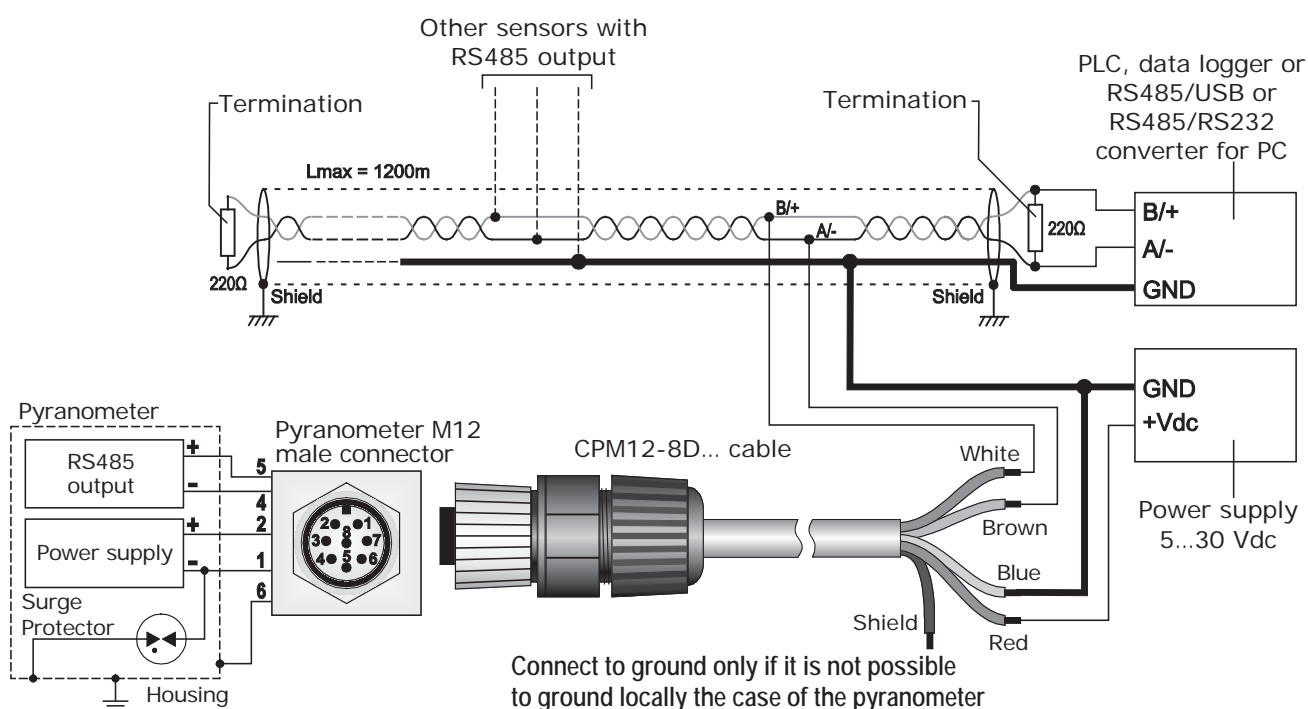


Fig. 4.4: LPPYRA10S connections

Before connecting the pyranometer to the RS485 network, set the address and the communication parameters, if different from the factory preset (see chapter 6).

4.5 LPPYRA10S12 CONNECTIONS

The pyranometer LPPYRA10S12 has **SDI-12** output and requires **7...30 Vdc** external power supply. It is to be connected to a power supply and to an acquisition system (data logger) as shown in fig. 4.5.

