Environmental Analysis

HD 9408T BARO
HD 9408TR BARO
HD 9908T BARO

HD 9408T BARO, HD 9408TR BARO, HD 9908T BARO BAROMETRIC TRANSMITTERS

HD 9408T BARO, HD 9408TR BARO and **HD 9908T BARO** are analog output electronic barometers. They use a piezoresistive sensor element which gives extremely accurate and stable measurement of the atmospheric pressure and assures excellent repeatability, low hysteresis and very good temperature stability. The output signal of the sensor is conditioned to provide a voltage or a current output linearly proportional to the barometric pressure. The transmitters are ready as they have been calibrated at the factory. A zero adjustments potentiometer is available for offset to station elevation.

HD9408T BARO requires a continuous dc power supply, its low power consumption (< 4 mA) makes it ideal for portable and remote battery or solar powered applications. It is available in different kinds of analog output: 0-1 Vdc, 0-5 Vdc (1-5 Vdc, 1-6 Vdc on request) or 4-20 mA (two wires).

HD 9408TR BARO offers superior temperature performance: the internal circuitry allows the sensor to work at constant temperature so that it achieves accurate temperature compensation over the whole range from -40°C to +60°C.
HD 9408TR BARO requires a continuous dc power supply and a differential cabling connection to achieve best results. It is available in different output versions: 0÷1 Vdc, 0÷5 Vdc (1÷5 Vdc, 1÷6 Vdc on request).

HD 9908T BARO, unlike the other models, is equipped with a display showing the pressure measurements, an analog output 0÷20 mA, 4÷20 mA, 0÷1 V and 0÷5 V (0÷10 V on request) configurable by the customer and with an ON/OFF relay output with programmable alarm threshold.
HD 9908T BARO requires a 24 Vac (or 220 Vac on request) power supply.

HD 9408T BARO, HD 9408TR BARO and **HD 9908T BARO** are low cost and excellent performance solutions for meteorological applications, environmental monitoring systems, metrological and environmental data logging, altitude applications, barometric pressure compensation in the performance of internal combustion engine, cleanroom barometric pressure compensation, testing of vehicle emissions.

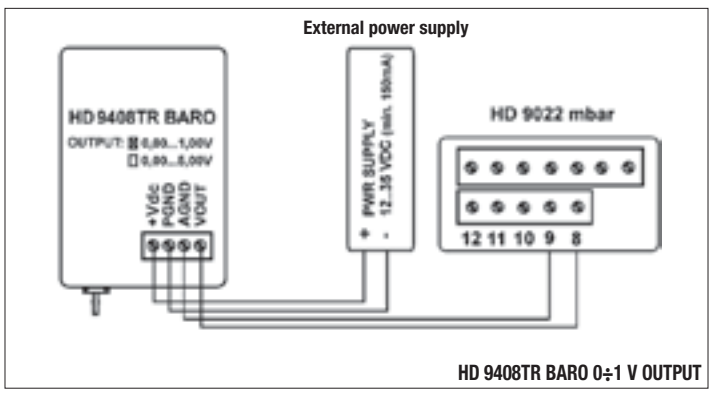
HOUSING AND INSTALLATION

In all models the sensor electronics are housed in a sturdy MACROLON with IP67 protection. Opening the lid holes are available that allow you to secure the base of the transmitter directly to a panel or a wall. The measurement accuracy is independent of the position of the transmitter. However, it is advisable to mount the transmitter so that the sensor is facing down to reduce dust and dirt on the filter. If the installation is in an open environment is recommended to use a special static port to minimize errors caused by the wind flow on the input pressure.

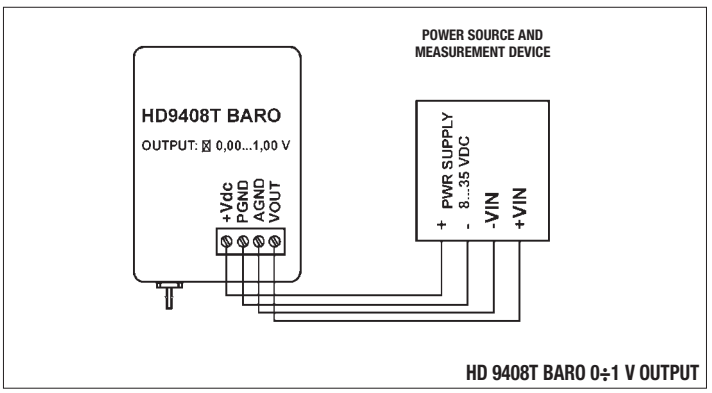
CONNECTION DIAGRAM AND OPERATION

- Make the power connections for the HD 9908T BARO.
- Make the connections for the relay output, the relay contact is free.
- Select the analog output 0÷20 mA, 4÷20 mA, 0÷1 V, 0÷5 V by means of the jumper.
- Switch on the instrument, press the PUSH button and turn the SET trimmer to set the desired threshold value between 800 and 1100 mbar; the set value is shown on the LCD display.
- Using the trimmer , set the desired HYS (=hysteresis) value between 5 and 50 mbar.
- The instrument will now indicate the barometric pressure; HI led, LO led or ALARM led and ALARM relay will switch on if one the following cases occurs (see table 1).
  NOTE: the ALARM led comes on to indicate that the relay is energized and the contact is closed.
- **Once installation is completed, check that the cover is tightly closed; the same applies to the grommets.**

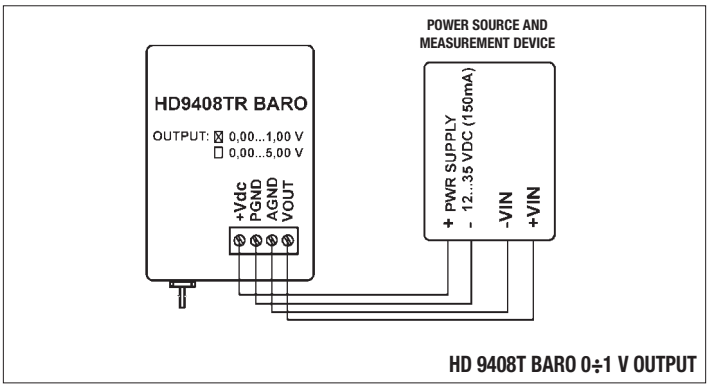
TABLE 1	HI	LO	ALARM LED
MEASURE > SET, MEASURE < SET + HYS	ON	OFF	OFF
MEASURE > SET, MEASURE > SET + HYS	ON	OFF	ON
MEASURE < SET, MEASURE > SET - HYS	OFF	ON	OFF
MEASURE < SET, MEASURE < SET - HYS	OFF	ON	ON



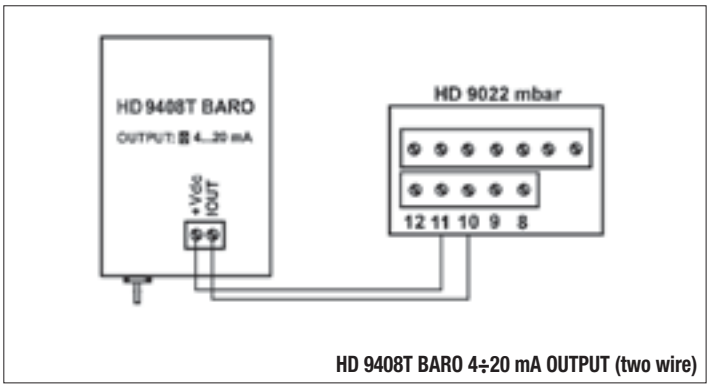
HD 9408TR BARO 0÷1 V OUTPUT



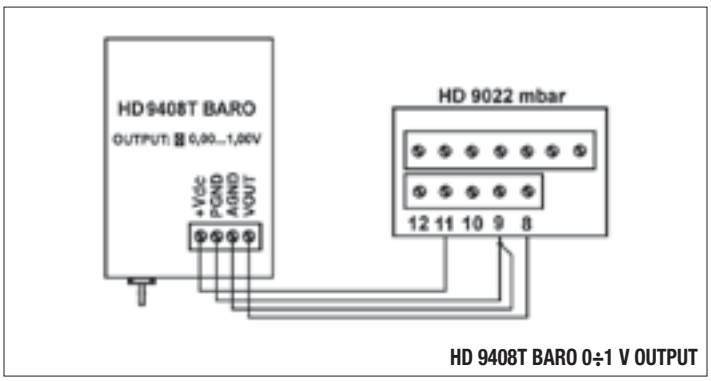
HD 9408T BARO 0÷1 V OUTPUT



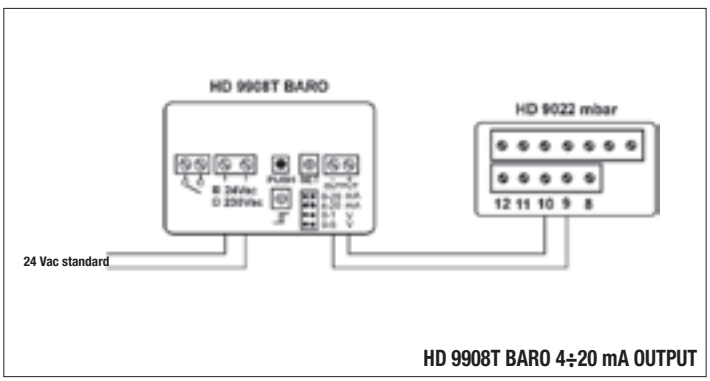
HD 9408T BARO 0÷1 V OUTPUT



HD 9408T BARO 4÷20 mA OUTPUT (two wire)



HD 9408T BARO 0÷1 V OUTPUT



HD 9908T BARO 4÷20 mA OUTPUT

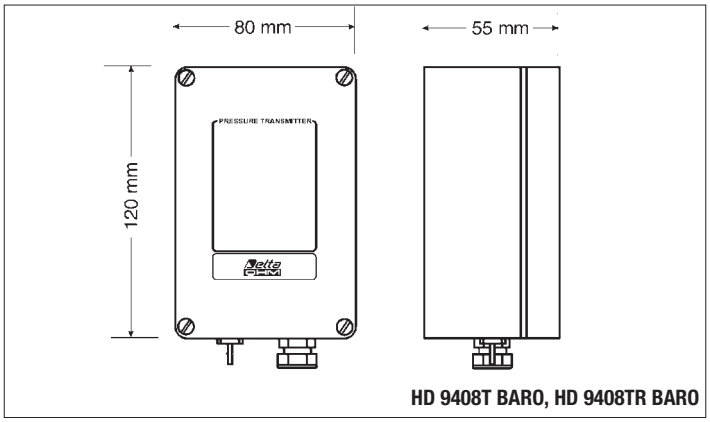
	HD9408T BARO	HD9408TR BARO	HD9908T BARO
Sensor type	Piezoresistive diaphragm		
Measuring range	800 ÷ 1100 mbar / 600 ÷ 1100 mbar on request		
Analog output	0 ÷ 1 Vdc standard; 0 ÷ 5 Vdc, 1 ÷ 6 Vdc and 4 ÷ 20 mA (two wires) on request	0 ÷ 1 Vdc standard; 0 ÷ 5 Vdc, 1 ÷ 5 Vdc and 1 ÷ 6 Vdc on request	0 ÷ 20 mA, 4 ÷ 20 mA, 0 ÷ 1 V and 0 ÷ 5 V (0 ÷ 10 V on request), configurable by means of a jumper.
Accuracy	± 0.5 mbar, @ 20°C	± 0.5 mbar, @ 20°C	Display: ± 1 mbar, @20°C Analog output: ± 0,8 mbar, @ 20°C
Resolution	Infinite	Infinite	Display: 1 mbar Analog output: Infinite
Thermal effects	< 1% F.S., zero; <1% F.S., span over –20°C to +60°C (-4° to 140°F)	± 0.8 mbar over –40°C to +60°C (-40° to 40°F)	< 1% F.S. zero, <1% F.S. span over –20°C to +60°C (-4° to 140°F)
Long term stability	< 0.25 % F.S. over 6 months at 20°C	< 0.2 % F.S. over 6 months at 20°C	< 0.25 % F.S. over 6 months at 20°C
Turn on time	1 sec. to 99% of full scale reading	5 min @ 24 Vdc supply to 99% of full scale reading	5 sec. to 99% of full scale reading
Response time	< 200 msec. after pressure stabilization		
Relay contact output	---	---	3A/230 Vac resistive load
Set point	---	---	Configurable from 800 to 1100 mbar
Supply Voltage	8 ÷ 35 Vdc	12 ÷ 35 Vdc	24 Vac ±10% (230 Vac on request)
Supply current	< 4 mA	25 mA @ 20°C, 24 Vdc (warm-up 120 mA)	1VA
Operating Temperature	-30 ÷ +60°C	-40 ÷ +60°C	-20 ÷ +60°C
Media ompatibility	Air and dry gases only		
Overload pressure	2bar -30 psi		

ORDERING CODE

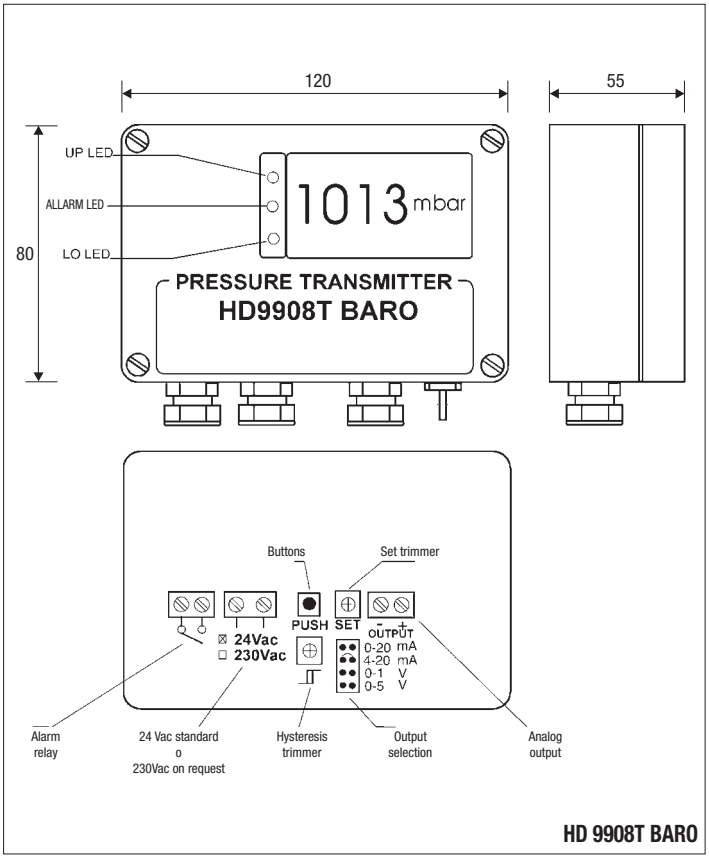
HD9408T BARO 800÷1100mbar barometric transmitter output 0÷1Vdc. Upon request output: 0÷5Vdc, 1÷6Vdc, 4÷20mA. Working temperature range -30°C ÷ +60°C.

HD9408TR BARO 800÷1100mbar barometric transmitter output 0÷1Vdc. Upon request output 0÷5Vdc, 1÷5Vdc. Temperature working range –40°C ÷ +60°C, heated sensor

HD9908T BARO 800÷1100mbar digital barometric transmitter with LCD indication. Outputs: 0÷20mA, 4÷20mA, 0÷1Vdc, 0÷5Vdc. Working temperature range -20°C ÷ +60°C.

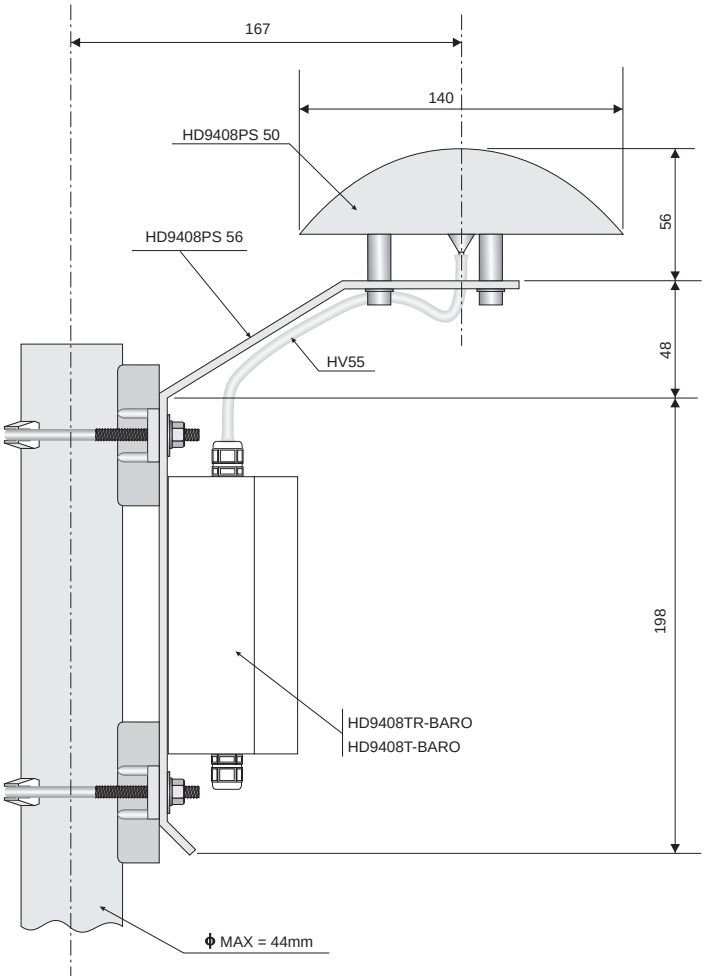


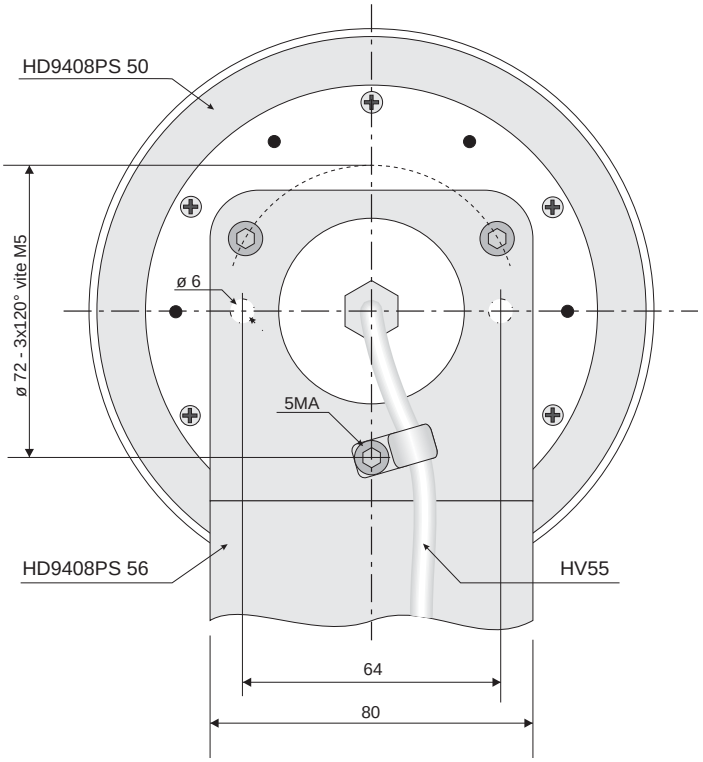
HD 9408T BARO, HD 9408TR BARO



HD 9908T BARO

HD9408PS 50





HD9408PS 50
STATIC PORT FOR BAROMETRIC MEASUREMENTS

The measurement of the barometric pressure in free field can give incorrect values of hundred pascal fluctuation and wind direction. With the static port for barometric measurements, HD9408PS 50 can minimize these errors because, in addition to act as a filter (brake) against the dynamic pressure of the wind, the barometer can operate correctly even in the presence of snow or ice and comply with the recommendations of the WMO (World Meteorological Organization). The materials used for th construction of the static are UV resistant and can operate in temperatures between -40°C and +80°C.

INSTALLATION AND CONNECTION

Installation is simple: it must be installed away from buildings, trees or any other source which can disrupt the flow of wind. To install the bracket is available HD9408PS 56 and three stainless steel screws M5x16 Acc. The connection of the static to the barometer, for example, HD9408T or HD9408TR, is made with a special tube HV55 (internal diameter of 3mm, 6mm outer diameter) and UV resistant to climate changes. Maintenance or cleaning is minimal. The plastic parts are manufactured by BASF LURAN S777K. Clean using non aggressive detergents compatible with the material.