Connector	Function	Cable 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	

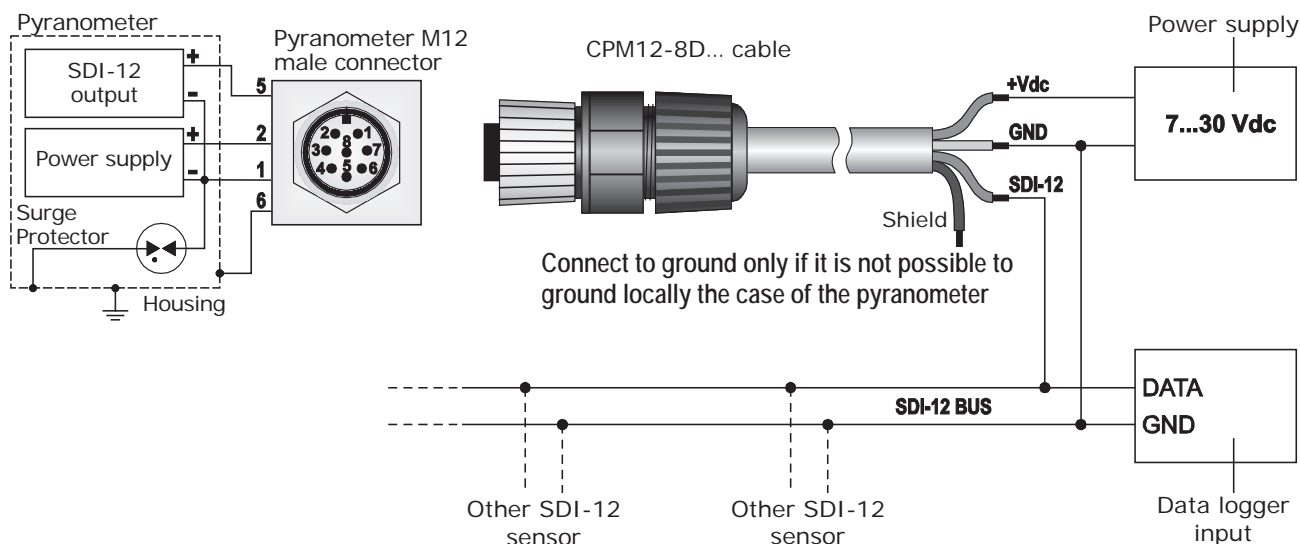


Fig. 4.5: LPPYRA10S12 connections

More SDI-12 sensors can be connected in parallel. The distance between a sensor and the acquisition system (data logger) should not exceed 60 m.

Due to its low power consumption ($< 200 \mu\text{A}$), LPPYRA10S12 is particularly suitable for battery/solar panel-powered data acquisition systems.

Before connecting the instrument to an SDI-12 network containing other sensors, set the address by using the proper SDI-12 command (see chapter 7).



5 MEASUREMENT IN THE MODELS WITH ANALOG OUTPUT

Below are the ways to calculate the global irradiance in the models with analog output LPPYRA10, LPPYRA10AC and LPPYRA10AV.

5.1 LPPYRA10

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

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

$$E_e = DDP / S$$

where:

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

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

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

5.2 LPPYRA10AC

The 4...20 mA output signal corresponds to the 0...2000 W/m^2 (0...4000 W/m^2 on request) irradiance range.

The irradiance **E_e** is obtained by measuring with a multimeter the current **I_{out}** absorbed by the sensor and applying the following formula:

$$\begin{aligned} E_e &= 125 \cdot (I_{out} - 4) & \text{if f.s.} = 2000 \text{ W/m}^2 \\ E_e &= 250 \cdot (I_{out} - 4) & \text{if f.s.} = 4000 \text{ W/m}^2 \end{aligned}$$

where:

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

I_{out} is the current expressed in mA absorbed by the pyranometer.

5.3 LPPYRA10AV

The output signal (0...1 V, 0...5 V or 0...10 V depending on the version) corresponds to the 0...2000 W/m^2 (0...4000 W/m^2 on request) irradiance range.

The irradiance **E_e** is obtained by measuring with a multimeter the output voltage **V_{out}** of the sensor and applying the following formula:

$$\begin{aligned} E_e &= 2000 \cdot V_{out} & \text{for the version 0...1 V with f.s.} = 2000 \text{ W/m}^2 \\ E_e &= 4000 \cdot V_{out} & \text{for the version 0...1 V with f.s.} = 4000 \text{ W/m}^2 \\ \\ E_e &= 400 \cdot V_{out} & \text{for the version 0...5 V with f.s.} = 2000 \text{ W/m}^2 \\ E_e &= 800 \cdot V_{out} & \text{for the version 0...5 V with f.s.} = 4000 \text{ W/m}^2 \\ \\ E_e &= 200 \cdot V_{out} & \text{for the version 0...10 V with f.s.} = 2000 \text{ W/m}^2 \\ E_e &= 400 \cdot V_{out} & \text{for the version 0...10 V with f.s.} = 4000 \text{ W/m}^2 \end{aligned}$$

where:

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

V_{out} is the output voltage expressed in V measured by the multimeter.

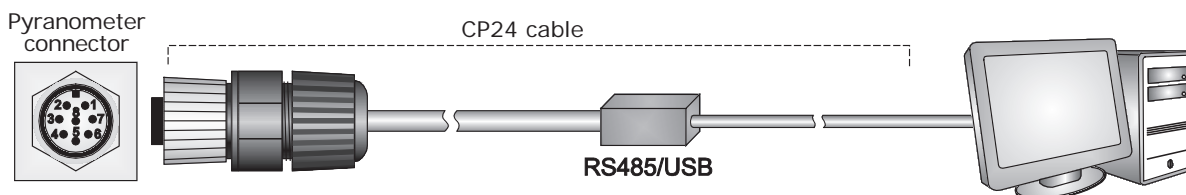
6 RS485 MODBUS-RTU OUTPUT

Before connecting the pyranometer to the RS485 network, an address must be assigned and the communication parameters must be set, if different from the factory preset.

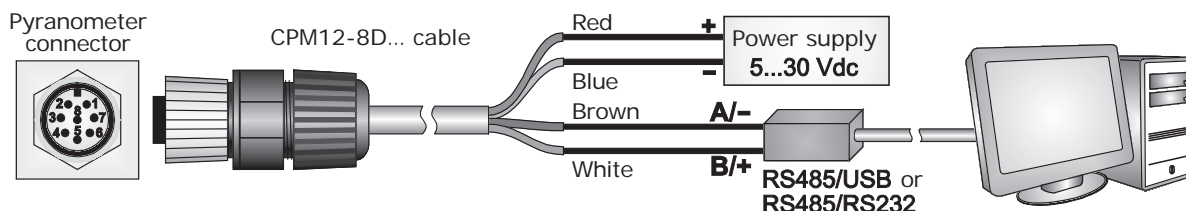
6.1 SETTING THE COMMUNICATION PARAMETERS

Connect the pyranometer to the PC in one of the following two ways:

- A.** By using the optional **CP24** cable, with built-in RS485/USB converter. In this connection mode, the sensor is powered by the PC USB port. To use the cable, it is necessary to install the related USB drivers in the PC.



- B.** By using the supplied 8-pole M12 female connector or the optional **CPM12-8D...** cable and a generic RS485/USB or RS485/RS232 converter. In this connection mode, it is necessary to power the pyranometer separately. If a RS485/USB converter is used, it is necessary to install the related USB drivers in the PC.



NOTES ON THE INSTALLATION OF UNSIGNED USB DRIVER: before installing unsigned USB driver into operating systems starting from Windows 7, it is necessary to restart the PC by disabling the driver signing request. If the operating system is 64-bit, even after installation the request of driver signing have to be disabled each time the PC is restarted.

Procedure:

1. Start with the pyranometer not powered (if the CP24 cable is used, disconnect one end of the cable).
2. In the PC, start a serial communication program. Set the Baud Rate to 57600 and set the communication parameters as follows (the pyranometer is connected to a COM type port):
 - Data Bits: 8
 - Parity: None
 - Stop Bits: 2

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

3. Switch the pyranometer on (if the CP24 cable is used, connect both ends of the cable).



4. Wait until the pyranometer transmits the **&** character, then send (within 10 seconds from the pyranometer power on) the **@** command and press **Enter**.

Note: if the pyranometer does not receive the **@** command within 10 seconds from power on, the RS485 MODBUS mode is automatically activated. In such a case, it is necessary to switch off and on again the pyranometer.