TECHNICAL SPECIFICATIONS

According to recommendations of the WMO, the deviation allowed measurement of wind speed 20meters/second is equal to 0.3mbar, corresponding to 300 Pascal. The HD9408PS 50 static port for barometric measurements falls within that value. The following tables show the values obtained from the tests performed in the wind tunnel.

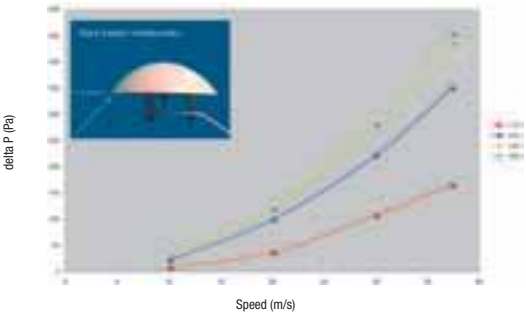
ORDERING CODE

HD9408PS 50K: Kit consists of by static port, pole mounting bracket and HV55 tube
HD9408PS 50: Static port for barometric measurements equipped with the HV55 tube
HD9408PS 56: Mounting bracket for static port, barometer fastening, pole anchor
HV55: UV- and temperature-resistant silicone tube, inside Ø : 3mm, outside Ø : 6mm, L=400mm

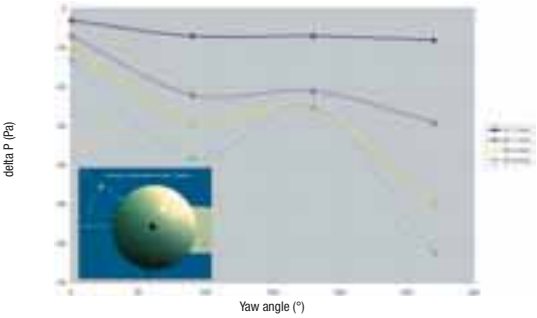
Error due to the dynamic pressure	Lower than 0.3mbar @20°C
Working temperature	-40°C… +80°C
Connection pipe (for a tube with inside ø : 3mm, outside ø: 6mm)	Ø 3.4 mm
Weight of the static port.	200 gr
Weight of the static port equipped with the bracket	570 gr

TESTS MADE IN THE WIND TUNNEL

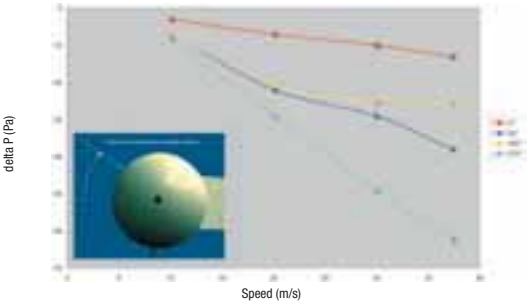
Static port put in front of the wind tunnel



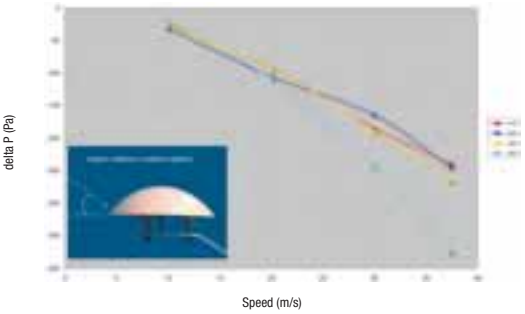
ΔP as a function of speed (yaw angle β = 0°)



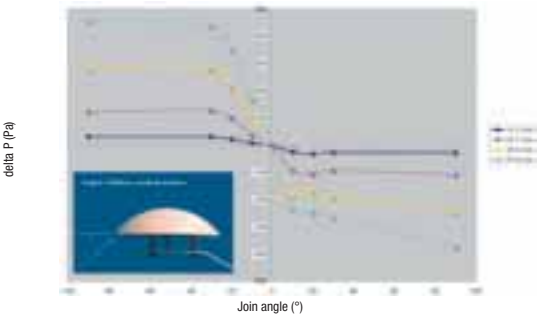
ΔP as a function of yaw angle (join angle α = 0°)



ΔP as a function of speed (join angle α = 0°)



ΔP as a function of speed (yaw angle β = 0°)



ΔP as a function join angle (yaw angle β = 0°)

HD 4V8T Baro
BAROMETRIC TRANSMITTER

Barometric transmitter to wall mount for indoor use, with 0…1 Vdc analog output. Measuring range 600…1100mbar. Power supply 10…40 Vdc. Working temperature -30°C… 60°C. Suitable for installation in the housings for weather stations HD32.35, HD32.35FP, HD32.36 and HD32.36FP.

Technical specifications

Type of sensor	Piezoresistive
Measuring range	600÷1100 mbar
Analog output	0÷1Vdc
Accuracy	±0.5 mbar, @ 20°C
Resolution	Infinite
Temperature drift	<1% F.S., zero; <1% F.S., span from -20°C to +60°C (-4°F to 140°F)
Long term stability	<0.25% F.S. at 6 months at 20°C
Settling Time	1 sec. Al 99% of the measure
Response time	<200ms after pressure stabilization
Power Supply	10÷40 Vdc
Current Supply	< 4 mA
Working temperature	-30 ... +60°C
Compatibility	Dry air and gases, non-corrosive
Overpressure	2 bar – 30 psi
Dimensions	65mm x 58mm x 35mm

HD 9008TRR
HD 9009TRR
HD 9007

HD 9008TRR, HD 9009TRR, HD 9007
TEMPERATURE AND HUMIDITY TRANSMITTERS, MULTIPLATE RADIATION SHIELD

CHARACTERISTICS

The HD9008TRR and HD9009TRR are single block RH and temperature microprocessor transmitters, temperature configurable. The HD9008TRR is a passive transmitter with a 4…20mA output and 10…30Vdc power supply; the HD9009TRR is a transmitter with a 0…1V standard voltage output (other outputs available on demand) and 5…35Vdc power supply. Sensors are mounted at the end of a plastic tube: a capacitive humidity sensor and a Platinum temperature sensor (100Ω @0°C).

The instrument can be reprogrammed by means of a key, and no jumper or potentiometer actions are required. The humidity input can be recalibrated by using two saturated solutions: the first one at 75%, the second one at 33%; the 0%RH…100%RH relative humidity range is fixed, 4mA (or 0Vdc) correspond to 0%RH, 20mA (or 1Vdc) equal 100%RH.

Temperature standard configuration is -40…+80°C for the HD9008TRR and for the HD9009TRR, corresponding to 4…20mA and 0…1Vdc, respectively.

The user can configure the temperature output in ranges different from the standard one by means of a Pt100 simulator or of a set of fixed resistances, provided that it is included in the -40°C…+80°C range with a minimum amplitude of 25°C. Two LEDs give alarm indications (temperature exceeding set range, sensor breakage or short-circuit) and help the operator when programming.

An out-of-standard temperature operating range can be requested when placing the order.

Important Warning: probes work in the -40°C…+80°C temperature range. Outside this range data are not correct; electronics is designed to operate in this range.

SENSORS

The humidity sensor is a condenser which dielectric is made up by an hygroscopic polymer. As water dielectric constant is approximately 80, you'll get a strong change in capacity as the humidity content of this polymer changes. The advantages of this kind of sensor are: good linearity, insensitivity to temperature changes, fast response time and long-lasting life. The sensor temporary looses its accuracy if some condensation develops on its surface (the transmitted value is higher than the real one because of an increase in effective capacity).

The temperature sensor is a Platinum resistance thermometer (100Ω @0°C). The Pt100 resistance variation is transformed into a current or voltage signal, linear to temperature.

SIGNAL TRANSMISSION

The electronic circuit design provides the signal to increase linearly as humidity and temperature raise.

In presence of cables transmitting high currents or machines causing electromagnetic noises, the transmitter connection cables have to be placed in a separate raceway, or far from them, to prevent these noises. It is recommended to use a shielded cable for the connections of instruments having a voltage output (HD9009TRR).

INSTALLATION AND ASSEMBLY

Figures 1 and 2 show the connection diagram of the two models. R_{RH} and $R_{°C}$ represent the current input of any device connected to the 4…20mA loop, that is: an indicator, a controller, a data logger or a recorder. In figure 1, "Vin%RH and Vin°C" symbols have the same meaning.

Accuracy in measuring does not depend on the transmitter position. However, it is suggested to install the transmitter with the sensor faced downwards (where possible) to reduce dust deposit on the sensor protection filter. The transmitter shall not be mounted next to doors, in draughtiness, in areas with scarce air circulation, or near a heat source, as heating air involves a decrease of relative humidity (the quantity of available water vapour being equal).

Protection degree: IP54.

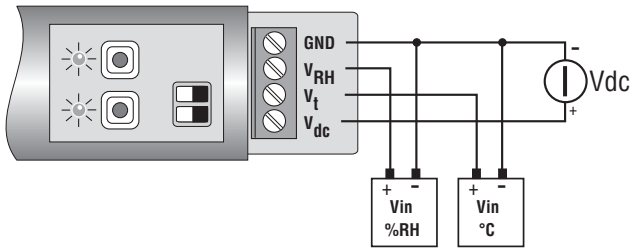


Fig. 1

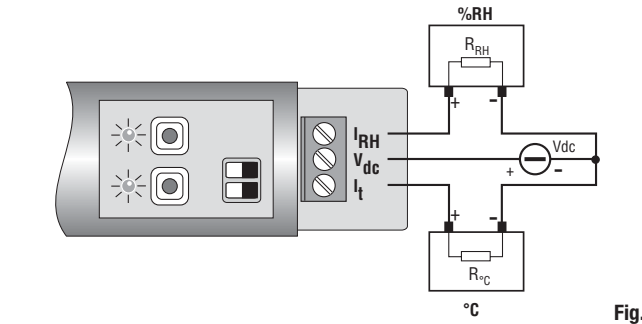


Fig. 2

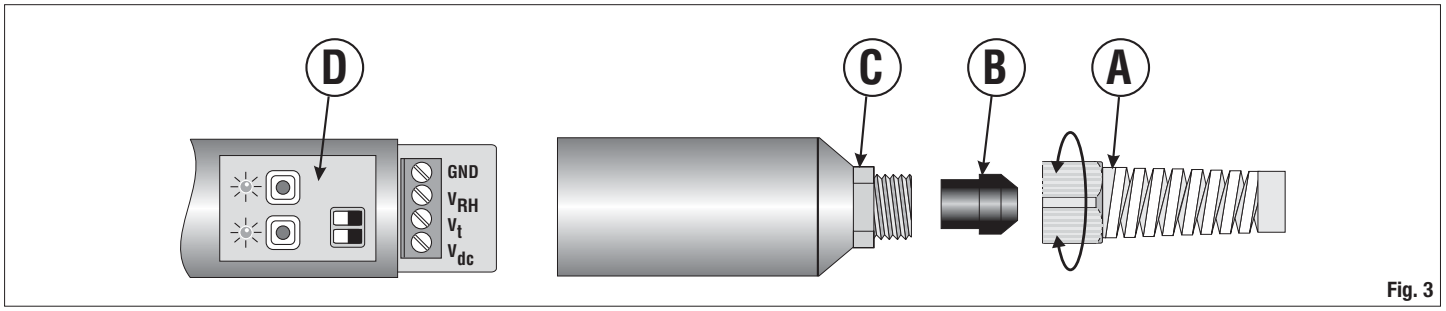


Fig. 3

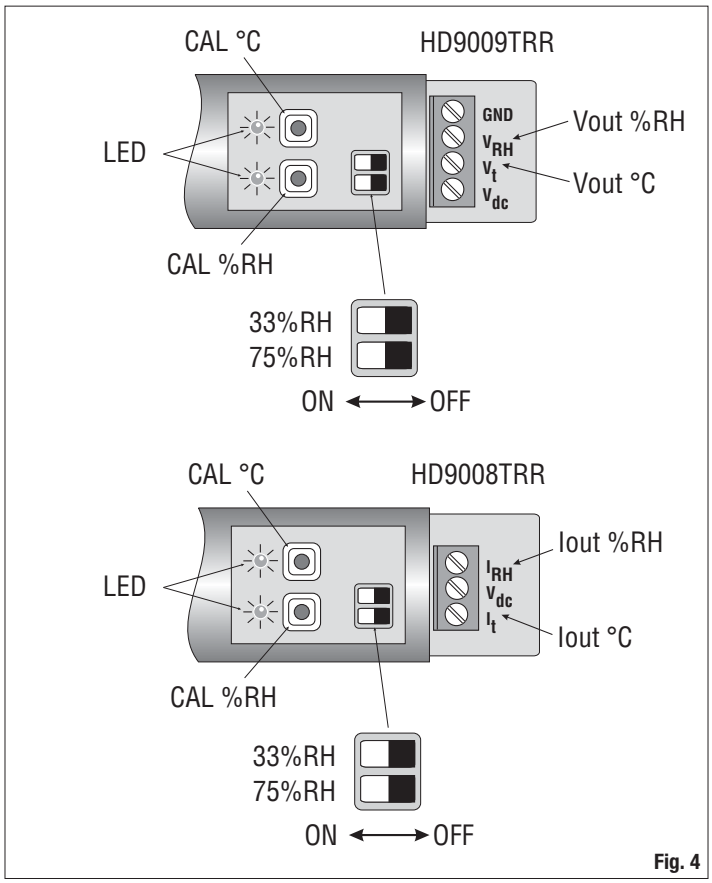


Fig. 4

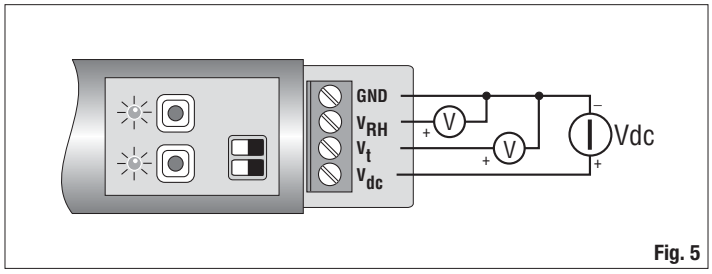


Fig. 5

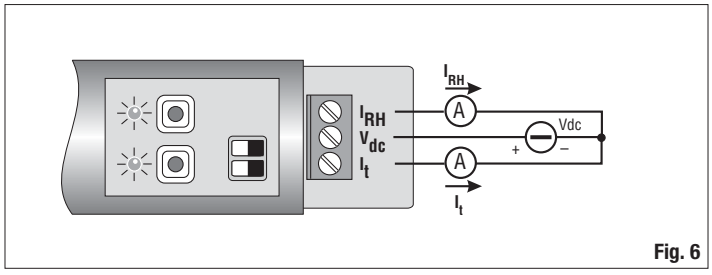


Fig. 6

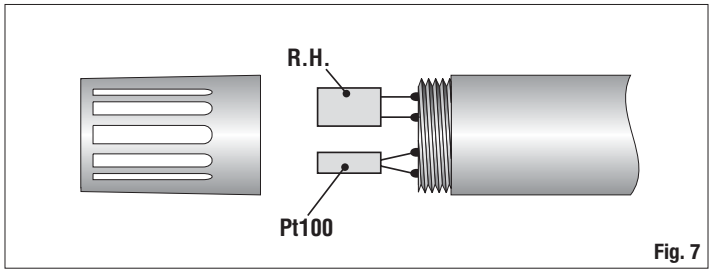


Fig. 7

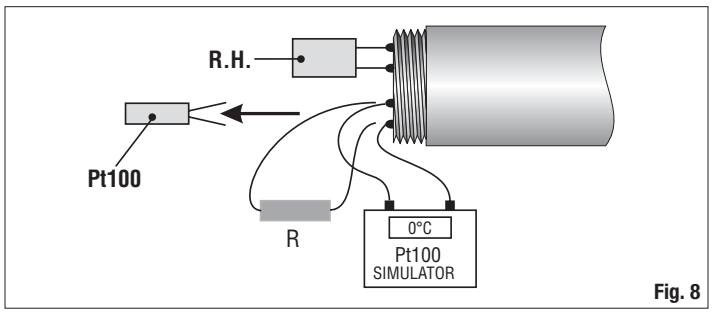


Fig. 8

Ensure that the sensor is compatible with the atmosphere where it is installed.
Follow these procedures to access the transmitter terminal board (see fig.3):
Unscrew grommet "A", take off rubber bulb "B" and unscrew bottom "C". Insert the cable through A, B and C elements and connect it to the terminal board. Hold the cable firmly while screwing grommet "A" to avoid twisting.

PROGRAMMING
HD9008TRR and HD9009TRR relative RH and temperature transmitters are factory calibrated. The HD9008TRR is provided with a 4…20mA current output, while the HD9009TR with a 0…1Vdc voltage output.
In the HD9008TRR standard configuration, 4mA correspond to 0%RH and -40°C, while 20mA equal 100%RH and +80°C.
In the HD9009TRR one, 0Vdc corresponds to 0%RH and -40°C, while 1Vdc equals 100%RH and +80°C.
The user can re-calibrate the RH probe holding the 0%…100%RH range and setting a different range for temperature, as long as it is within -40 and +80°C limits.
Figure 4 shows the transmitter programming elements.

Humidity Sensor Calibration
The following accessories are needed.
HD9008TRR model: a 5…35Vdc continuous voltage power supply, a precision ammeter with a 0…25mA min. range.
HD9009TRR: a 5…35Vdc continuous voltage power supply, a precision voltmeter with a 0…1Vdc min. range.
The calibration of the humidity sensor is carried out at two fixed points: at 75.4%RH - **always as first point** - and at 33%RH - second point.

Procedure:
1. To access the panel board, unscrew grommet "A" (see fig. 3) and hold the cable firmly to avoid twisting. Take off the rubber bulb and unscrew the bottom of the instrument.
2. Connect the wires to provide the instrument with power supply, as shown in the connection diagrams (Fig. 5: HD9008TRR and Fig.6: HD9009TRR).
3. Insert the probe in the container with the saturate solution at 75%RH and wait **30 minutes at least.** Probes and solutions have to be at the same temperature.
4. Turn 75%RH dip-switch on ON.
5. Press the CAL%RH little key and **hold it down for 5 seconds, at least,** until the corresponding LED does not flash. Now the little key can be released: the LED will remain on. A built-in sensor compensates the temperature difference of the solution compared with 20°C.
6. Turn the 75%RH dip-switch on OFF.
7. Put the probe in the container with the saturate solution at 33%RH and **wait for 30 minutes, at least.** Probes and solutions have to be at the same temperature.
8. Turn the 33%RH dip-switch on ON.
9. Press the CAL%RH small key and **hold it down for 5 seconds, at least,** until the corresponding LED is not off. Now the little key can be released.
   If the solution is at 20°C, the output will equal 9.28mA (in HD9008TRR model) and 0.330V (in HD9009TRR model).
10. Turn the 33%RH dip-switch on OFF again.
11. Re-close the instrument: re-screw the bottom, put the rubber bulb again at its place and screw the grommet: hold the cable firmly to avoid twisting it.
12. The calibration of the RH probe is finished.

Important Note: the first calibration point has to be always at 75%RH

Programming of Temperature Operating Range
The following accessories are needed.
For HD9008TRR: a 10…30Vdc continuous voltage power supply, a precision ammeter with 0…25mA minimum range.
For HD9009TRR: a 5…35Vdc continuous voltage power supply, a precision voltmeter with 0…1Vdc minimum range.
Pt100 simulator or a set of precision resistances.

Procedure:
1. To access the panel board, unscrew grommet "A" (see figure 3) and hold the cable firmly to avoid twisting. Take the rubber bulb off and unscrew the bottom of the instrument.
2. Unscrew the sensor protection filter.
3. Unsolder the Pt100 sensor (the narrowest one) and in place of it, solder the output wires or those of a Pt100 simulator or of a precision resistance, as shown in figures 7 and 8. Then wait a few seconds for the junction to get cold.
4. Set the Pt100 simulator at the temperature corresponding to the scale upper value. For example, if you want to configure the -10°C…+80°C range, the simulator has to be set at -10°C; the equivalent resistance value will be 96.09Ω. If the calibration is carried out with a fixed resistance, connect a 96.09Ω fixed resistance to the terminals to which the sensor was soldered.
5. Wait 10 seconds until the measurement becomes steady, **press the "CAL °C" key** (calibration) **and hold it down for min. 5 seconds,** until the LED first flashes (once) and then remains on.
6. Set the Pt100 simulator at the temperature value provided for the full scale. According to the above example, the simulator will be set at +80°C; the equivalent resistance value will be 130.89Ω; if the calibration is carried out with a fixed resistance, a 130.89Ω fixed resistance will have to be connected to the terminals to which the sensor was soldered.
7. Wait 10 seconds until the measurement becomes steady, **press the "CAL °C" key** (calibration) **and hold it down for min. 5 seconds,** until the LED is off. **When you**

release the key, the LED will flash twice to confirm that programming took place. Now the procedure is over.