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

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

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

Command	Response	Description
CMA _{nnn}	&	Set RS485 address to nnn Ranging from 1 to 247 Preset on 1
CMB _n	&	Set RS485 Baud Rate n=0 ⇒ 9600 n=1 ⇒ 19200 Preset on 1 ⇒ 19200
CMP _n	&	Set RS485 transmission mode n=0 ⇒ 8-N-1 (8 data bits, no parity, 1 stop bit) n=1 ⇒ 8-N-2 (8 data bits, no parity, 2 stop bits) n=2 ⇒ 8-E-1 (8 data bits, even parity, 1 stop bit) n=3 ⇒ 8-E-2 (8 data bits, even parity, 2 stop bits) n=4 ⇒ 8-O-1 (8 data bits, odd parity, 1 stop bit) n=5 ⇒ 8-O-2 (8 data bits, odd parity, 2 stop bits) Preset on 2 ⇒ 8-E-1
CMW _n	&	Set receiving mode after RS485 transmission n=0 ⇒ Violate protocol and go in Rx mode right after Tx n=1 ⇒ Respect protocol and wait 3.5 characters after Tx Preset on 1 ⇒ Respect the protocol

7. You can check the parameters setting by sending the following serial commands:

Command	Response	Description
RMA	<i>Address</i>	Read RS485 address
RMB	<i>Baud Rate</i> (0,1)	Read RS485 Baud Rate 0 ⇒ 9600 1 ⇒ 19200
RMP	<i>Tx Mode</i> (0,1,2,3,4,5)	Read RS485 transmission mode 0 ⇒ 8-N-1 1 ⇒ 8-N-2 2 ⇒ 8-E-1 3 ⇒ 8-E-2 4 ⇒ 8-O-1 5 ⇒ 8-O-2
RMW	<i>Rx Mode</i> (0,1)	Read receiving mode after RS485 transmission 0 ⇒ Violate protocol and go in Rx mode right after Tx 1 ⇒ Respect protocol and wait 3.5 characters after Tx

Note: it is not required to send the CAL USER ON command to read the settings.



6.2 READING THE MEASURES WITH THE MODBUS-RTU PROTOCOL

In MODBUS mode, you can read the values measured by the pyranometer through the function code 04h (Read Input Registers). The following table lists the quantities available with the appropriate register address:

Number	Address	Quantity	Format
3	2	Solar radiation in W/m ²	16-bit Integer
4	3	Status register: bit0=1 ⇒ solar radiation measurement error bit2=1 ⇒ configuration data error bit3=1 ⇒ program memory error	16-bit Integer
5	4	Average values of the last 4 measurements	16-bit Integer
6	5	Signal generated by the sensor in $\mu\text{V}/10$ [e.g.: 816 means 8160 μV , the resolution is 10 μV]	16-bit Integer

Note: Register address = Register number - 1, as defined in the Modbus standard.

OPERATING MODE: the pyranometer enters RS485 MODBUS-RTU mode after 10 seconds from power on. In the first 10 seconds from power on the pyranometer does not reply to requests from the MODBUS master unit. After 10 seconds, it is possible to send MODBUS requests to the pyranometer.



7 SDI-12 OUTPUT

The LPPYRA10S12 pyranometers are compatible with version 1.3 of SDI-12 protocol.

The protocol communication parameters are: Baud rate = 1200. Data bits = 7, Parity = Even, Stop bits = 1.

The communication with the instrument is performed by sending a command in the following form:

<Address><Command>!

with <Address> = address of the instrument the command is sent to
<Command> = type of operation requested to the instrument

The instrument reply is as follows:

<Address><Data><CR><LF>

with <Address> = address of the instrument which replies
<Data> = information sent by the instrument
<CR> = ASCII character *Carriage Return*
<LF> = ASCII character *Line Feed*

The sensors come with a factory address preset to 0. The address can be modified by using the proper SDI-12 command reported in the following table.

The following table reports the SDI-12 commands available. For consistency with SDI-12 standard documentation, the instrument address is indicated in the table with the letter **a**.

SDI-12 Commands

Command	Instrument reply	Description
a!	a<CR><LF>	Verifies the presence of the instrument.
a!	allccccccmmmmmmvvvsssssss<CR><LF> with: a = address of the instrument (1 character) ll = SDI-12 compliant version (2 characters) ccccccc = manufacturer (8 characters) mmmmmm = instrument model (6 characters) vvv = firmware version (3 characters) sssssss = serial number (8 characters) ⇒ Example of response: 013DeltaOhmLP-PYRA0016051518 with: 0 = instrument address 13 = SDI-12 version 1.3 compliant DeltaOhm = manufacturer's name LP-PYR = instrument model A00 = firmware version A.0.0 16051518 = serial number	Requests for information from the instrument.
aAb! Where: b = new address	b<CR><LF> Note: if the b character is not an acceptable address, the instrument responds with a instead of b.	Modification of the instrument address.

Command	Instrument reply	Description
?!	a<CR><LF>	Request of the address of the instrument. If more than one sensor is connected to the bus, a conflict occurs.
TYPE M (START MEASUREMENT) AND TYPE C (START CONCURRENT MEASUREMENT) COMMANDS		
Irradiance, signal internal level and internal temperature (if available)		
aM! aC!	atttn<CR><LF> with: ttt = number of seconds necessary for the instrument to make the measure available (3 characters) n = number of detected variables (1 character for aM!, 2 characters for aC!) Note: ttt = 000 means datum immediately available.	Request to execute the measurement.
aDO!	a+n+w...w+v...v+t...t<CR><LF> with: n = content of the status register w...w = irradiance in W/m ² v...v = signal internal level in mV t...t = internal temperature in the set unit of measurement (default °C) if the NTC temperature sensor is present, otherwise the fixed value 25 °C ⇒ Example of response: 0+0+228.7+3.294+25.0 probe address = 0 content of the status register = 0 irradiance = 228.7 W/m ² signal internal level = 3.294 mV internal temperature or fixed value = 25.0 °C Note: the status register normally contains zero; a value different from zero indicates an error condition.	Reads the measurement.
Irradiance and internal temperature (if available)		
aM1! aC1!	atttn<CR><LF> with: ttt = number of seconds necessary for the instrument to make the measure available (3 characters) n = number of detected variables (1 character for aM1!, 2 characters for aC1!) Note: ttt = 000 means datum immediately available.	Request to execute the measurement.
aDO!	a+w...w+t...t<CR><LF> with: w...w = irradiance in W/m ² t...t = internal temperature in the set unit of measurement (default °C) if the NTC temperature sensor is present, otherwise the fixed value 25 °C ⇒ Example of response: 0+228.7+25.0 probe address = 0 irradiance = 228.7 W/m ² internal temperature or fixed value = 25.0 °C	Reads the measurement.



Command	Instrument reply	Description
Internal temperature (if available)		
aM2! aC2!	atttn<CR><LF> with: ttt = number of seconds necessary for the instrument to make the measure available (3 characters) n = number of detected variables (1 character for aM2!, 2 characters for aC2!) Note: ttt = 000 means datum immediately available.	Request to execute the measurement.
aD0!	a+t...t<CR><LF> with t...t = internal temperature in the set unit of measurement (default °C) if the NTC temperature sensor is present, otherwise the fixed value 25 °C ⇒ Example of response: 0+25.0 probe address = 0 internal temperature or fixed value = 25.0 °C	Reads the measurement.
Signal internal level		
aM3! aC3!	atttn<CR><LF> with: ttt = number of seconds necessary for the instrument to make the measure available (3 characters) n = number of detected variables (1 character for aM3!, 2 characters for aC3!) Note: ttt = 000 means datum immediately available.	Request to execute the measurement.
aD0!	a+v...v<CR><LF> with v...v = signal internal level in mV ⇒ Example of response: 0+3.294 probe address = 0 signal internal level = 3.294 mV	Reads the measurement.

In addition to the above-mentioned commands, the sensor also implements the corresponding commands with CRC, that require to add a 3-character CRC code at the end of the reply before <CR><LF>. The format of these commands is obtained from the previous by adding the letter C: aMC!, aMC1!, aMC2!, aMC3!, aCC!, aCC1!, aCC2!, aCC3!. The sensor **does not** implement the type R (Continuous Measurements) commands.