8. Check that the configuration corresponds to the requested specifications, by setting the simulator (or connecting the precision resistances) at the values corresponding to the upper and full scale value and by checking the output with the ammeter (HD9008TRR) or with the voltmeter (HD9009TRR).
9. Solder again the temperature sensor.
10. Insert again the sensor protection filter, screw the bottom, put the rubber bulb again at its place and screw the grommet holding the cable firmly to avoid twisting.
11. The temperature output programming is over.

Saturate reference solutions are available for RH calibration. Calibration is suggested every 12/18 months for instruments with continuous operation, according to the environment they are working in. **Check that the sensor and the atmosphere where it is employed be compatible, above all in case of aggressive environments** (they might corrode the sensor).

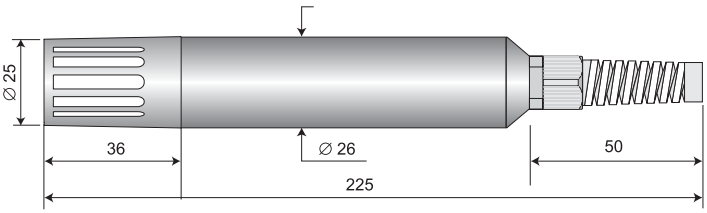
TECHNICAL DATA		HD9008TR	HD9009TR
Electronics Working Temperature		-40…+80°C	
Sensor Working Temperature		-40…+80°C	
Transmitter Power Supply		10...30Vdc (4…20mA)	5…35Vdc (2mA)
HUMIDITY	Capacity	300 pF typ.	
	Measuring Range	0…100%RH	
	Accuracy at 20°C	±1.5%RH (0…90%RH) ±2.0%RH (for the remaining range values)	
	Response time at 63% of final variation	3 min. with filter; 6s without filter no thermal shock	
	Output Signal	0%RH = 4.0mA 100%RH = 20.0mA	0%RH = 0.00 Vdc 100%RH = 1.00 Vdc (*)
	Load Resistance	$R_{Lmax}=\frac{(Vcc-10)}{22mA}$	R_{inMIN}=10kΩ
TEMPERATURE	Measuring Range - Standard Configuration - (**)	-40…+80°C	-40…+80°C
	Accuracy	±0.15°C ±0.1% of measurement	
	Response time at 63% of final variation	3 Minutes; 6s without filter	
	Output Signal	-40°C = 4.0mA +80°C = 20.0mA	-40°C = 0.00 Vdc +80°C= 1.00 Vdc (*)
	Load Resistance	$R_{Lmax}=\frac{(Vcc-10)}{22mA}$	R_{inMIN}=10kΩ
Dimensions		Ø 26 x 225mm	
Cable Dimensions			
Maximum Length (***)		200m	10m
Wire Min. Section		20 AWG - 0.5mm²	20 AWG - 0.5mm²
Cable Max. Diameter		Ø5mm	Ø5mm

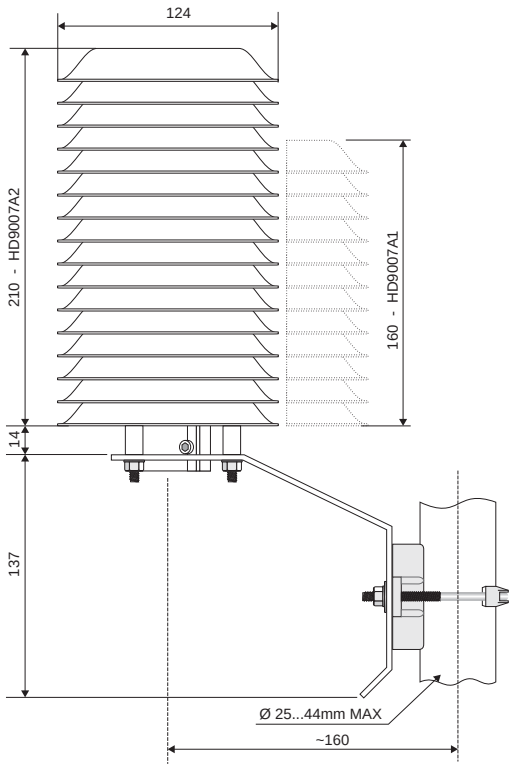
(*) For HD9009TRR models, 0…5Vdc, 1…5Vdc, 0…10Vdc voltage outputs can be provided on ordering for at least 5 pcs.
(**) Out-of-standard measuring ranges have to be requested when ordering or have to be re-programmed with a Pt100 simulator.
(***) Use screened cables.

HD9007
MULTIPLATE RADIATION SHIELD

Characteristics
Luran S777K (BASF) antistatic UV-resistant thermoplastic material with low thermal conductivity and high reflection.
White power-painted, anticorodal aluminium support bracket. Stainless steel U-bar mounting bracket for shafts from 25 to 44mm.
Dimensions: external Ø : 124 mm.
Height, excluding bracket: HD9007 A1: 190 mm, weight: 640 gr.
HD9007 A2: 240 mm, weight: 760 gr.
Sensor fixing ring nuts: Ø 25 mm ÷ Ø 27 mm
HD9007 ring-shield is suitable to protect temperature and RH/temperature sensors used in weather stations from solar radiations, rain and wind.

ORDERING CODES
HD9008TRR: Dual passive RH and temperature microprocessor transmitter 4…20mA outputs in 0…100%RH and -40…+80°C ranges.
HD9009TRR: dual RH and temperature microprocessor transmitter. 0…1V output in 0…100%RH and -40…+80°C ranges.
HD9008.1: Meteorological **relative humidity** transmitter. Measuring range 0…100%RH. 4mA correspond to 0%RH and 20mA to 100%RH. **Power supply 10…40Vdc**. Probe Ø 26mm, L=185mm.
HD9008TR.1: Dual temperature and relative humidity transmitter. Measuring range 0…100%RH. **Temperature measurement with 2-wire Pt100 sensor.** 4mA correspond to 0%RH and 20mA to 100%RH. **Power supply 10…40Vdc**. Probe Ø 26mm, L=185mm.
HD9008TR.2: Dual temperature and relative humidity transmitter. Measuring range 0…100%RH. **Temperature measurement with 4-wire Pt100 sensor.** 4mA correspond to 0%RH and 20mA to 100%RH. **Power supply 10…40Vdc**. Probe Ø 26mm, L=185mm.
HD9009TR.1: Dual temperature and relative humidity transmitter. Measuring range 0…100%RH. **Temperature measurement with 2-wire Pt100 sensor.** 0Vdc correspond to 0%RH and 1Vdc 100%RH. **Power supply 5…35Vdc**. Probe Ø 26mm, L=185mm.
HD9009TR.1: Dual temperature and relative humidity transmitter. Measuring range 0…100%RH. **Temperature measurement with 4-wire Pt100 sensor.** 0Vdc correspond to 0%RH and 1Vdc 100%RH. **Power supply 5…35Vdc**. Probe Ø 26mm, L=185mm.
HD9007 A1: 12-ring protection L=190 mm complete with mounting brackets.
HD9007 A2: 16-ring protection L=240 mm complete with mounting brackets.
HD75: Saturated salt solution 75% R.H. with adapter M 24x1,5
HD33: Saturated salt solution 33% R.H. with adapter M 24x1,5
HD9008.21.1: Holder for vertical sensor, wall distance 250mm, hole Ø 26.
HD9008.21.2: Holder for vertical sensor, wall distance 125mm, hole Ø 26.

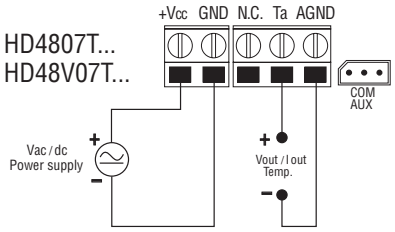




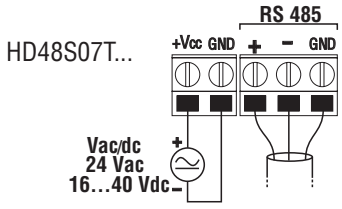
HD4807TFP…, HD48V07TFP…, HD48S07TFP… HD4907TFP… ACTIVE AND PASSIVE TEMPERATURE TRANSMITTERS FOR SOLAR PANELS

HD48… active and **HD49..** passive temperature transmitters complete with **contact temperature probe for solar panels** with 5 or 10m cable, 1/3DIN thin-film Pt100 sensor.
HD48…is available with active 4…20mA or 0…10V analogue output, or with the only RS485 MODBUS-RTU output.
HD49… is available with passive 4..20mA output. Versions with analogue output provide a signal suitable to be transmitted to a remote display, a recorder or a PLC. The versions with RS485 output are suitable for connection to a PC or a PLC.
Probe operating temperature: 0…+80°C. Also available with LCD (option L).
Working temperature of the electronics: -5°C…+60°C.
Power supply: 16…40Vdc or 24Vac for models HD48…, 12…40Vdc for models HD49…
Upon request, HD48… can be provided for 90…240Vac power supply, but only in 80x120mm housing, height 56mm, without display.

Electrical connections
HD48.. series with analogue output
Power the instrument as shown in the below connection schemes, the power supply terminals are marked as +Vcc and GND.
The output signal is available between Ta and AGND terminals for the transmitters of the HD4807T..and HD48V07T… series.

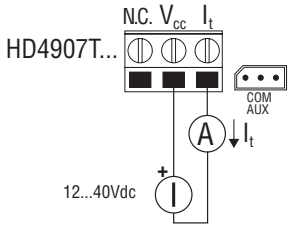


HD48…series with RS485 output
Connect the instrument as shown in the below connection schemes, the power supply terminals are marked as +Vcc and GND.



Thanks to the RS485 output, several instruments can be connected to form a network. The instruments are connected in a sequence through a shielded cable with twisted pair for signals and a third wire for the mass.

HD49… series
Follow the connection schemes shown below, the maximum load resistance that can be connected to each 4…20mA output depends on the power supply Vcc applied, according to the relation:
RLMax = (Vcc-12)/0.022, e.g. if Vcc=24Vdc the max load is RLMax =545 ohm



ORDERING CODES

HD48 ☐ **07TFP** ☐ [L] — **L=** with LCD display

Cable length
5 = 5m
10 = 10m

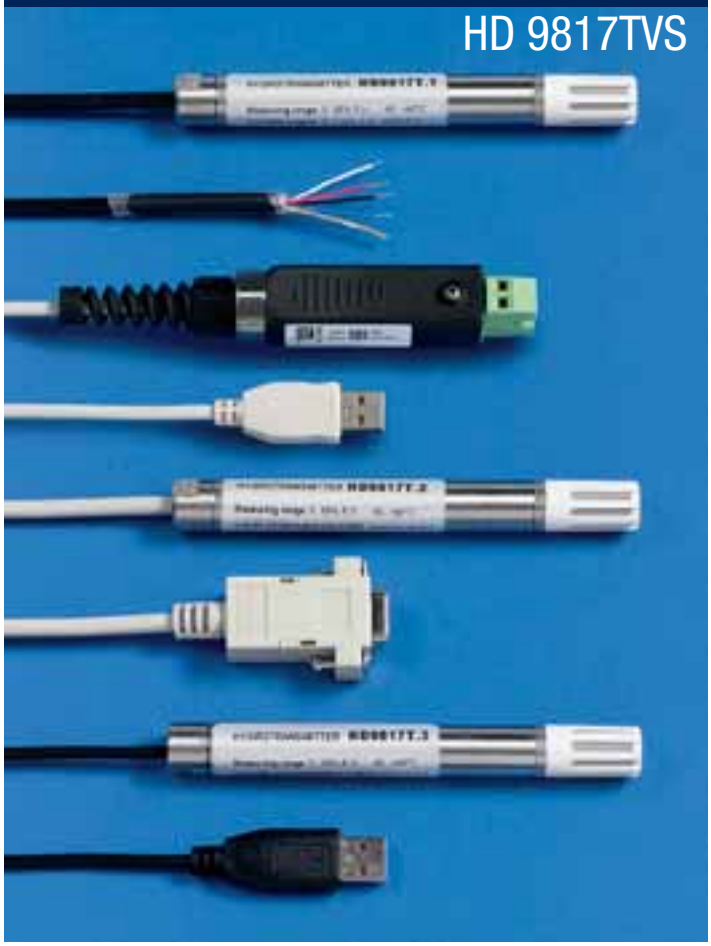
Blank = 4…20mA analog output
V = 0…10Vdc analog output
S = RS485 MODBUSRTU output only

HD4907TFP ☐ [L] — **L =** with LCD display

Cable length
5 = 5m
10 = 10m

CP 27: Serial connection cable with USB connector for PC and 3-pole connector for COM AUX port. The cable has a built-in USB/RS232 converter and connects the transmitter directly to the USB port of the PC. The cable is suitable only for the models with analog output.
HD 48TCAL: The kit includes the **CP27** serial connection cable and the CD-ROM **HD4817CAL**: for Windows® operating systems for the configuration of the transmitters with analog output. The cable has USB connector for PC and 3-pole connector for transmitter COM AUX port.
RS 48: Cable for RS485 connection with built-in USB/RS485 converter. The cable has USB connector for PC and 3 separate wires for the instruments. The cable is suitable for the models with RS485 output only.
HD 48STCAL: The kit includes the **RS48** connection cable and the CD-ROM **HD4817CAL**: for Windows® operating systems for the configuration of the transmitters with RS485 output. The CD also includes a software for the Modbus connection. The cable has USB connector for PC and 3 separate wires for the instruments.
HD 4817CAL: Further copy of the CD-ROM with the software HD4817CAL for the configuration of the transmitters. For Windows® operating systems.

HD 9817T1R
HD 9817T2R
HD 9817T3R
HD 9817TVS



HD 9817T1R, HD 9817T2R, HD 9817T3R, HD9817TVS TEMPERATURE AND HUMIDITY TRANSMITTERS WITH ANALOG OR DIGITAL OUTPUT RS232, USB OR RS485 MODBUS-RTU

Dual relative humidity and temperature transmitter for HVAC applications, environmental monitoring, pharmaceutical storage, food transport, greenhouse automation, etc. Equipped with an IP65 stainless steel AISI 304 housing, it is suitable even for severe environments; besides, its ultra-compact dimensions (Ø 14 x 133 mm) and wide range of outputs (analogue 0...1V, digital RS232C OR RS485-MODBUS RTU, USB 1.1-2.0) make it ideal for integrating into a variety of OEM applications. It is supplied with the HD9817TC software for reading measurements and calibrating the relative humidity sensor.

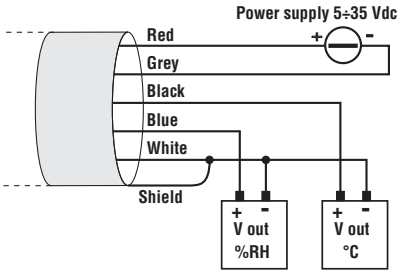
VERSIONS, OUTPUTS AND CONNECTIONS

	HD9817T1R	HD9817T1R.1	HD9817T2R
Output	0...1V = 0…100%RH 0...1V = –40…+60°C		RS232C non insulated, 2400 baud rate
Temperature sensor	Pt100	NTC 10kΩ	Pt100
Load resistance	Rl > 10kΩ		
Cable Connection	L=1,5m (7 wires + shield)		L= 2m DB9 female connector

	HD9817T2R.B	HD9817T3R	HD9817TVS
Output	RS232C non insulated, 2400 baud rate	USB 1.1-2.0 non insulated	0...1V = 0…100%RH or 0...1V = –40…+60°C DP 0..1V = –40…+60°C RS485 Modbus RTU non insulated
Temperature sensor		Pt100	Pt100
Load resitance			R_l > 10kΩ
Cable Connection	L= 2, without connector	L= 2m USB connector type A	M12 8-pole connector. Provided with cable CP9817.3, L=3m

Connections

HD9817T1 and HD9817T1.1 models with 0...1Vdc analogue output.



The instrument is equipped with a 7 wire + shield cable.
The **Yellow** and **Green** wires are used during calibration only for PC connection through the HD9817T.1CAL interface module (see the paragraph about the RH sensor calibration).
Power is supplied to the **Red** (+) and **Grey** (-) wires.
The output signal voltage is taken from:
- **Black** (+) and **White** (-) wires for temperature,
- **Blue** (+) and **White** (-) wires for relative humidity.

The **shield** must be connected to the White wire.

HD9817T2 model with RS232C output and HD9817T3 model with USB output.

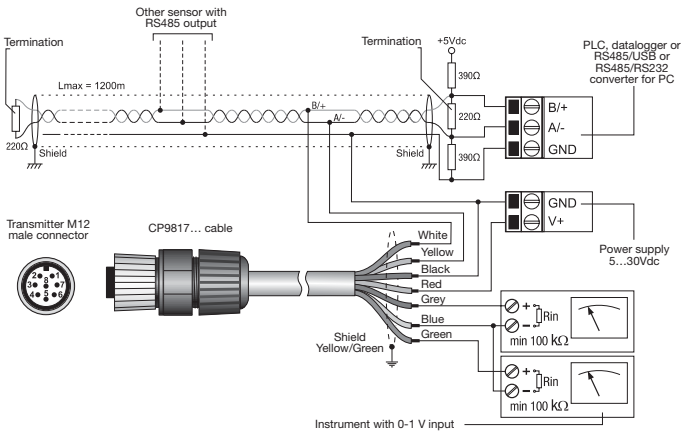
The HD9817T2 cable ends in a RS232C 9-pole subD female connector, while the HD9817T3 cable ends in a USB type A connector.
The following set of commands is available for both instruments.

Command	Response	Description
G0	HD9817T_Pt100_RH_RS232	Model
G3	Firm.Ver.=01-00	Firmware version
HAnn.n	&	75% calibration point where nn.n stands for the actual humidity value
HBnn.n	&	33% calibration point where nn.n stands for the actual humidity value
S0	0072.7 l 063.9	It sends the current measurement (tttt.t l hhh.h) t = temperature h = RH
U0	&	International System of units
U1	&	Imperial units

Note for HD9817T3 model with USB ouput

This model requires that you install USB drivers first in order to ensure a correct PC connection: **don't connect the instrument to your PC before installing the drivers**. For further details, see the guide in the CDRom which is supplied with the instrument.

Wiring diagram of the 0…1Vdc analog outputs and of the RS485 digital output.



Setting parameters for RS485 communication

Before connecting the transmitter to the RS485 network you must assign an address and set the communication parameters if different those preset at the factory.
The setting of the parameters is made by connecting the transmitter to the PC by using the cable **CP24** (optional) with integrated RS485/USB converter or the cable **CP9817.3** supplied with the instrument and a generic RS485/USB or RS485/RS232 converter.

RELATIVE HUMIDITY CALIBRATION

The instruments are supplied factory calibrated and ready to use. The CDRom supplied with the instruments includes a relative humidity calibration procedure. The online help describes this procedure in detail.

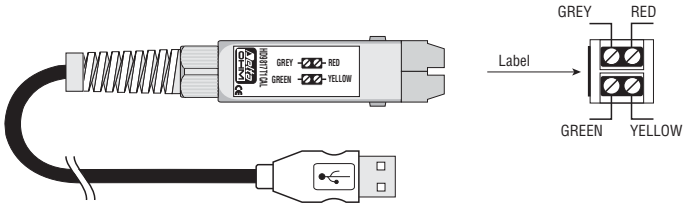
No procedure exists for temperature calibration.

To connect HD9817T1 and HD9817T1.1 models to your PC, use the HD9817T.1CAL interface module: the module is equipped with a USB type A connector for your PC USB port connection as well as a 4-pole terminal board to connect the transmitter.

Before connecting the module to your PC, you need to install the USB drivers: **don't connect the module to your PC before installing the drivers**. For further details, see the guide in the CDRom which is supplied with the instrument.

Please connect the **Red** (power supply positive), **Grey** (power supply negative), **Yellow** (Tx) and **Green** (Rx) wires as shown in the figure below.

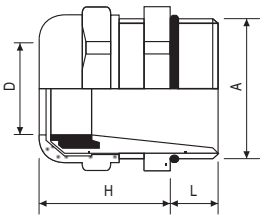
The terminal board is seen from above: in order to direct the clamps correctly, make sure that the label on the side of the module is placed as shown in the figure below.



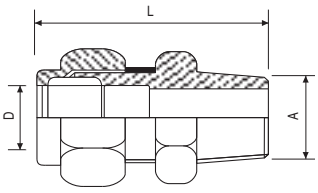
INSTALLATION NOTES

To fix the probe in a ventilation duct, pipe ,etc. you can use, for example, the HD9008.31.12 flange, a PG16 metal cable gland (⌀10…14mm) or a 3/8" universal biconical connection.

HD9008.31 Flange

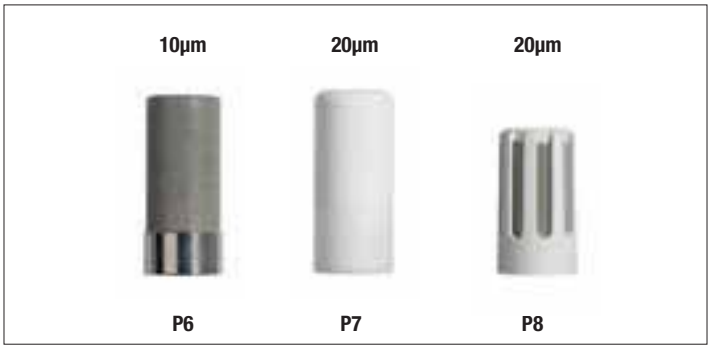


PG16.12 Metal cable gland
D = 10…14mm
L = 6.5mm
H = 23mm
A = PG16

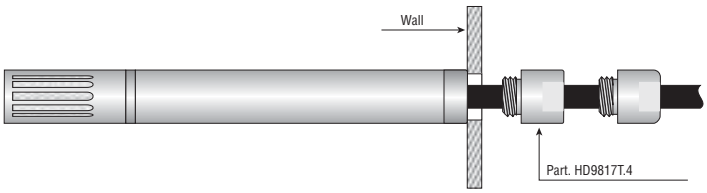


Universal biconical connector
L = 35mm
D = 14mm
A = 3/8"

For wall-mounted installation, the HD9008.21.1 (distance from wall 250mm) and HD9008.21.2 (distance from wall 125mm) supports are available. Both require the HD9008.26/14 adapter.



For direct wall mounting on a metal support, the HD9817T.4 part is available as shown in the figure below (for HD9817T1 and HD9817T1.1 versions only).



The wall can be 2mm thick at most while the hole in the wall can be 10.5mm.

Electrical connection

HD9817T1 and HD9817T1.1 models

Power supply

The power supply voltage must be as per the electrical specifications (5...35Vdc) between the wires:

Red = (+) power supply positive

Grey = (-) power supply negative.

Analogue output

The voltage output signals are taken from the following wires:

Blue = (+)%RH output positive

Black = (+)Temperature output positive

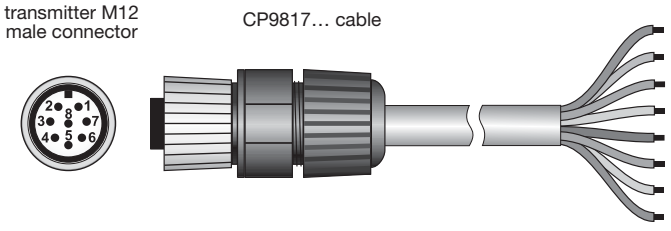
White = (-) ground. Common reference between %RH and Temperature outputs.

Shield = the braid is connected to the common ground (White wire).

HD9817T2 and HD9817T3 models

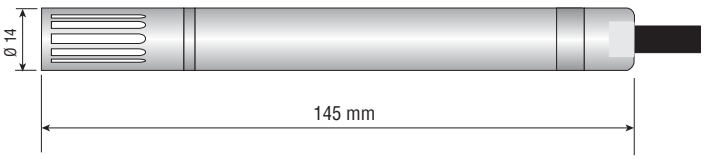
These models are powered directly from your PC port and no external power supply is required.

Models HD9817TVS with analog outputs 0…Vdc and RS485 MODBUS-RTU output. They are supplied with the cable CP9817.3 equipped with the the M12 connector on the one side for the connection to the instrument and loose wires on the other side.



Connector	Function	Color
1	Power supply negatine	Black
2	Power supply positive	Red
3	Not connected	
4	RS485 A/-	Yellow
5	RS485 B/+	White
6	Analog output negative	Blue
7	Temperature analog output positive	Grey
8	humidity analog output positive	Green
	Cable shield (not connected tothe M12 connector)	Yellow/Green

HD9817T… DIMENSIONS



Technical data		
HD9817T1R - HD9817T1R.1 - HD9817T2R - HD9817T3R-HD9817TVS		
Relative humidity	Sensor	Capacitive
	Sensor protection	P8, stainless steel grid and PTFE, 20µ
	Measuring range	0..100%RH
	Sensor working range	-40…+80°C
	Accuracy @20°C	±1.5% (0…90%RH), ±2,0% in the remaining range
	Temperature dependence	2% on the whole temperature range
	Hysteresis and repeatability	0.4%RH
	Long term stability	1%/year
Temperature	Sensor type	Pt100 1/3 DIN (on request, NTC 10kΩ: code HD9817T1R.1
	Measuring range	-40...+60°C
	Accuracy	±0.2°C ±0.15% of the measured value
	Long term stability	0.2°C/year
General	Power voltage	5…35Vdc
	Consumption	Typically 2mA
	Max. operating temperature	-40…+80°C (for short periods)
	Operating humidity	0…100%RH
Housing	Dimensions	Ø14x145mm
	Degree of protection	IP65

ORDER CODES

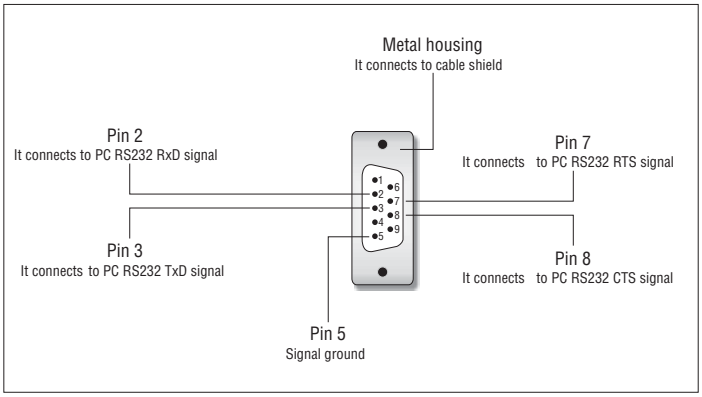
HD9817T1R: Dual relative humidity and temperature transmitter, Pt100 sensor. 0...1Vdc analogue outputs. Temperature measuring range -40...+60°C (-20…+80°C on request). Power supply 5...35Vdc. AISI 304 housing. Probe protection class IP65. Dimensions Ø14x145mm. Output with cable L=1,5m (7 wires + shield). Max. working temperature -40°…+80°C. **Supplied with HD9817TC software.**

HD9817T1R.1: Dual relative humidity and temperature transmitter, NTC sensor 10kΩ. 0...1Vdc analogue outputs. Temperature measuring range -40...+60°C (-20…+80°C on request). Power supply 5...35Vdc. AISI 304 housing. Probe protection class IP65. Dimensions Ø14x145mm. Output with cable L=1,5m (7 wires + shield). Max. working temperature -40°…+80°C. **Supplied with HD9817TC software.**

HD9817T2R: Dual relative humidity and temperature transmitter, Pt100 sensor. RS232C digital output. Temperature measuring range -40...+60°C (-20…+80°C on request). Powered directly from your PC RS232C port. AISI 304 housing. Probe protection class IP65. Dimensions Ø14x145mm. Output with cable L= 2m with DB9 female connector. Max. working temperature -40°…+80°C. **Supplied with HD9817TC software.**

HD9817T3R: Dual relative humidity and temperature transmitter, Pt100 sensor. USB1.1-2.0 digital output. Temperature measuring range -40...+60°C (-20…+80°C on request). Powered directly from your PC USB port. AISI 304 housing. Probe protection class IP65. Dimensions Ø14x133mm. Output with cable L= 2m with USB type A connector. Max. working temperature -40°…+80°C. **Supplied with HD9817TC software.**

HD 9817T2 - RS232 SERIAL CONNECTIONS



HD9817TVS: Dual relative humidity and temperature transmitter, Pt100 sensor. 0...1Vdc analogue and RS485 MODBUS-RTU output. Temperature measuring range - 40...+60°C. Power supply 5...35Vdc. AISI 304 housing. Probe protection class IP65. Dimensions Ø14x145mm. Output with cable M12 8-pole connector. **Supplied with CP9817.3 cable, length 3m.**

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

CP9817.3: Spare cable for HD9817TVS transmitter, with 8-pole M12 female connector on one side, open wires on the other side.Length 3 m.

HD9817T.4: Wall-mounting adapter. Only for HD9817T1 and HD9817T1.1 on request.

HD9817T1CAL: USB interface module for connecting HD9817T1 and HD9817T1.1 transmitters to your PC USB port as well as calibrating or checking the humidity sensor. USB connector type A, cable L=1.5m. Connection through 4-pole terminal board.

HD75: saturated salt solution 75% R.H. thread M 12x1.

HD33: saturated salt solution 33% R.H. thread M 12x1.

HD9008.21.1: holder for vertical sensor, wall distance 250mm, hole Ø 26. HD9008.26.14 adapter is required.

HD9008.21.2: holder for vertical sensor, wall distance 125mm, hole Ø 26. HD9008.26.14 adapter is required.

HD9008.26/14: holders for Ø 26 and Ø 14mm holes, for HD9008.21.1 and HD9008.21.2

HD9008.31: flange with sensor block Ø 14mm for duct sensorsTC and TO series.

HD9007 A-1: 12 ring protection from solar radiations for Ø 26mm probes. Complete with mounting brackets. For the transmitters HD9817T the HD9007T26.2 adapter can be provided.

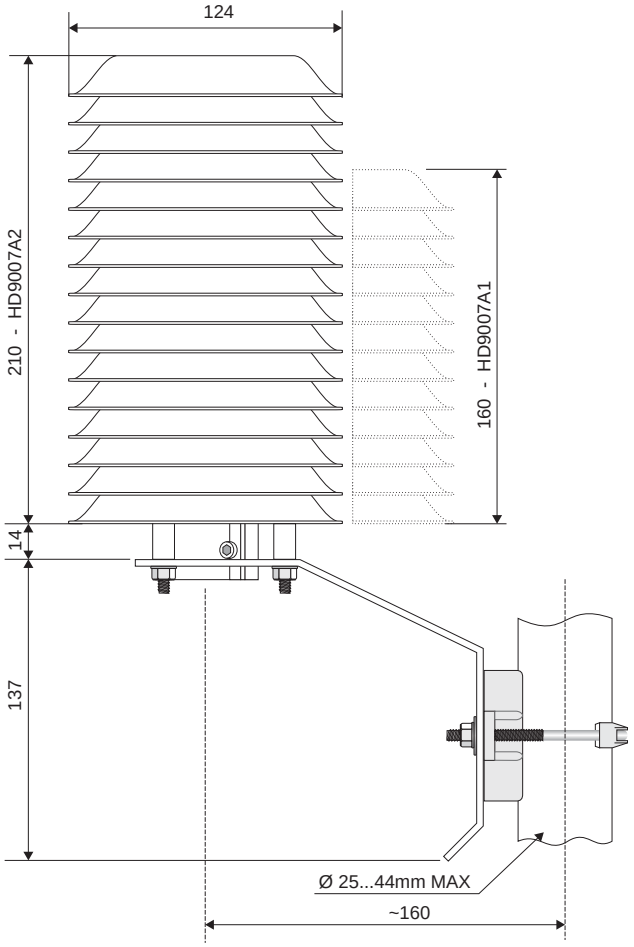
HD9007 A-2: 16 ring protection from solar radiations for Ø 26mm probes. Complete with mounting brackets. For the transmitters HD9817T the HD9007T26.2 adapter can be provided.

HD9007T26.2: fitting for Ø 14mm transmitters (HD9817T…) for the protections from solar radiations HD9007 A-1 and HD9007 A-2.

P6: 10µ sintered stainless steel protection for probes Ø 14mm, thread M 12x1.

P7: 20µ PTFE protection for probes Ø 14mm, thread M 12x1.

P8: 20µ stainless steel and Pocan grid protection, thread M 12x1.



- reduces the measurement error
- the Pt100 (100Ω at 0°C) 1/3DIN wire wound sensor is accurate and stable over time and can be extracted for periodical calibration
- the support structure of the sensor has a low thermal conductivity
- the electric motor power is 12Vdc, 35mA maximum current
- the construction of the screen is UV resistant Luran S777K plastic
- support of the probe is provided for the installation on weather stations poles

Features

- intake by electric motor
- suction flow: 422 l / min, 35Pa
- power: 12Vdc - 25mA nominal
- expected life time: 12,000 hours (MTTF)
- working temperature: -20…+65°C
- dimensions: 270mm diameter, 245mm overall height
- M12 male connector for probe connection
- support rod: diam.16mm, length 580mm, complete with bracket on pole diameter 25 ÷ 44mm maximum
- cable: 8-wire (Pt100 sensor + power). Cable CPM12AA8 ... on request 2 meters, 5 meters, 10 meters.

PURCHASING CODES

HD 9006: Aspirated air temperature sensor with radiation shield. Power 12Vdc, 35mA max, length 580mm.

CPM12.AA8.2: 8-pin cable for Pt100 sensor and motor. 8 pin female connector on one end and open wires on the other side. Length 2 meters.

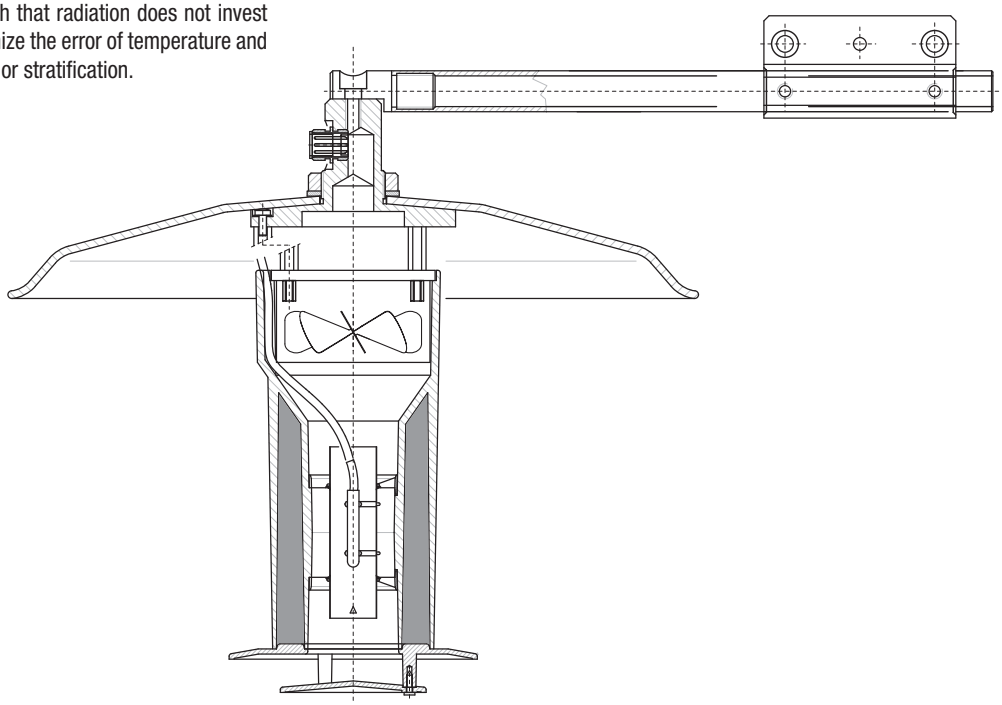
CPM12.AA8.5: 8-pin cable for Pt100 sensor and motor. 8 pin female connector on one end and open wires on the other side . Length 5 meters.

CPM12.AA8.10: 8-pin cable for Pt100 sensor and motor. 8 pin female connector on one end and open wires on the other side. 10 m.

HD 9006.14: Flange to install the HD 9006 aspirated air temperature probe to the 40 ÷ 50 mm diameter mast.

HD 9006
ASPIRATED AIR TEMPERATURE PROBE WITH PROTECTION SCREEN

Temperature measurement in air is also influenced by temperature as well as light and terrestrial radiation. An appropriate screen and air intake with an electric motor detects the air temperature without the measure is influenced by solar radiation and terrestrial heat by the convection of the screen.
The position of the sensor inside the screen is such that radiation does not invest the sensor. The screen is constructed so as to minimize the error of temperature and convective air flow is such as to prevent stagnation or stratification.
The advantages of the radiation shield:

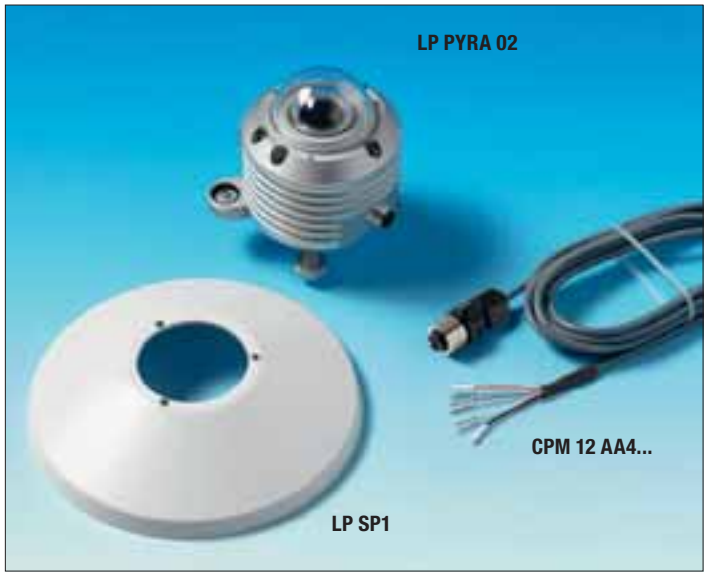


LP PYRA 02
LP PYRA 03
LP PYRA 12

LP PYRA 02 - LP PYRA 03 - LP PYRA 12 PYRANOMETERS

Delta Ohm manufactures First Class **LP PYRA 02** and **LP PYRA 12** and Second Class **LP PYRA 03** 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…



LP PYRA 02

Pyranometers LP PYRA 02 and LP PYRA 03 are well suited for the measurement of incoming global solar radiation (0.3µm…3µm spectral range). LP PYRA 12 shadow ring is designed to shield the instrument sensor from direct radiation; by that, an exact measurement of the diffuse sky radiation is possible.

LP PYRA 0x with direct, unamplified output, no external power supply required

LP PYRA 0x AC with 4..20 mA current output- 2-wire connection, requires external power supply

LP PYRA 0x AV with 0..1Vdc, 0..5Vdc or 0..10 Vdc voltage output, requires external power supply

LP PYRA 0x S with serial RS485 and MODBUS-RTU protocol, requires external power supply

The pyranometers with unamplified output have a typical sensitivity of:

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

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

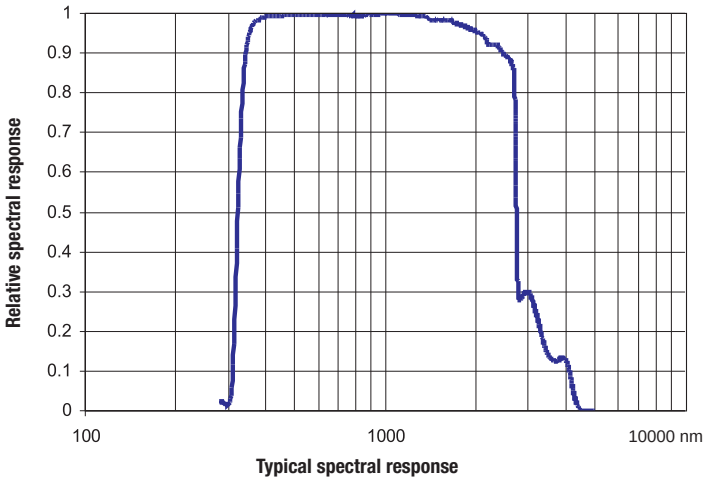
Technical Specification	LP PYRA 02 / LP PYRA 12	LP PYRA 03
Typical sensitivity	10 µV/(W/m^2)	
Impedance	33 Ω ÷ 45 Ω	
Measuring range	0 ÷ 2000 W/m^2	
Viewing field	2π sr	
Spectral field	305 nm ÷ 2800 nm	
Operating temperature	-40 °C ÷ 80 °C	
Weight	0.90 Kg	0. 45 Kg
ISO 9060 Specifications		
Response time 95%	< 28 sec	< 30sec
Zero Off-set		
a) Response to thermal radiation (200Wm^{-2})	15 W/m^2	25 W/m^2
b) Response to temperature change 5K/h	<|± 4|W/m^2	<|± 6|W/m^2
3a) Non stability over 1 year	<|± 1.5|%	<|± 2.5|%
3b) Non linearity	<|± 1|%	<|± 2|%
3c) Cosine response	<|±18|W/m^2	<|±22|W/m^2
3d) Spectral selectivity	<|±5|%	<|±7|%
3e) Response with regard to temperature	< 4 %	< 8 %
3f) Tilt response	<|± 2|%	<|± 4|%
Shadow ring for LP PYRA 12		
Weight	5.90 Kg	
Diameter	570 mm	
Height	54 mm	
Basis diameter	300 mm	

ORDERING CODE

LP PYRA 02: First class pyranometer according to ISO 9060. Complete with: shade disk LP SP1, desiccant sachet with silica-gel crystals, 2 cartridges, spirit level, **M12** 4-pole connector and Report of Calibration. Typical sensitivity 10µV/(W/m²).**Connection cable has to be ordered separately**.