Extended SDI-12 Commands

Command	Instrument reply	Description
aXSCAL USER ON!	a> USER ENABLED!<CR><LF>	Enables the configuration mode.
aXSCFD!	a> &<CR><LF>	Sets °C as temperature unit of measurement.
aXSCFE!	a> &<CR><LF>	Sets °F as temperature unit of measurement.
aXSCAL END!	a> LOCKED!<CR><LF>	Disables the configuration mode.



The extended commands allow setting the temperature unit of measurement (if the temperature sensor is present). To change the unit of measurement:

- 1) Send the command **aXSCAL USER ON!** (note: **a**=instrument address).
- 2) Send the command **aXSCFD!** (to set °C) or **aXSCFE!** (to set °F).
- 3) Send the command **aXSCAL END!**

For more information about the SDI-12 protocol, visit the website "www.sdi-12.org".



8 MAINTENANCE

In order to grant measurements high accuracy, it is important to keep the outer glass dome clean. Consequently, the more the dome will be kept clean, the more measurements will be accurate.

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

Because of the high temperature changes between day and night, some condensation might appear on the pyranometer domes. In this case the performed reading is highly over-estimated. To minimize the condensation, the pyranometer is provided with a cartridge containing dessicant material (silica-gel). The efficiency of the silica-gel crystals decreases over time while absorbing humidity. Silica-gel crystals are efficient when their color is **yellow**, while they turn **white/translucent** as soon as they loose their efficiency. Read instructions at chapter 3 about how to replace the silica-gel crystals. Silica-gel typical lifetime goes from 2 to 6 months depending on the environment where the pyranometer works.

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



9 TECHNICAL SPECIFICATIONS

Sensor	Thermopile
Typical sensitivity	$6 \div 11 \mu\text{V}/\text{Wm}^{-2}$
Impedance	$5 \div 50 \Omega$
Measuring range	$0 \div 4000 \text{ W}/\text{m}^2$
Viewing angle	$2\pi \text{ sr}$
Spectral range (50%)	$283 \div 2800 \text{ nm}$
Operating temperature/humidity	$-40 \div 80 \text{ }^\circ\text{C} / 0 \div 100\%$
Output	Analog in $\mu\text{V}/\text{Wm}^{-2}$ (LP PYRA10) Analog $4 \div 20 \text{ mA}$ (LPPYRA10AC) Analog $0 \div 1 \text{ V}$, $0 \div 5 \text{ V}$ or $0 \div 10 \text{ V}$ (LPPYRA10AV) Digital RS485 Modbus-RTU (LPPYRA10S) Digital SDI-12 (LPPYRA10S12)
Power supply	$10 \div 30 \text{ Vdc}$ (LPPYRA10AC and LPPYRA10AV with $0 \div 1 \text{ V}$ and $0 \div 5 \text{ V}$ output) $15 \div 30 \text{ Vdc}$ (LPPYRA10AV with $0 \div 10 \text{ V}$ output) $5 \div 30 \text{ Vdc}$ (LPPYRA10S) $7 \div 30 \text{ Vdc}$ (LPPYRA10S12)
Consumption	$< 200 \mu\text{A}$ for the version LPPYRA10S12
Connection	4-pole M12 connector (LPPYRA10, LPPYRA10AC and LPPYRA10AV) 8-pole M12 connector (LPPYRA10S and LPPYRA10S12)
Dimensions	Fig. 3.2
Weight	0.9 kg
Accuracy of levelling device	$< 0.1^\circ$
Protection degree	IP 67
MTBF	$> 10 \text{ years}$

Technical Specifications According to ISO 9060:2018

Response time (95%)	$< 5 \text{ s}$
Zero offset	
a) response to a $200 \text{ W}/\text{m}^2$ thermal radiation	$< 7 \text{ W}/\text{m}^2$
b) response to a $5 \text{ K}/\text{h}$ change in ambiente temperature	$< \pm 2 \text{ W}/\text{m}^2$
Long-term instability (1 year)	$< \pm 0.5 \%$
Non-linearity	$< \pm 0.2 \%$
Response according to the cosine law	$< \pm 10 \text{ W}/\text{m}^2$
Spectral selectivity	$< \pm 3 \%$
Temperature response ($-10 \dots +40^\circ\text{C}$)	$< 1 \%$
Tilt response	$< \pm 0.2 \%$



10 SAFETY INSTRUCTIONS

General safety instructions

The instrument has been manufactured and tested in accordance with the safety standard EN61010-1:2010 "Safety requirements for electrical equipment for measurement, control and laboratory use" and has left the factory in perfect safety technical conditions.