LP PYRA 02AC: First class pyranometer according to ISO 9060. Complete with shade disk LP SP 1, desiccant sachet with silica-gel crystals, 2 cartridges, spirit level, **M12** 4-pole connector and Report of Calibration. **Connection cable has to be ordered separately. Current output 4…20mA**. 4mA = 0W/m², 20mA = 2000W/m². Power supply: 10…30Vdc.

LP PYRA 02AV: First class pyranometer according to ISO 9060. Complete with shade disk LP SP 1, desiccant sachet with silica-gel crystals, 2 cartridges, spirit level, **M12** 4-pole connector and Report of Calibration. **Voltage output**



0…1Vdc, 0…5Vdc, 0…10Vdc. 0V = W/m², 1/5/10Vdc = 2000W/m². Power supply: 10…30Vdc (15…30Vdc for models with output 0…10Vdc).

LP PYRA 02 S: First class pyranometer according to ISO 9060. Complete with shade disk LP SP 1, desiccant sachet with silica-gel crystals, 2 cartridges, spirit level, **M12** 8-pole connector and Report of Calibration. **Connection cable CPM12-8P…** with M12 connector with 2, 5 or 10m length have to be ordered separately. **Serial output RS485 MODBUS-RTU**. Power supply: 5…30Vdc.

LP S1: Mounting kit for LP PYRA 02: bracket for attachment to a mast, including fasteners and leveling screws.

LP SP1: Shade disk for LP PYRA 02

LP RING 02: Base with levelling device and adjustable holder for mounting the LP PYRA 02 pyranometers in an inclined position. Not suitable for LP PYRA02AV, LP PYRA02AC.

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

LP G: Pack of 5 cartridges of silicagel.

LP PYRA 03: Second class pyranometer according to ISO 9060. Complete with spirit level, **M12** 4-pole connector and Report of Calibration. Typical sensitivity 10µV/(W/m²). **Connection cable has to be ordered separately.**

LP PYRA 03AC: Second class pyranometer according to ISO 9060. Complete with spirit level, **M12** 4-pole connector and Report of Calibration. Typical sensitivity 10µV/(W/m²). **Connection cable has to ordered separately**. **Current output 4…20mA**. 4mA = 0W/m², 20mA = 2000W/m². Power supply: 10…30Vdc.

LP PYRA 03AV: Second class pyranometer according to ISO 9060. Complete with spirit level, **4-pole connector and Report of Calibration**. Typical sensitivity 10µV/(W/m²). **Connection cable has to ordered separately**. **Voltage output 0…1Vdc, 0…5Vdc, 0…10Vdc**. 0V = W/m², 1/5/10Vdc = 2000W/m². Power supply: 10…30Vdc (15…30Vdc for models with output 0…10Vdc).

LP PYRA 03 S: Second class pyranometer according to ISO 9060. Complete with spirit level, **8-pole connector and Report of Calibration**. Typical sensitivity 10µV/(W/m²). **Connection cable CPM12-8P…** with M12 connector with 2, 5 or 10m length have to be ordered separately. **Serial output RS485 MODBUS-RTU**. Power supply: 5…30Vdc.

LP RING 03: Base with levelling device and adjustable holder for mounting the LP PYRA 03 pyranometer in an inclined position.

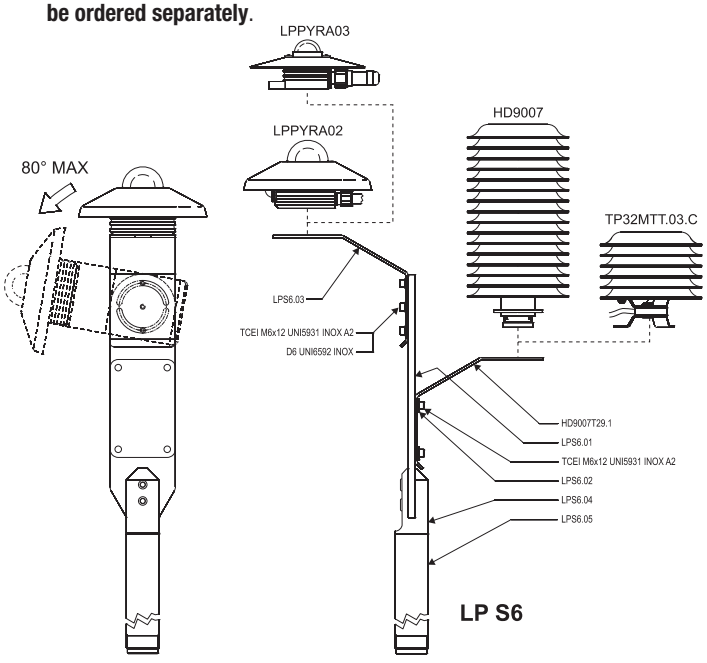
LP S2: Mounting kit: spirit level and stud for mounting LP PYRA 03 on a support which is also part of the kit. Fasteners, shade disk LP SP2 are included.

LP SP2: Shade disk.

LP S3: Attachment bracket for pyranometers LP PYRA 03, LP PYRA03AC…AV. Suitable for mast with diameter of 40÷50mm.

LP S6: Kit for the installation of LP PYRA 02 and LP PYRA 03 pyranometers. The kit includes: 1 m mast (LP S6.05), base fitting (LP S6.04), graduated support plate (LP S6.01), bracket for HD9007 or HD32MTT.03.C (HD 9007T29.1), bracket for pyranometers (LP S6.03).

LP PYRA 12: First Class Pyranometer (LP PYRA 02) according to ISO 9060. Complete with shade disk, shadow ring for diffuse radiation, drying cartridge for silicagel crystals, 2 silicagel cartridges and Report of Calibration. M12 4-pole connector. Typical sensitivity 10µV/(W/m²). **Connecting cable has to be ordered separately**.



HD 9007.T29.1: White powder-coated anticorodal aluminium mounting bracket. Supplied with screws for fixing to the LPS6.01 support. For the air temperature probe TP32MTT.03.C or the protection from solar radiations HD9007.

HD 9007.T29K: White powder-coated anticorodal aluminium mounting bracket. Supplied with accessories for fixing to a Ø 25…44 mm mast. For the air temperature probe TP32MTT.03.C.

LP PYRA 12AC: First Class Pyranometer (LP PYRA 02) according to ISO 9060. Complete with shade disk, shadow ring for diffuse radiation, drying cartridge for silicagel crystals, 2 silicagel cartridges and Report of Calibration. M12 4-pole connector. Typical sensitivity 10µV/(W/m²). **Connection cable has to ordered separately**. **Current output 4…20mA**. 4mA = 0W/m², 20mA = 2000W/m². Power supply: 10…30Vdc.

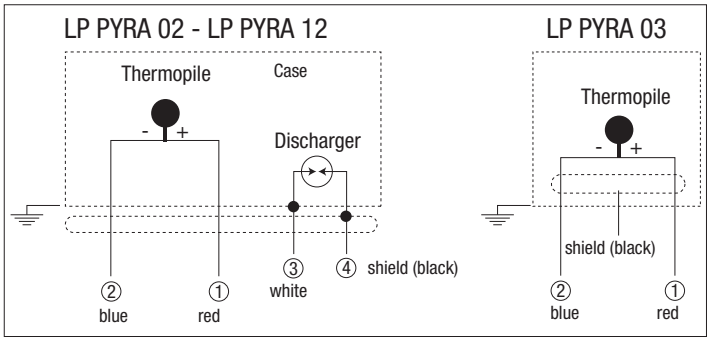
LP PYRA 12AV: First Class Pyranometer (LP PYRA 02) according to ISO 9060. Complete with shade disk, shadow ring for diffuse radiation, drying cartridge for silicagel crystals, 2 silicagel cartridges and Report of Calibration. M12 4-pole connector. Typical sensitivity 10µV/(W/m²). **Connection cable has to be ordered separately**. **Voltage output 0…1Vdc, 0…5Vdc, 0…10Vdc**. 0V = W/m², 1/5/10Vdc = 2000W/m². Power supply: 10…30Vdc (15…30Vdc for models with output 0…10Vdc).

LP PYRA 12 S : First Class Pyranometer (LP PYRA 02) according to ISO 9060. Complete with shade disk, shadow ring for diffuse radiation, drying cartridge for silicagel crystals, 2 silicagel cartridges and Report of Calibration. Typical sensitivity 10µV/(W/m²). **Connection cable CPM12-8P…** with M12 connector with 2, 5 or 10m length have to be ordered separately. **Serial output RS485 MODBUS-RTU**. Power supply: 5…30Vdc.

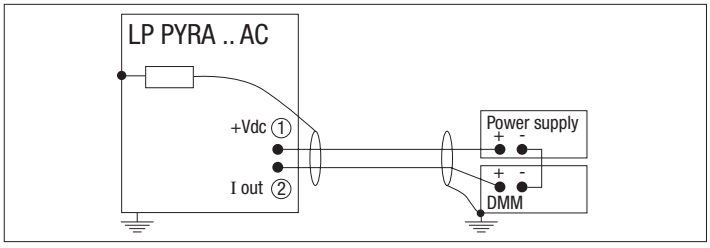
LP RING 12: Ring base for measuring the diffuse radiation, for LP PYRA 12.

LP RING 02: Base with levelling device and adjustable holder for mounting the LP PYRA 02 pyranometers in an inclined position.

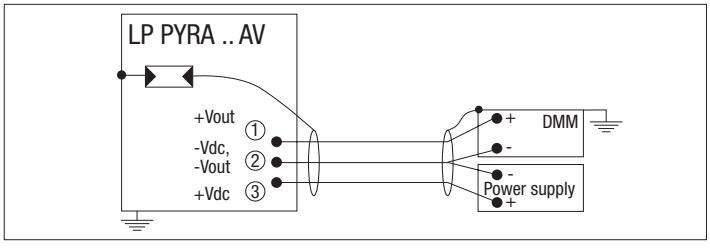
Wiring diagram LP PYRA



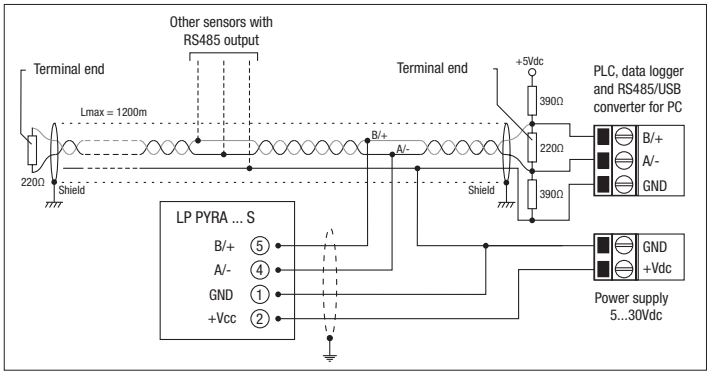
Wiring diagram LP PYRA .. AC



Wiring diagram LP PYRA .. AV



Wiring diagram LP PYRA ... S



Connection cables for LP PYRA 02… - 03…- 12…

CPM12 AA4.2: 4-pole cable. Length 2m. 4-pole M12 connector on one end, open wires on the other side

CPM12 AA4.5: 4-pole cable. Length 5m. 4-pole M12 connector on one end, open wires on the other side

CPM12 AA4.10: 4-pole cable. Length 10m. 4-pole M12 connector on one end, open wires on the other side

CPM12-8P.2: 8-pole cable. Length 2m. 8-pole M12 connector on one end, open wires on the other side (only for LP PYRA…S)

CPM12-8P.5: 8-pole cable. Length 5m. 8-pole M12 connector on one end, open wires on the other side (only for LP PYRA…S)

CPM12-8P.10: 8-pole cable. Length 10m. 8-pole M12 connector on one end, open wires on the other side (only for LP PYRA…S)

CP 24: PC connecting cable for the RS485 MODBUS-RTU parameters configuration of the LP PYRA…S pyranometers. With built-in RS485/USB converter. 8-pole M12 connector on instrument side and A-type USB connector on PC side. Supplied with a CD-ROM including the USB drivers and a software for the Modbus connection to PC.

HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range -10..+60mV. Default setting 0÷20mV. Minimum measuring range 2mV.

HD978TR4: Configurable signal converter amplifier with 0÷10 (10÷0Vdc) output. Input measuring range -10..+60mV. Default setting 0÷20mV. Minimum measuring range 2mV.

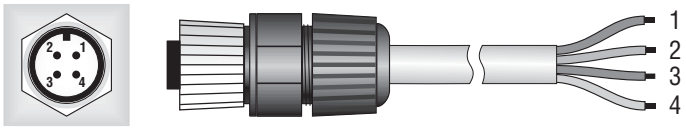
HD978TR5: Wall configurable, signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range –10...+60mV. Default settings 0÷20mV. Minimum measuring range 2mV.

HD978TR6: Wall configurable, signal converter amplifier with 0÷10 (10÷0Vdc) output. Input measuring range –10...+60mV. Default settings 0÷20mV. Minimum measuring range 2mV.

HD 778 TCAL: Voltage generator in the range -60mVdc…+60mVdc, controlled by PC through the RS232C serial port, **DELTALOG-7** software for setting of HD 978TR3, HD 978TR4, HD978TR5, HD978TR6 converters.

LP PYRA 02 + HD 9008TRR

WIRING DIAGRAM LP PYRA 02 - LP PYRA 03 - LP PYRA 12



Fixed 4-pole plug M12 **Flying 4-pole M12 connector**

LP PYRA 02 - LP PYRA 03 - LP PYRA 12

Connector	Function	Color
1	Positive signal (+)	Red
2	Negative signal (-)	Blue
3	Not connected (LP PYRA 03) Container (LP PYRA 02 - LP PYRA 12)	White
4	Shield (⏚)	Black

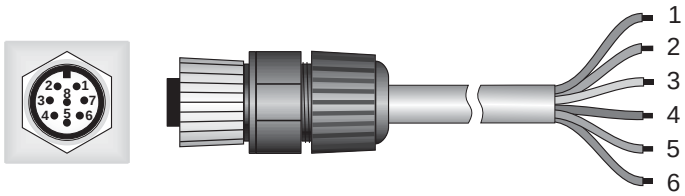
LP PYRA 02AC - LP PYRA 03AC - LP PYRA 12AC

Connector	Function	Color
1	Positive signal (+)	Red
2	Negative signal (-), -Vdc	Blue
3	Not connected (LP PYRA 03) Container (LP PYRA 02 - LP PYRA 12)	White
4	Shield (⏚)	Black

LP PYRA 02AV - LP PYRA 03AV - LP PYRA 12AV

Connector	Function	Color
1	(+) Vout	Red
2	(-) Vout e (-) Vcc	Blue
3	(+) Vcc	White
4	Shield (⏚)	Black

WIRING DIAGRAM LP PYRA 02 S - LP PYRA 03 S - LP PYRA 12 S



Fixed 8-pole plug M12 **Flying 8-pole M12**

LP PYRA 02 S - LP PYRA 03 S - LP PYRA 12 S

Connector	Function	Color
1	Positive power supply (-Vdc)	Black
2	Positive power supply (+Vdc)	Red
4	RS485 A/-	Brown
5	RS485 B/+	White
6	Not connected	Blue
8	Not connected	Green

LP RING 02

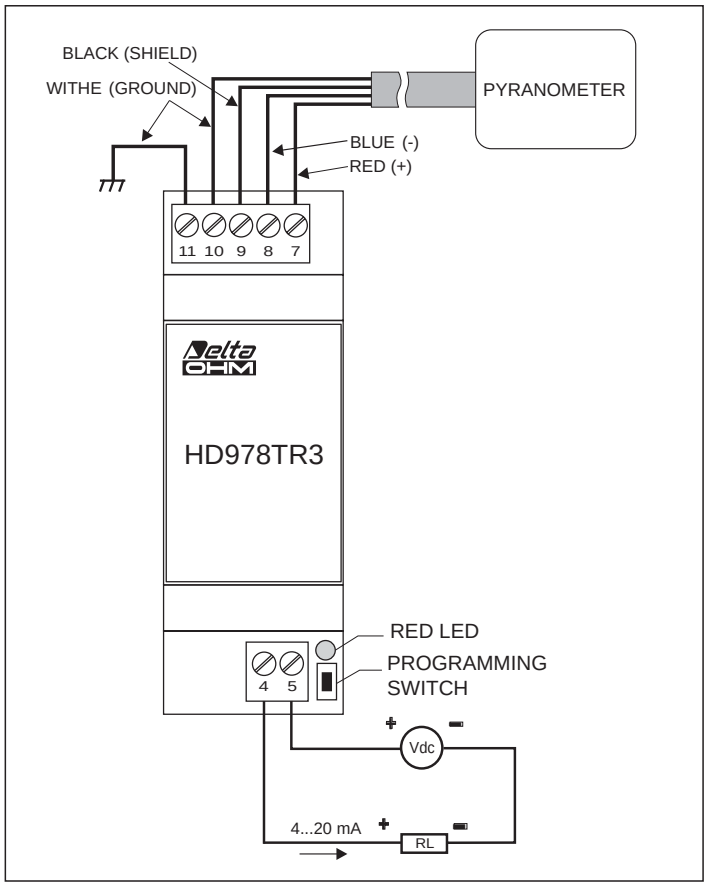


Fig.5 Connection diagram of the HD978TR3 to a pyranometer.

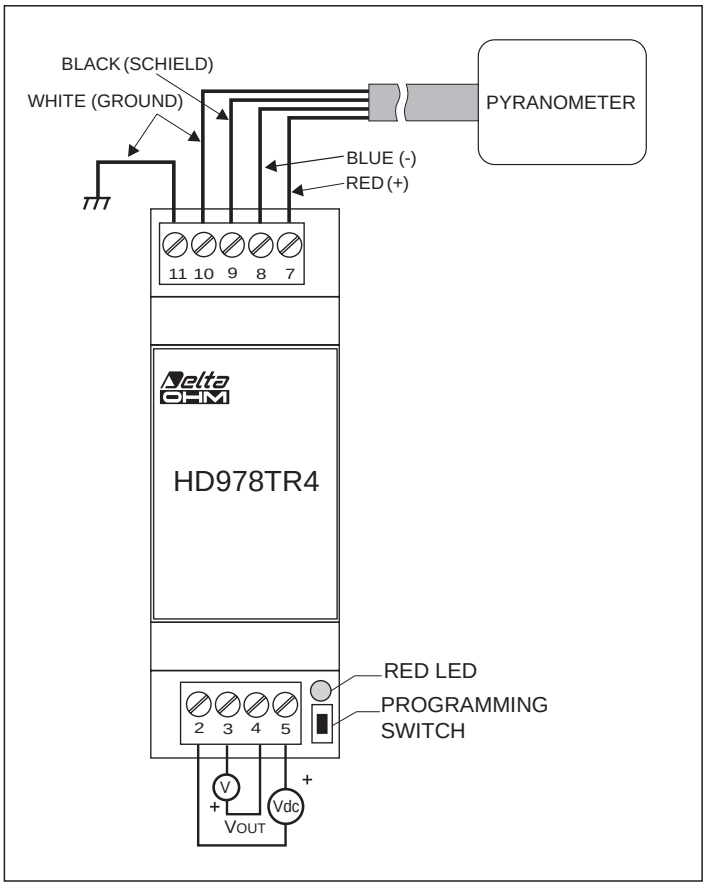
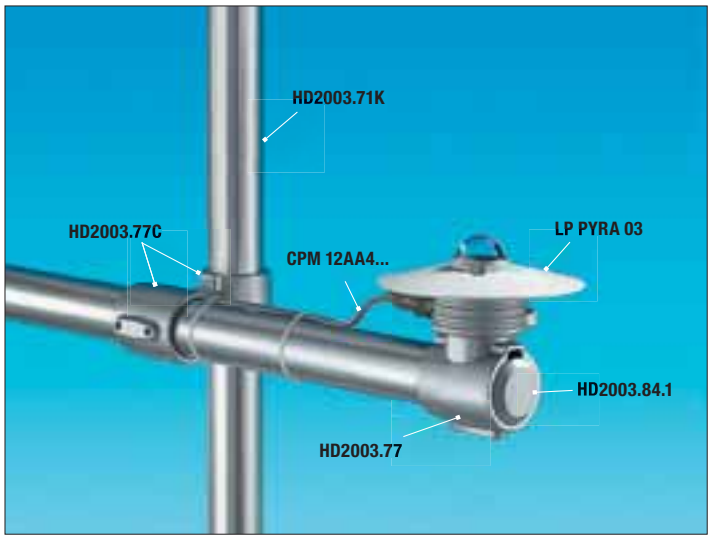
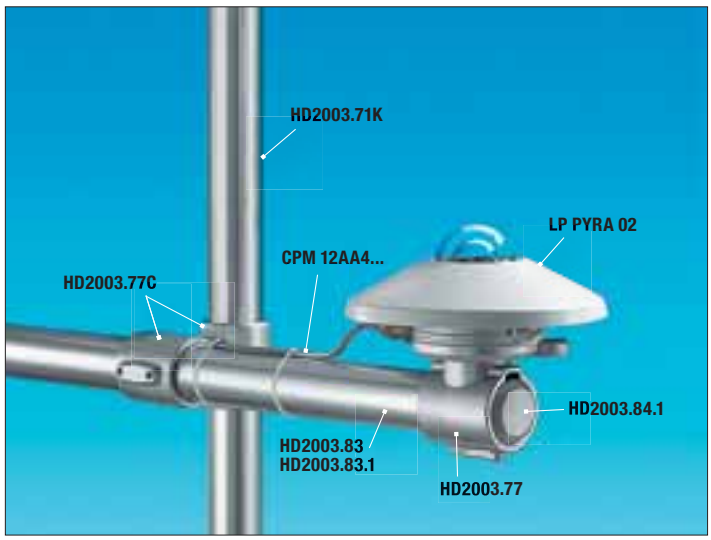


Fig.6 Connection diagram of the HD978TR4 to pyranometer.



LP PYRA 03 + HD2003.77 + HD2003.77C

HD978TR3, HD978TR4, HD978TR5, HD978TR6



LP PYRA 02 + HD2003.77C + HD2003.77

LP PYRA 02 + HD2003.85K + HD2003.77C

LP Silicon-PYRA 04

LP SILICON-PYRA 04 PYRANOMETER

The LP Silicon-PYRA 04. pyranometer measures the global solar radiation (W/m^2) by using a silicon photodiode (350nm-1100nm).
The special geometry and the diffuser allow to have a pyranometer field of view of 180 degrees according to cosine law.
The pyranometer is suitable for the measurement of natural sunlight. Under conditions of overcast sky or measures reflected light is recommended to use a thermopile pyranometer (model LP PYRA 03 or LP PYRA 02).
The LP Silicon-PYRA 04 pyranometer can be used in measurements of SOLAR RADIATION in the field of renewable energies such as solar thermal and solar photovoltaic.
The base with level LP BL (provided as an accessory) can be used to facilitate the assembly and placement in plan level.

The photocurrent generated by photodiode is converted into a voltage by the shunt resistance. The wiring diagram is reported in figure 2.

Features
LP Silicon-PYRA 04 with 5m fixed cable and open wires on the cable end, typical output 20 µV/(W/m^2). Different cable lengths available upon request.

Electrical properties.
The photodiode current signal is converted into voltage through the shunt resistance. According to the diagram 2.

Directional sensor properties
The measurement of radiation across a surface is possible if the probe surface is a Lambert receiver.
The difference between theoretical and measured response is shown in Figure 3.

The excellent concordance between the measured response and cosine law allows to use the equipment even when the sun has a very low elevation and then perform corrective actions throughout the year.

Spectral properties
The 97% of solar energy that reaches above the atmosphere (WMO) is confined to 290nm to 3000nm spectral range. The ideal tool for measuring this radiation should have a flat response at least in this spectral range.
The spectral characteristics of LP Silicon-PYRA 04 pyranometer determined primarily by the photodiode and marginally by the diffuser.
The spectral response curve is shown in Figure 4, together with a typical solar spectrum.

The spectral response of LP Silicon-PYRA 04. does not cover all the solar spectrum and is not constant. Reliable measurements can be obtained only if the LP Silicon-PYRA 04 pyranometer is calibrated with light whose spectrum is equal to the light to be measured. Under clear sky the value of radiation measured by pyranometer has uncertainty less than 3%.
In overcast conditions, at sunrise or sunset, the solar spectrum is quite different from that used to calibrate the instrument and therefore the measurement error increases.

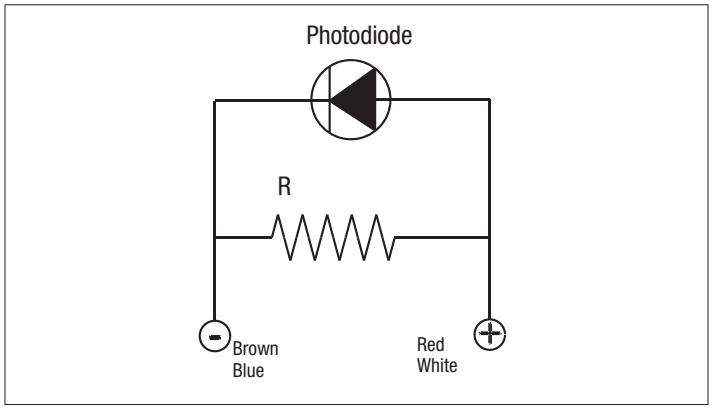


Fig. 2

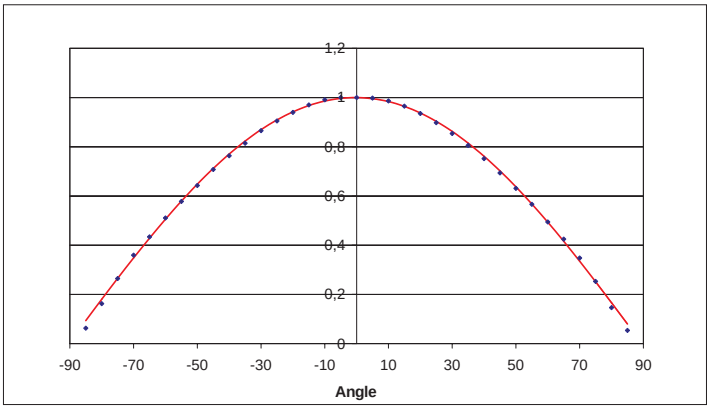


Fig. 3

Positioning
LP Silicon-PYRA 04 can be used outdoor for long periods. The probe can be fixed by two M4 threaded holes that are located on the base (Figure 5) or through the levels based LP BL.

You should take care that the diffuser surface is clean and free of deposits. If necessary, the diffuser can be washed with water and a towel for cleaning optical. The probe can be mounted on the support LP BL (accessory) fitted level for proper placement on work surface.
N.B.: The probe is not designed to be submerged in water.

Calibration
The probe calibration is performed by comparison with a second class pyranometer by using a solar simulator with appropriate filters that reproduce the solar spectrum at AM 1.5 (air mass index 1.5).

Specifications:

Typical sensitivity:	20µV/(W/m^2)
Measuring field:	0-2000 W/m^2
Spectral range:	350nm-1100nm
Response time:	<0.5 s
Nonlinearity:	<1%
Stability:	<± 2% per year
Temperature drift:	<±0.15%/ °C
Calibration uncertainty:	<3%
Response according to the cosine law:	±3% for angles between 0° - 75°
Working temperature:	-40°C + 65°C
Impedance output:	25 Ω

PURCHASING CODES
LP Silicon-PYRA 04: Pyranometer with silicon photodiode with 5m fixed cable and open wires on the cable end. Spectral range: 350 m...1100nm.

The probe can be connected the series of converters/amplifiers:
- HD978TR3 and 978TR5 for the 4-20 mA output.
- HD978TR4 and HD978T6 for the 0-10 Vdc output.

LP BL: Base with level (for the LP 471 Silicon-PYRA probe, the base with level is assembled in the factory when ordering)

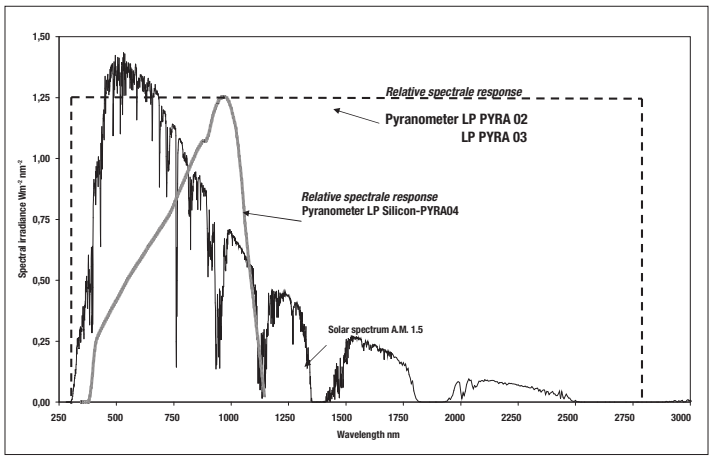


Fig. 4

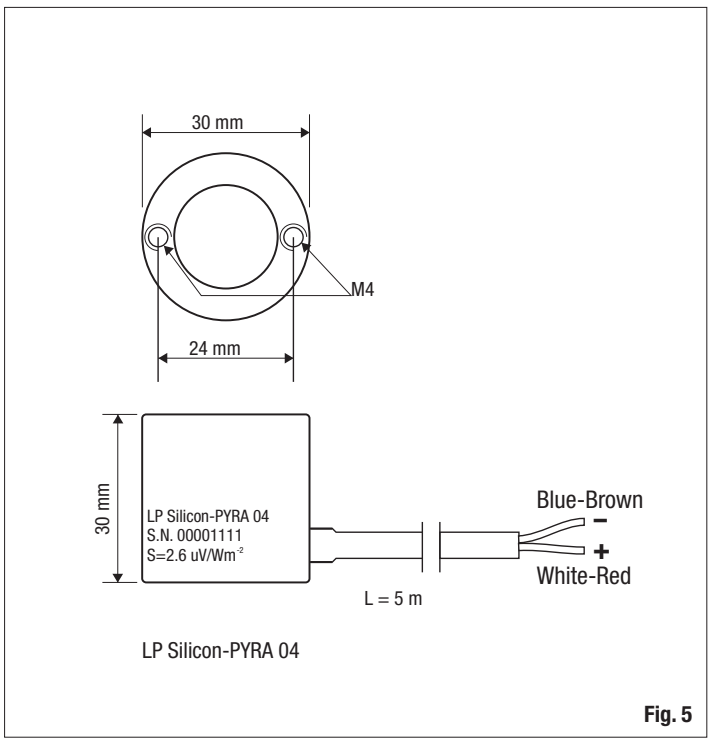


Fig. 5

LP Silicon-PYRA 04 + LP BL

LP PYRA 08

LP PYRA 08 - LP PYRA 08AC - LP PYRA 08AV PIRANOMETERS

Delta Ohm manufactures, according to ISO 9060 and the recommendations of the WMO, the range of 2nd class pyranometers **LP PYRA 08**. These instruments are robust and reliable, provided to withstand adverse climatic conditions and suitable for installation in the field.
The pyranometer **LP PYRA 08** measures the radiation on a flat surface (Watt/m^2). The radiation measured is the sum of direct solar irradiance and diffuse irradiance (global radiation).
The sensors have mV output and do not need to be powered, their typical sensitivity is 10 mV/(kW/m^2). The pyranometers are also available with an amplified and converted 4...20mA current or 0...10Vdc voltage signal.

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 **LP PYRA 08** 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.

Technical specifications	**LP PYRA 08**
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 1)
Working temperature	-40 °C – 80 °C
Specifications according to ISO 9060	
Response time (95%)	**<8 sec**
Zero Off-set	25 W/m^2
a) Response to thermal radiation (200W/m^2) b) Response to a change of temperature 5K/h	<25W/m^2 <|±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| %

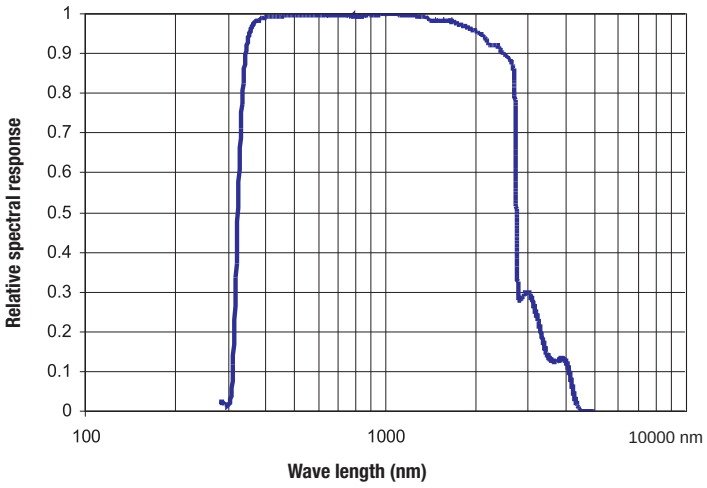


Figure 1. Typical spectral response of the pyranometers.

PURCHASING CODES

LP PYRA 08: Second Class pyranometer according to ISO 9060, fast response sensor, complete with calibration report. Different configurations available. **M12** male connector. **The cable with the female connector has to be ordered separately**. Uses **CPM12 AA4** cables... , 2, 5 or 10 meter length.

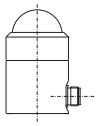
LP PYRA ☐

- **08** = output in mV/(kW/m²)
- **08BL** = output mV/(kW/m²), complete with base and level
- **08BLAC** = output 4÷20 mA, complete with base and level
- **08BLAV** = 0÷10 V, complete with base and level

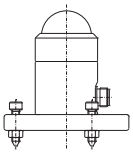
CABLES:

CPM12 AA4 . ☐

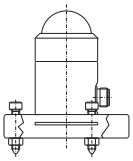
- **2** = 2m long
- **5** = 5m long
- **10** = 10m long



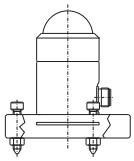
LP PYRA 08



LP PYRA 08BL



LP PYRA 08BLAC

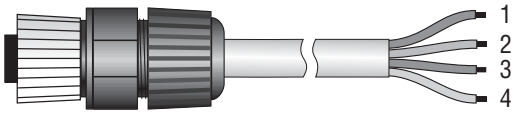


LP PYRA 08BLAV

WIRING DIAGRAMS:

4-poles cable CPM12 AA4…

Fixed 4-pole plug M12



Flying 4-pole M12 connector

LP PYRA 08, **LP PYRA 08BL**

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Not connected	White
4	Screen (⏚)	Black

LP PYRA 08BLAC

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Not connected	White
4	Screen (⏚)	Black

LP PYRA 08BLAV

Connector	Function	Color
1	(+) Vout	Red
2	(-) Vout and (-) Vcc	Blue
3	(+) Vcc	White
4	Screen (⏚)	Black

LP PYRA 08BLAC
LP PYRA 08BLAV

LP PYRA 08 BL

LP PYRA 08

LP PYRA 10
LP PYRA 13

LP PYRA 10- LP PYRA 13
PYRANOMETER

The pyranometers LP PYRA 10 and LP PYRA 13 measure the irradiance on a flat surface (Watt/m²). The radiation measured is the sum of direct solar irradiance and diffuse irradiance (global radiation). LP PYRA 13 is equipped with an adjustable shadow ring for the measurement of diffuse radiation only.
LP PYRA 10 and LP PYRA 13 are pyranometers classified as "Secondary Standards" in accordance with ISO 9060 and according to the publication "Guide to Meteorological Instruments and Methods of Observation", fifth edition (1983) of WMO

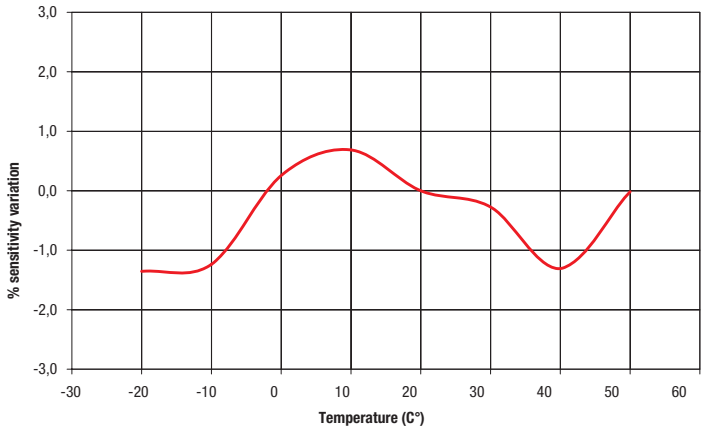
The pyranometers are available in four versions:

LP PYRA 10	PASSIVE
LP PYRA 10 AC	ACTIVE with 4..20mA CURRENT output
LP PYRA 10 AV	ACTIVE with 0..1V, 0..5V, 0..10V VOLTAGE output, to specify at the time of ordering
LP PYRA 10 S	with serial RS485 MODBUS-RTU protocol output
LP PYRA 13	PASSIVE
LP PYRA 13AC	ACTIVE with 4..20mA CURRENT output
LP PYRA 13 AV	ACTIVE with 0..1V, 0..5V, 0..10V VOLTAGE output, to specify at the time of ordering
LP PYRA 13 S	with serial RS485 MODBUS-RTU protocol output

Working principle
The pyranometers LP PYRA 10 and LP PYRA 13 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 ISO9060 standard for classification of Secondary Standard pyranometers (response time is generally less than 6 seconds, where ISO9060 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 LP PYRA 10 and LP PYRA 13 are equipped with a passive compensation circuit. The graph 1 shows the typical variation of sensitivity at different temperatures.



Graph 1: % change of the sensitivity of the pyranometer LP PYRA 10 - LP PYRA 13 compared to the sensitivity at 20°C in the temperature range between -20 and 50°C.

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

LP PYRA 10 and LP PYRA 13 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.

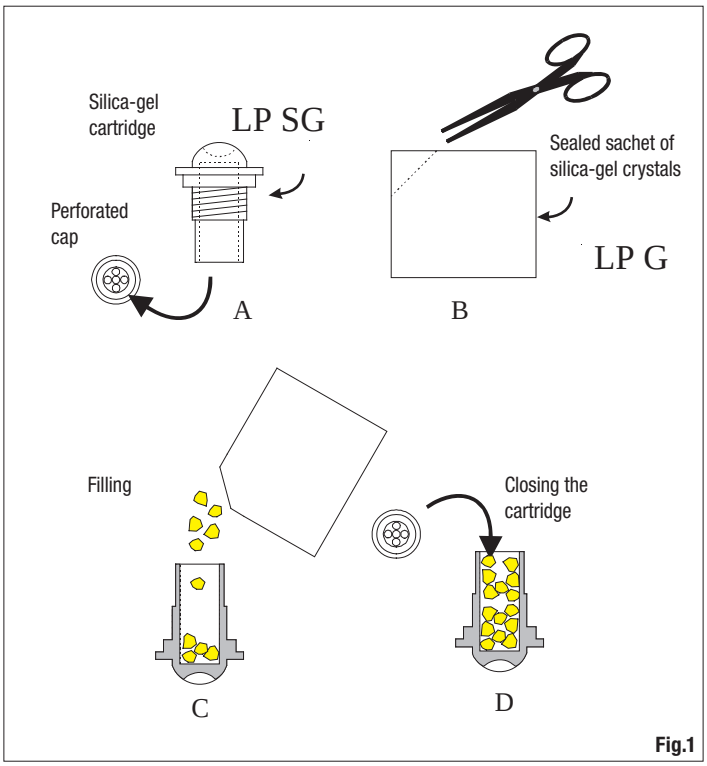


Fig.1

Installation and mounting of the pyranometers to measure global radiation:
Before installing the pyranometers you need to load the cartridge containing silica gel crystals. 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 is ready for use

Figure 1 briefly describes the operations necessary for loading the cartridge with silica-gel crystals.

- The LP PYRA 10 and LP PYRA 13 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.

- The pyranometer should be located far from any kind of obstacle that can project the reflection of the sun (or shadow) on the same pyranometer.
- 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 LP PYRA 10 and LP PYRA 13 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 2.
- In order to facilitate the installation of the pyranometer, Delta Ohm provides on request a range of accessories illustrated in Figure 3. The installer must take care that the height of the mast does not exceed the floor 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.