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

The instrument proper operation and operating safety can be ensured only in the climatic conditions specified in this manual.

Do not use the instruments in places where there are:

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

User obligations

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

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



11 ORDERING CODES

LPPYRA10	Spectrally Flat Class A (Secondary Standard) pyranometer according to ISO 9060:2018. Complete with shade disk, cartridge for silica-gel crystals, 2 spare sachets, levelling device, M12 4-pole connector and Calibration Report. CPM12AA4... cable has to be ordered separately.
LPPYRA10AC	Spectrally Flat Class A (Secondary Standard) pyranometer according to ISO 9060:2018. Complete with shade disk, cartridge for silica-gel crystals, 2 spare sachets, levelling device, M12 4-pole connector and Calibration Report. Output 4...20 mA corresponding to 0...2000 W/m ² (on request 0...4000 W/m ²). Power supply 10...30 Vdc. CPM12AA4... cable has to be ordered separately.
LPPYRA10AV	Spectrally Flat Class A (Secondary Standard) pyranometer according to ISO 9060:2018. Complete with shade disk, cartridge for silica-gel crystals, 2 spare sachets, levelling device, M12 4-pole connector and Calibration Report. Output 0...1 Vdc, 0...5 Vdc or 0...10 Vdc (to be defined when ordering) corresponding to 0...2000 W/m ² (on request 0...4000 W/m ²). Power supply 10...30 Vdc for the versions with output 0...1 Vdc and 0...5 Vdc, 15...30 Vdc for the version with output 0...10 Vdc. CPM12AA4... cable has to be ordered separately.
LPPYRA10S	Spectrally Flat Class A (Secondary Standard) pyranometer according to ISO 9060:2018. Complete with shade disk, cartridge for silica-gel crystals, 2 spare sachets, levelling device, M12 8-pole connector and Calibration Report. RS485 Modbus-RTU output. Power supply 5...30 Vdc. CPM12-8D... cable has to be ordered separately.
LPPYRA10S12	Spectrally Flat Class A (Secondary Standard) pyranometer according to ISO 9060:2018. Complete with shade disk, cartridge for silica-gel crystals, 2 spare sachets, levelling device, M12 8-pole connector and Calibration Report. SDI-12 output. Power supply 7...30 Vdc. CPM12-8D... cable has to be ordered separately.
LPSP1	UV-resistant shade disk.
LPS1	Fixing bracket for the pyranometer, suitable for Ø 40 ÷ 50 mm mast. Installation on horizontal or vertical mast.
LPRING02	Base with levelling device and adjustable holder for mounting the pyranometer in an inclined position (specify upon ordering on which pyranometer model has to be mounted).
LPRING04	Adjustable holder for mounting the pyranometer in an inclined position on Ø 40 mm mast with internal thread.
HD2003.79K	Kit to mount the pyranometer on Ø40 mm clamping. To install the pyranometer on a transverse mast.



HD2003.85K	Kit with adjustable height to mount the pyranometer on a Ø40 mm mast.
LPS6	Kit for the installation of the pyranometer, including: 750 mm mast (HD2003.83.1), base fitting (LPS6.04), graduated support plate (LPS6.01), bracket for pyranometers (LPS6.03).
CPM12AA4.2	Cable with 4-pole M12 connector on one end, open wires on the other end. Length 2 m.
CPM12AA4.5	Cable with 4-pole M12 connector on one end, open wires on the other end. Length 5 m.
CPM12AA4.10	Cable with 4-pole M12 connector on one end, open wires on the other end. Length 10 m.
CPM12-8D.2	Cable with 8-pole M12 connector on one end, open wires on the other end. Length 2 m.
CPM12-8D.5	Cable with 8-pole M12 connector on one end, open wires on the other end. Length 5 m.
CPM12-8D.10	Cable with 8-pole M12 connector on one end, open wires on the other end. Length 10 m.
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.
LPSG	Cartridge with desiccant silica-gel crystals, complete with O-ring and cap.
LPG	Pack of 5 sachets of silica-gel crystals.
LPRING12	Ring base for measuring the diffused radiation.