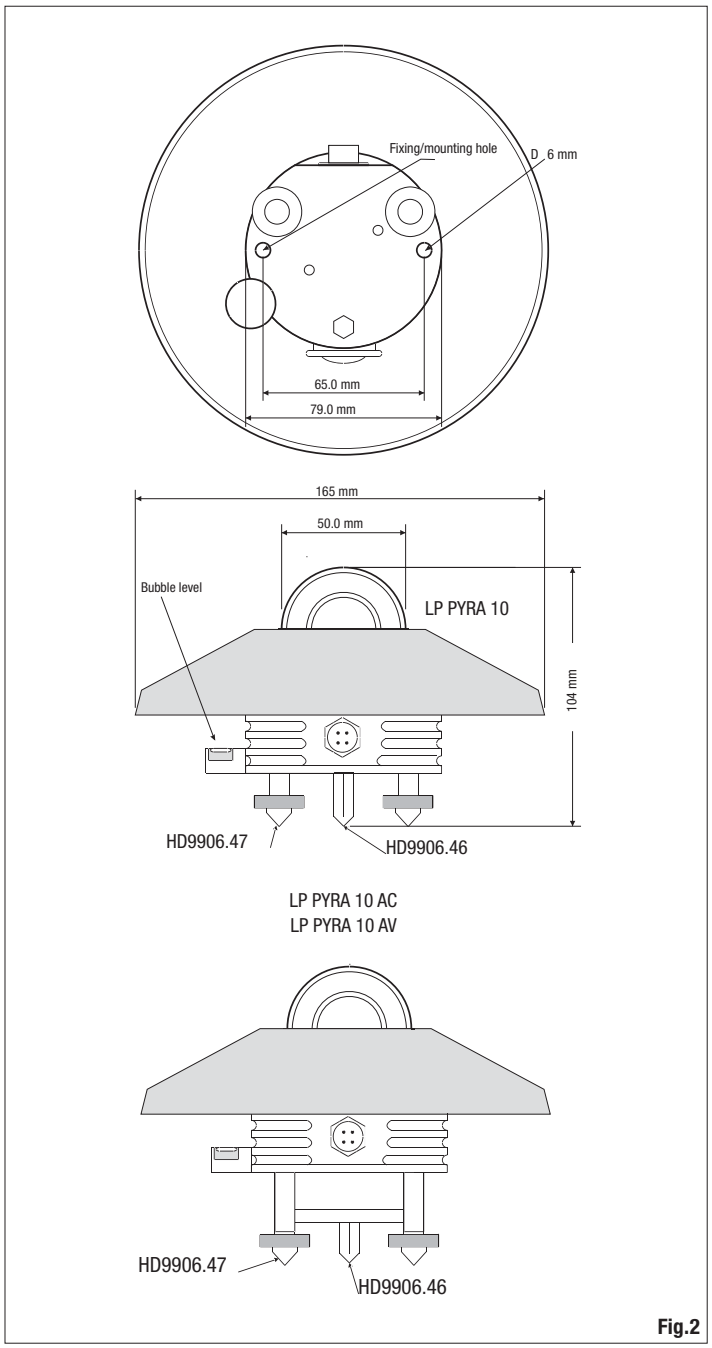


Fig.2

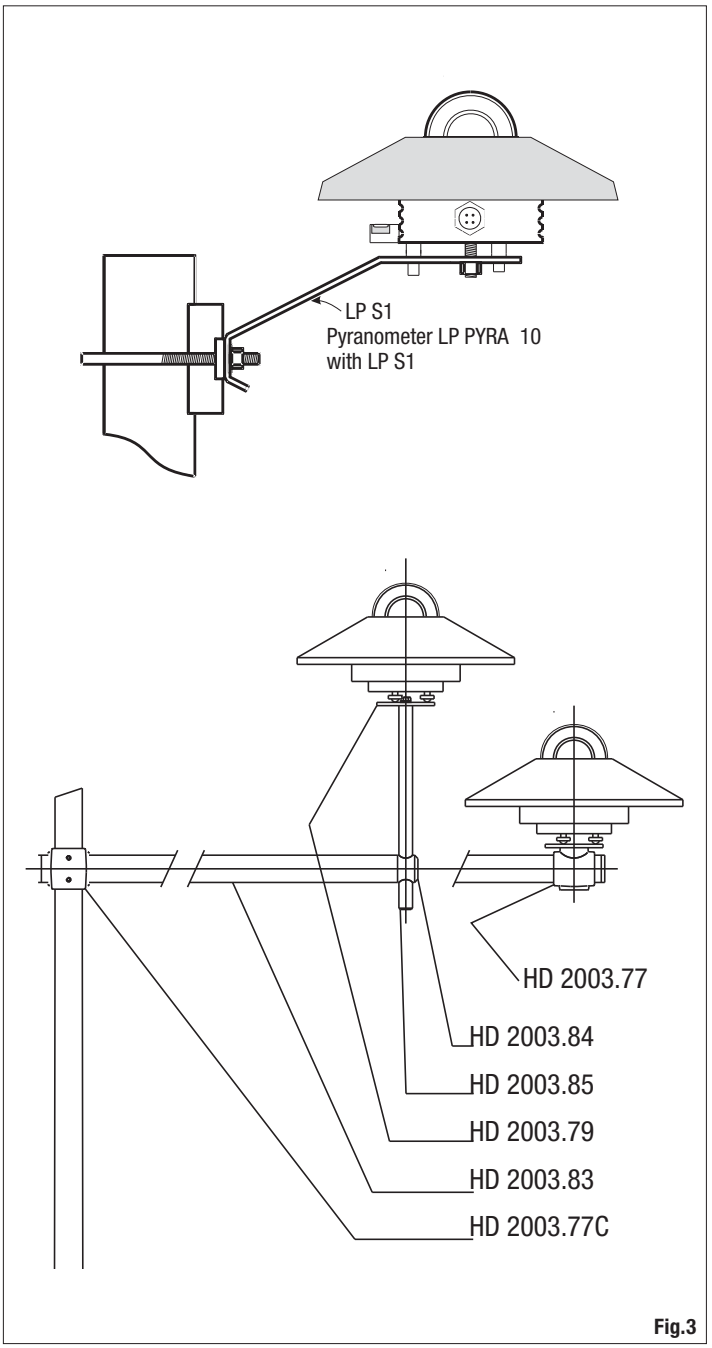


Fig.3

Electrical Connections and Requirements for Electronic reading:

LP PYRA 10 and LP PYRA 13 are produced in four versions:
LP PYRA 10, LP PYRA 10AC, LP PYRA 10 AV and LP PYRA 10 S
LP PYRA 13, LP PYRA 13AC, LP PYRA 13AV, and LP PYRA 13 S

- LP PYRA 10 and LP PYRA 13 are passive and do not need power.
- Versions LP PYRA 10 AC, AV, S and LP PYRA 13 AC, AV, S 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 LP PYRA 10 S and LP PYRA 13 S with RS485 output
- All versions are equipped with 4-pin output connector (8-pole the S version).
- The (optional) cable, with M12 connector is made in PTFE resistant to UV and is provided with 3 wires plus braid (screen), (4 wires plus braid in the S versions).

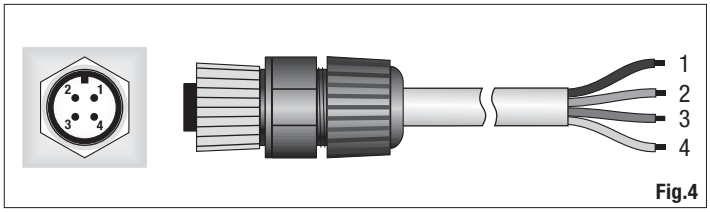


Fig.4

LP PYRA 10 - LP PYRA 13

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Case (⏚)	White
4	Screen (⏚)	Black

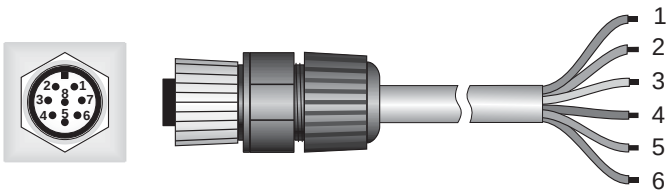
LP PYRA 10 AC- LP PYRA 13AC

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Case (⏚)	White
4	Screen (⏚)	Black

LP PYRA 10 AV- LP PYRA 13AV

Connector	Function	Color
1	(+) Vout	Red
2	(-) Vout and (-)Vcc	Blue
3	(+) Vcc	White
4	Screen (⏚)	Black

CONNECTION SCHEME LP PYRA 10 S - LP PYRA 13 S



Fixed 8-pole plug M12 **Flying 8-pole M12**

Connector	Function	Color
1	(-)Vcc	Black
2	(+) Vcc	Red
4	RS485 A/-	Brown
5	RS485 B/+	White
6	Not connected	Blue
8	Not connected	Green

- LP PYRA 10 and LP PYRA 13 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.

An example of connection to a reading system is shown in Figure 6.

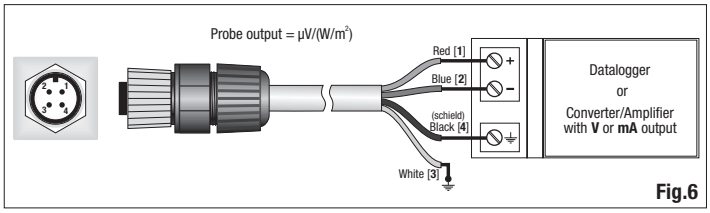


Fig.6

- LP PYRA 10 AC, LP PYRA 13 AC have to be connected to a power supply and a multimeter as shown below (Figure 7), resistance load for reading the signal must be ≤ 500 Ω:

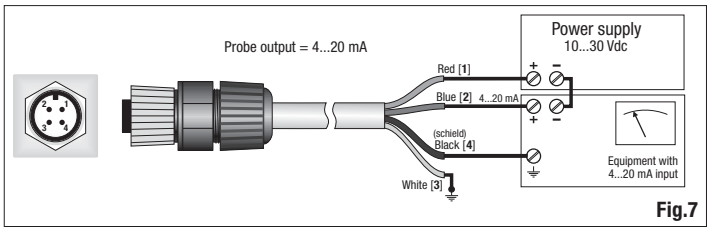


Fig.7

- LP PYRA 10 AV, LP PYRA 13AV have to be connected to a power supply and a multimeter, as shown below (Figure 8), the load resistance for reading the signal must be ≥ 100 kΩ:

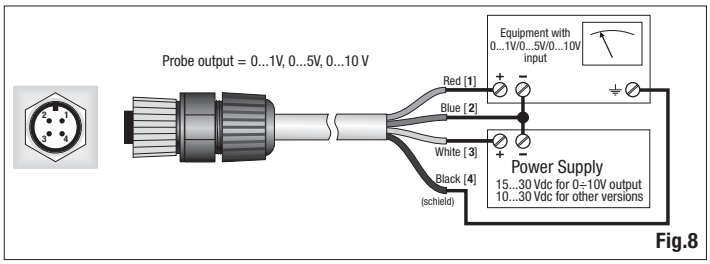
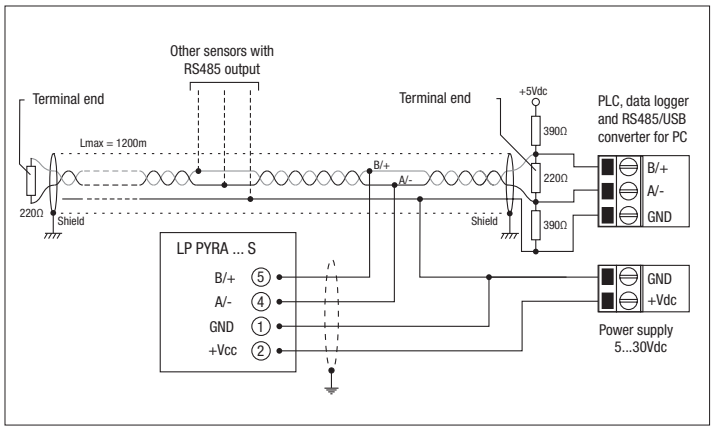


Fig.8

LP PYRA ... S has to be connected according to the following scheme:



Maintenance:

In order to ensure a high measurement accuracy, it is necessary to keep the external dome, so the higher the frequency of cleaning, the best measurement accuracy will be. Cleaning can be done with normal tissue for cleaning photographic objectives and water, if not possible, simply use pure ethyl alcohol. After cleaning with alcohol, it is necessary also to clean the dome again with water only.

Due to the high temperature fluctuations between day and night, it is possible that you get some condensation inside the pyranometer dome; in this case the reading done is strongly overestimated. To minimize condensation inside the pyranometer, a cartridge of Silica gel is placed inside the instrument. The efficiency of silica-gel crystals decreases over time with the absorption of moisture. When crystals of silica gel are efficient their colour is **yellow**, while when they gradually lose efficiency, their colour becomes **white/transparent**; to replace them, please refer to the instructions at paragraph Installation of pyranometers. Silica gel typically lifetime goes from 4 to 12 months according to the environmental conditions where the pyranometer is installed.

Calibration and measures:

LP PYRA 10, LP PYRA 13

The sensitivity of the pyranometer **S** (or calibration factor) allows to determine the global irradiance by measuring a volt signal at the end 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,

LP PYRA 10

LP PYRA 10 AC, LP PYRA13AC

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

LP PYRA 10 AV, LP PYRA 13AV

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 LP PYRA 10 and LP PYRA 13 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.

Specifications:

Typical sensitivity:	
LP PYRA 10 - LP PYRA 13	10 μV/(W/m²)
LP PYRA 10AC - LP PYRA 13AC	4..20 mA (0...2000 W/m²)
	4...20mA (0...4000W/m²) on request
LP PYRA 10AV - LP PYRA 13AV	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
Field of view:	2π sr
Spectral range:	283 nm ... 2800 nm (50%)
Working temperature:	-40 °C ... 80 °C
Dimensions:	figure 1
Weight:	0.90 Kg

Shadow ring of LP PYRA 13

Weight	5.90 Kg
Diameter of the ring	570mm
Height of the ring	54mm
Diameter of the base	300mm

Specifications according to ISO 9060

1-	Response time: (95%)	<6 sec
2-	Off-set Zero:	
	a) response to a thermal radiation of 200W/m²:	<7 W/m²
	b) response to a change of 5K/h in the room temperature:	<|±2|W/m²
3a-	Long-term instability: (1 year)	<|±0.8| %
3b-	Nonlinearity:	<|±0.5| %
3c-	Response according to Cosine law:	< |÷10| W/m²
3d-	Spectral selectivity:	< |±3| %
3e-	Temperature response:	<2 %
3f-	Tilt response:	<|0.5| %

PURCHASING CODE

LP PYRA 10: Secondary Pyranometer according to ISO 9060. Equipped with protection, silica-gel crystals cartridge, 2 recharges, level, 4-poles M12 connector and Report of Calibration ISO9001.

LP PYRA 10 AC: Secondary Pyranometer according to ISO 9060. Equipped with protection, silica-gel crystals cartridge, 2 recharges, level, 4-poles M12 connector and Report of Calibration ISO9001. 4...20mA current output signal (0...2000W/m²). 4...20mA (0...4000W/m² on request).

LP PYRA 10 AV: Secondary Pyranometer according to ISO 9060. Equipped with protection, silica-gel crystals cartridge, 2 recharges, level, 4-poles M12 connector and Report of Calibration ISO9001. Voltage 0..1Vdc, 0..5Vdc, 0..10Vdc output signal, to define when ordering (0...2000W/m²). 0..1V, 0...5V, 0...10V (0...4000W/m²) on request.

LP PYRA 10 S: Secondary Pyranometer according to ISO 9060. Equipped with protection, silica-gel crystals cartridge, 2 recharges, level, M12 8-pole connector and Report of Calibration. Connection cable CPM12-8P… with M12 connector with 2, 5 or 10m length have to be ordered separately. **Serial output RS485 MODBUS-RTU**. Power supply: 5…30Vdc.

LP PYRA 13: Secondary Pyranometer according to ISO 9060. Equipped with protection, shadow ring for diffuse radiation, silica-gel crystals cartridge, 2 recharges, level, 4-poles M12 connector and Report of Calibration ISO9001.

LP PYRA 13 AC: Secondary Pyranometer according to ISO 9060. Equipped with protection, shadow ring for diffuse radiation, silica-gel crystals cartridge, 2 recharges, level, 4-poles M12 connector and Report of Calibration ISO9001. 4...20mA current output signal (0...2000W/m²). 4...20mA (0...4000W/m²) on request.

LP PYRA 13 AV: Secondary Pyranometer according to ISO 9060. Equipped with protection, shadow ring for diffuse radiation, silica-gel crystals cartridge, 2 recharges, level, 4-poles M12 connector and Report of Calibration ISO9001. Voltage 0..1Vdc, 0..5Vdc, 0..10Vdc output signal, to define when ordering (0...2000W/m²). 0..1V, 0...5V, 0...10V (0...4000W/m²) on request.

LP PYRA 13 S: Secondary Pyranometer according to ISO 9060. Equipped with protection, shadow ring for diffuse radiation, silica-gel crystals cartridge, 2 recharges, level, M12 8-pole connector and Report of Calibration. Connection cable CPM12-8P… with M12 connector with 2, 5 or 10m length have to be ordered separately. **Serial output RS485 MODBUS-RTU**. Power supply: 5…30Vdc.

CPM12 AA4.2: 4-pole cable. Length 2m. 4-pole M12 connector on one end, open wires on the other side

CPM12 AA4.5: 4-pole cable. Length 5m. 4-pole M12 connector on one end, open wires on the other side

CPM12 AA4.10: 4-pole cable. Length 10m. 4-pole M12 connector on one end, open wires on the other side

CPM12-8P.2: 8-pole cable. Length 2m. 8-pole M12 connector on one end, open wires on the other side (only for LP PYRA…S)

CPM12-8P.5: 8-pole cable. Length 5m. 8-pole M12 connector on one end, open wires on the other side (only for LP PYRA…S)

CPM12-8P.10: 8-pole cable. Length 10m. 8-pole M12 connector on one end, open wires on the other side (only for LP PYRA…S)

CP 24: PC connecting cable for the RS485 MODBUS parameters configuration of the LP PYRA…S pyranometers. With built-in RS485/USB converter. 8-pole M12 connector on instrument side and A-type USB connector on PC side. Supplied with a CD-ROM including the USB drivers and a software for the Modbus connection to PC.

HD 2003.85: Mounting kit with adjustable height for the installation of the pyranometer on pole with diameter Ø 40 mm (HD2003.84 + HD2003.85 + HD2003.79)

HD 2003.79: Mounting kit pyranometer on clamping Ø 40mm (HD2003.77 + HD2003.79)

HD 2003.77: Clamping for mast Ø 40mm

LP SP1: Protective screen plastic UV resistant. LURAN S777K by BASF®

LP S1: Bracket positioning pyranometer LP PYRA 10, suitable for pole with a maximum diameter of 50mm.

LP RING 02: Base with levelling device and adjustable holder for mounting the LP PYRA 10 pyranometers in an inclined position.

LP S6: Kit for the installation of LP PYRA 10 pyranometers. The kit includes: 1 m mast (LP S6.05), base fitting (LP S6.04), graduated support plate (LP S6.01), bracket for HD9007 or HD32MTT.03.C (HD 9007T29.1), bracket for pyranometers (LP S6.03).

LP SG: Cartridge containing silica gel crystals, complete with O-ring and cap.

LP G: Pack of 5 cartridges of silica gel crystals.

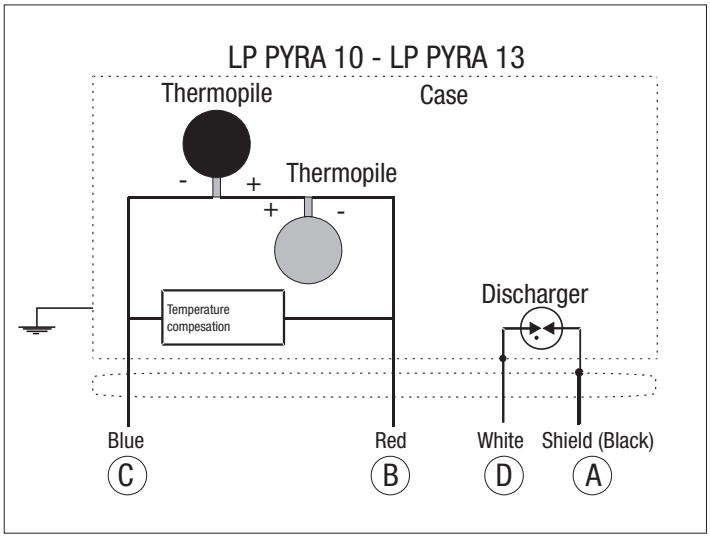
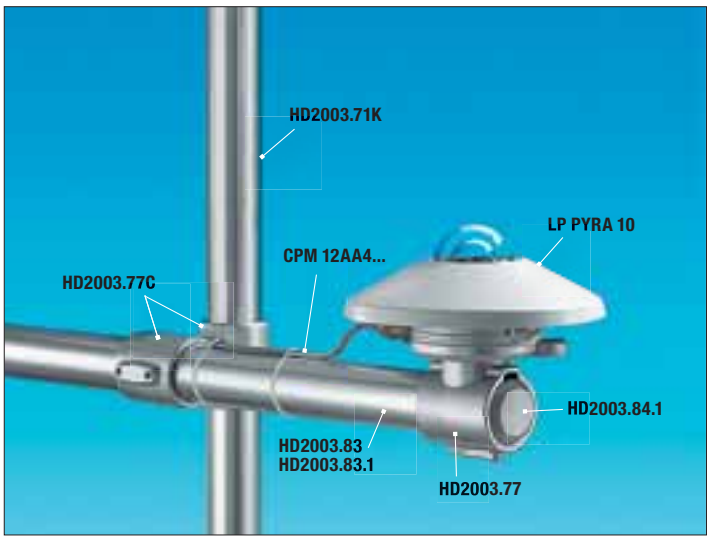


Fig.5



LP PYRA 10 + HD2003.77C + HD2003.77

HD 9906.51
HEATING AND VENTILATION UNIT

The heating and ventilation unit HD 9906.51 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 HD 9906.51 unit can be used with LP PYRA 02 and LP PYRA 10, with the pyrgeometer LP PIRG 01 and the radiometers LP PHOT 02, LP UVA 02 and LP UVB 02.