DELTA OHM metrology laboratories LAT N° 124 are ISO/IEC 17025 accredited by ACCREDIA for Temperature, Humidity, Pressure, Photometry / Radiometry, Acoustics and Air Velocity. They can supply calibration certificates for the accredited quantities.



DICHIARAZIONE DI CONFORMITÀ UE
EU DECLARATION OF CONFORMITY

Delta Ohm S.r.L. a socio unico – Via Marconi 5 – 35030 Caselle di Selvazzano – Padova – ITALY

Documento Nr. / Mese.Anno: **5107 / 05.2018**
Document-No. / Month.Year :

Si dichiara con la presente, in qualità di produttore e sotto la propria responsabilità esclusiva, che i seguenti prodotti sono conformi ai requisiti di protezione definiti nelle direttive del Consiglio Europeo:
We declare as manufacturer herewith under our sole responsibility that the following products are in compliance with the protection requirements defined in the European Council directives:

Codice prodotto: **LPPYRA10 – LPPYRA10AC – LPPYRA10AV**
Product identifier : **LPPYRA10S – LPPYRA10S12**

Descrizione prodotto: **Piranometro**
Product description : **Pyranometer**

I prodotti sono conformi alle seguenti Direttive Europee:
The products conform to following European Directives:

Direttive / Directives	
2014/30/EU	Direttiva EMC / EMC Directive
2014/35/EU	Direttiva bassa tensione / Low Voltage Directive
2011/65/EU	RoHS / RoHS

Norme armonizzate applicate o riferimento a specifiche tecniche:
Applied harmonized standards or mentioned technical specifications:

Norme armonizzate / Harmonized standards	
EN 61010-1:2010	Requisiti di sicurezza elettrica / Electrical safety requirements
EN 61326-1:2013	Requisiti EMC / EMC requirements
EN 50581:2012	RoHS / RoHS

Il produttore è responsabile per la dichiarazione rilasciata da:
The manufacturer is responsible for the declaration released by:

Johannes Overhues

Amministratore delegato
Chief Executive Officer

Caselle di Selvazzano, 14/05/2018

Questa dichiarazione certifica l'accordo con la legislazione armonizzata menzionata, non costituisce tuttavia garanzia delle caratteristiche.
This declaration certifies the agreement with the harmonization legislation mentioned, contained however no warranty of characteristics.

note: subject to change without any notice, JDA pay no responsibility



GUARANTEE

TERMS OF GUARANTEE

All DELTA OHM instruments are subject to accurate testing, and are guaranteed for 24 months from the date of purchase. DELTA OHM will repair or replace free of charge the parts that, within the warranty period, shall be deemed non efficient according to its own judgement. Complete replacement is excluded and no damage claims are accepted. The DELTA OHM guarantee only covers instrument repair. The guarantee is void in case of incidental breakage during transport, negligence, misuse, connection to a different voltage than that required for the appliance by the operator. Finally, a product repaired or tampered by unauthorized third parties is excluded from the guarantee. The instrument shall be returned **FREE OF SHIPMENT CHARGES** to your dealer. The jurisdiction of Padua applies in any dispute.



The electrical and electronic equipment marked with this symbol cannot be disposed of in public landfills. According to the Directive 2011/65/EU, the european users of electrical and electronic equipment can return it to the dealer or manufacturer upon purchase of a new one. The illegal disposal of electrical and electronic equipment is punished with an administrative fine.

This guarantee must be sent together with the instrument to our service centre.

IMPORTANT: Guarantee is valid only if coupon has been correctly filled in all details.

Instrument Code: LPPYRA10...

Serial Number _____

RENEWALS

Date	Date
Inspector	Inspector
Date	Date
Inspector	Inspector
Date	Date
Inspector	Inspector



note: subject to change without any notice, JDA pay no responsibility