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 HD 9906.51 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 HD 9906.51.)
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 HD 9906.51 bell into place and tighten the screws

The pyranometer is fixed to ventilation unit by 2 set screws M5x50. To allow an accurate reading of ground solar radiation is necessary place the HD 9906.51 parallel to the ground, this can be done using the bubble on the ventilation unit.

The electrical connections of the HD 9906.51 happen are 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 2 shows the correspondence between two terminals and features:

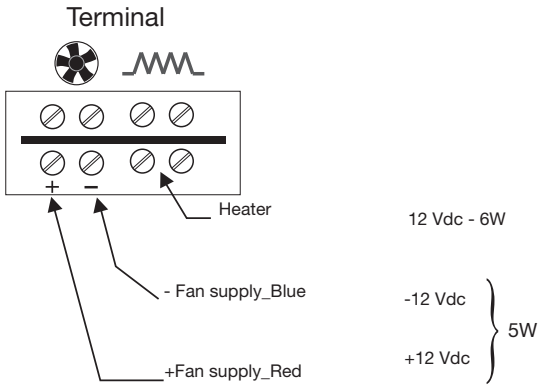


Figure 2

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), is equipped with a filter (EBMPAPST: PMFA 120T) 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

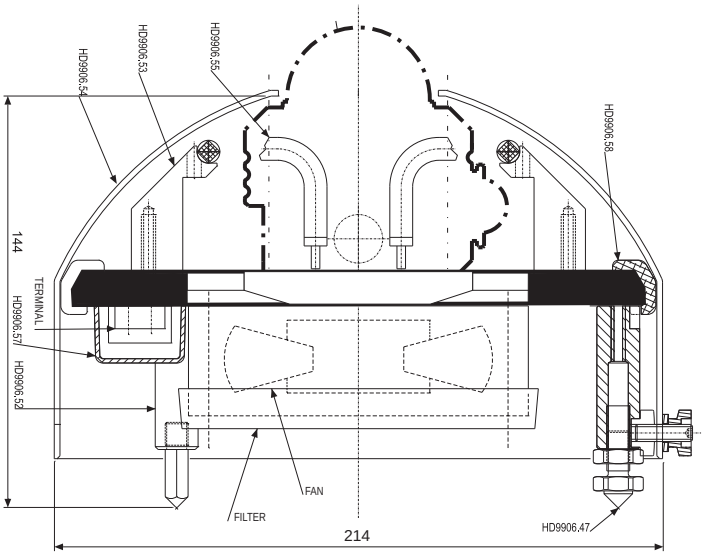
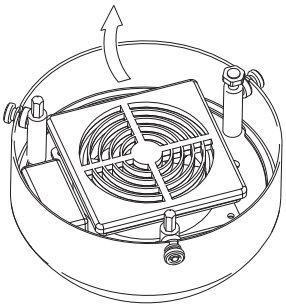
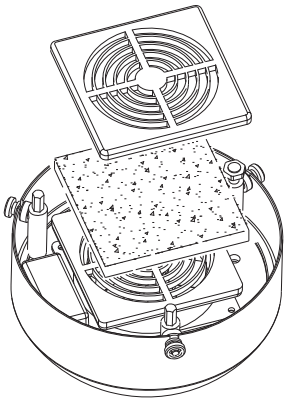


Figure 1



1



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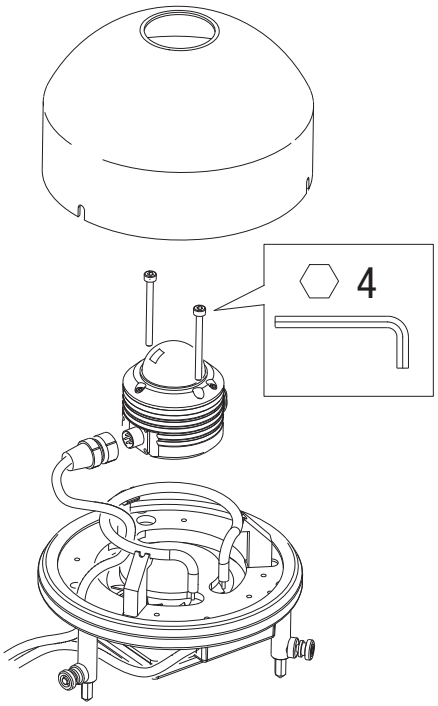

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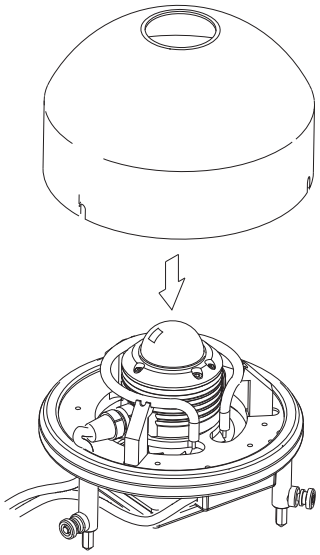

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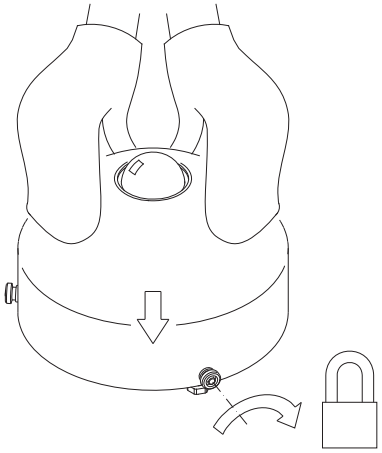

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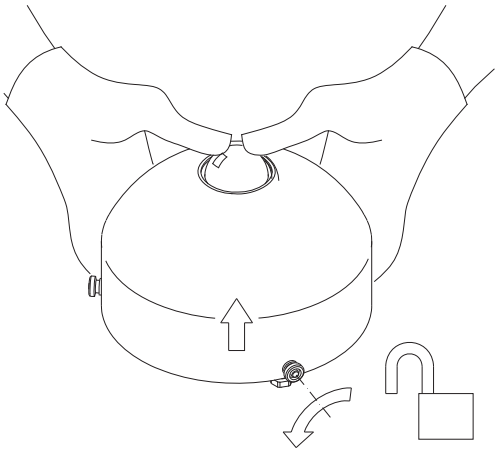

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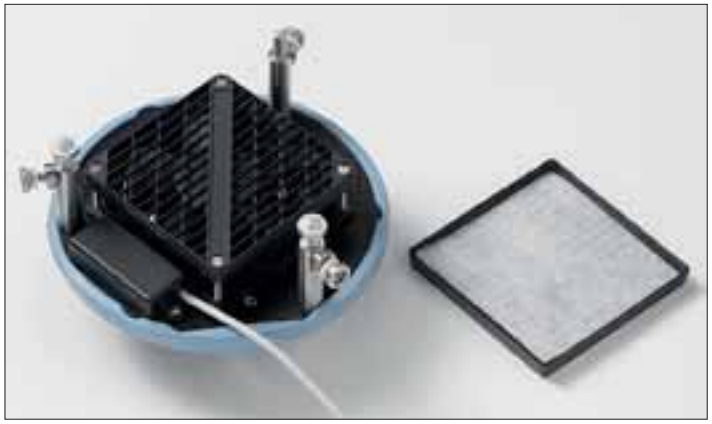
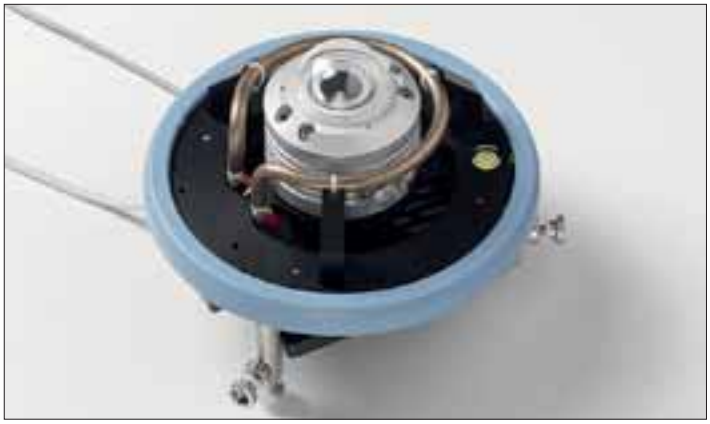




LP PYRA 05
LP PYRA 06

LP PYRA 05 - LP PYRA 06
ALBEDOMETERS

Delta Ohm manufactures two different models of albedometers:
LP PYRA 05 is constructed starting from two 1st class pyranometers and the **LP PYRA 06** starting from two 2nd class pyranometers (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 of the LP PYRA 05 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:

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

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:

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

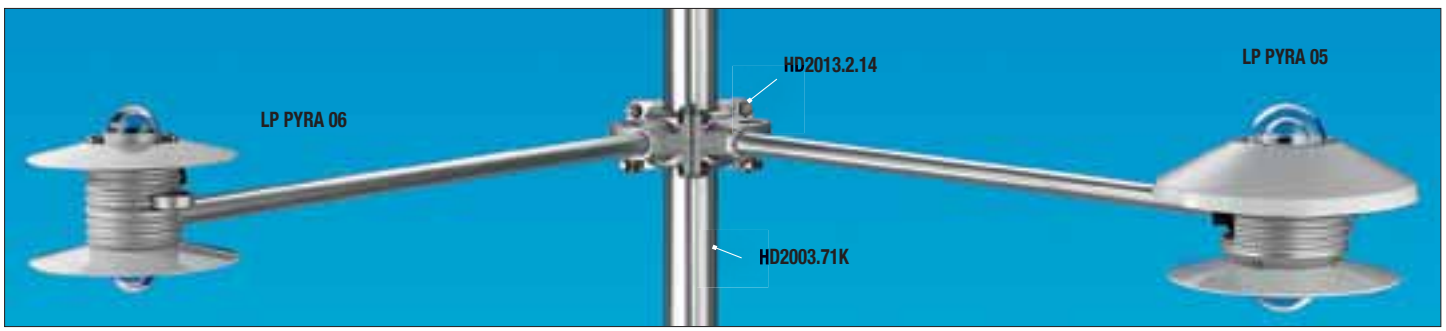
Every pyranometer composing the albedometer is calibrated separately as per the WRR (World Radiometric Reference) standard and is supplied with the relevant Report of Calibration.
These are strong and reliable ground-based instruments, especially designed to be used under all weather conditions. They are suitable for installation of the field.
Recommended use: climatological research, weather stations, road weather stations, agriculture stations, etc…

Technical Specification	LP PYRA 05*	LP PYRA 06*
Typical sensitivity	10 µV/(W/m²)	
Typical Impedance	33 Ω ÷ 45 Ω	
Irradiance range	0 ÷ 2000 W/m²	
Viewing angle	2π sr	
Spectral range	305 nm ÷ 2800 nm W/m² (50%)	
Operating Temperature	-40 °C ÷ 80 °C	
Weight (pyranometer only)	1.35 Kg	1.1 Kg
ISO 9060 Specifications		
Response time (95 %)	< 28 sec	< 30sec
Zero off-set		
3a) thermal radiation (200 Wm⁻²)	15 W/m²	25 W/m²
3b) temperature change 5K/h	<|± 4|W/m²	<|± 6|W/m²
3a) Long term stability 1 year	<|± 1.5|%	<|±2.5|%
3b) Non linearity	<|± 1|%	<|± 2|%
3c) Cosine response	<|±18|W/m²	<|±22|W/m²
3d) Spectral selectivity	<|±5|%	<±7|%
3e) Temperature response	< 4 %	< 8 %
3f) Tilt response	<|±2|%	<|±4|%

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

ORDERING CODES

LP PYRA 05: Albedometer made up of two 1st Class pyranometers, according to ISO 9060. Complete with: top shade disk and bottom shade disc, drying cartridge with silicagel crystals, 2 silica gel cartridges, spirit level, Ø 16x500 rod for attachment to a mast, M12 8-pole connector and Report of Calibration. Typical sensitivity 10µV/(W/m²). **The connection cable has to be ordered separately.**
LP SP1: Top shade disc for albedometer LP PYRA 05 (upward pyranometer).
LP SP3: Bottom shade disk for albedometer LP PYRA 05 (downward pyranometer).
LP SG: Drying cartridge with silicagel crystals, complete with O-ring.
LP G: Pack of 5 cartridges of silicagel.
LP PYRA 06: Albedometer made up of two 2nd Class pyranometers, according to ISO 9060. Complete with: top shade disk and bottom shade disc, spirit level, Ø 16x500 rod for attachment to a mast, M12 8-pole connector and Report of Calibration. Typical sensitivity 10µW/(W/m²). **The connection cable has to be ordered separately.**



HD 2013.2.14 + LP PYRA 05 + LP PYRA 06

CPM12 AA8.2: 8-pole M12 connector with UV resistant cable L= 2m, for LP PYRA 05 - LP PYRA 06.

CPM12 AA8.5: 8-pole M12 connector with UV resistant cable L= 5m, for LP PYRA 05 - LP PYRA 06.

CPM12 AA8.10 : 8-pole M12 connector with UV resistant cable L= 2m, for LP PYRA 05 - LP PYRA 06.

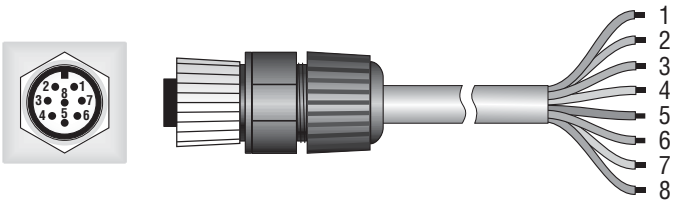
HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range -10..+60mV. Default setting 0÷20mV. Minimum measuring range 2mV. DIN rail 2-module housing. 58mmx65mmx35mm height.

HD978TR5: Wall configurable, signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range –10...+60mV. Default settings 0÷20mV. Minimum measuring range 2mV. Wall mouting, dimensions: 58mmx65mmx35mm height.

HD978TR4: Configurable signal converter amplifier with 0÷10 Vdc (10÷0 Vdc) output. DIN rail 2-module housing. Input measuring range -10..+60mV. Default setting 0÷20mV. Minimum measuring range 2mV.

HD978TR6: Wall configurable, signal converter amplifier with 0÷10 Vdc (10÷0Vdc) output. Input measuring range –10...+60mV. Default settings 0÷20mV. Minimum measuring range 2mV. Wall mouting, dimensions: 58mmx65mmx35mm height.

WIRING DIAGRAM LP PYRA 05 - LP PYRA 06

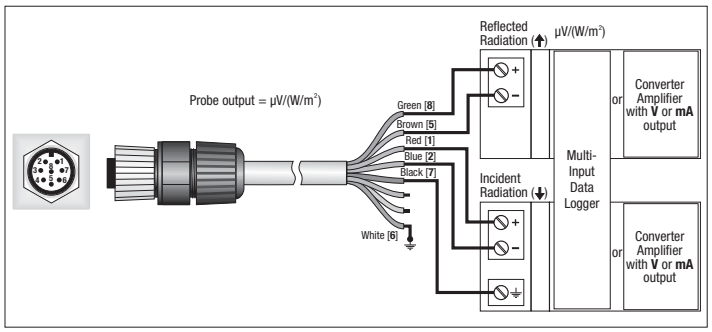


Fixed 8-pole plug M12 **Flying 8-pole M12 socket**

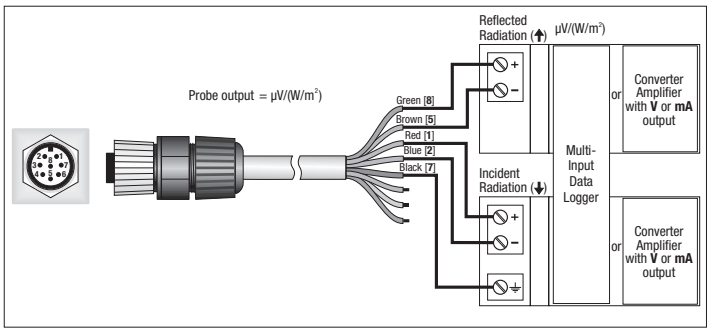
Connector	Function	Colour
8	V out (+) of the signal generated by the lower detector (↑)	Green
6	Housing (⏚) (LP PYRA 05) Not connected (LP PYRA 06)	White
2	V out (-) of the signal generated by the upper detector (↓)	Blue
1	V out (+) of the signal generated by the upper detector (↓)	Red
7	Shield (⏚)	Black
5	V out (-) of the signal generated by the lower detector (↑)	Brown

CONNECTION DIAGRAMS

LP PYRA 05



LP PYRA 06



LP PYRA 05

LP PYRA 06

LP NET 07
NET IRRADIANCE METER

LP NET 07 measures the net radiation across a surface, from near ultraviolet to far infrared. The Net radiation is defined as the difference between the radiation that reaches the upper surface and the irradiation on the lower surface of the net radiometer. The surface of the upper receiver measures the direct solar radiation plus the diffuse one and the radiation at longer wavelengths emitted from the sky (clouds), while the lower receiving area measures the solar radiation reflected from the ground (albedo) and the radiation length wavelengths emitted from the earth.
The instrument is designed and constructed to be used outdoors in any weather conditions.
Besides its use in meteorology to measure energy balance, the LP NET 07 can be used indoors for the measurement of radiant temperature (ISO 7726)

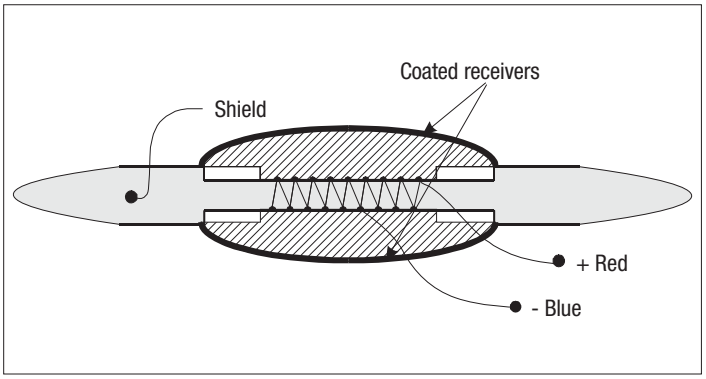
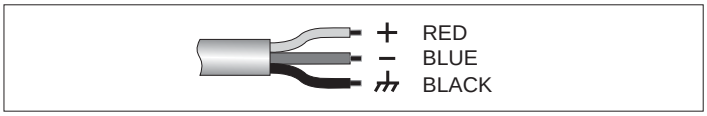


FIG. 1

Working Principle
The net radiometer LP NET 07 is based on a thermopile sensor whose warm joints are in thermal contact with the receiver while the upper cool joints are in thermal contact with the lower receiver. The temperature difference between the two receivers is proportional to the net irradiation. The temperature difference between hot and cold junction is converted into a voltage by Seebeck effect. The two receivers are made from a portion of spherical coated Teflon®. The particular form of the two receivers provides a response in accordance with the cosine. The Teflon® coating, as well as allowing outdoor installation for long periods without risk of damage, can have a constant spectral response from ultraviolet (200nm) up to far infrared (100 µm).

Installing and mounting the net radiometer for total irradiance measurements:
- To allow cleaning the two receiving surfaces regularly, LP NET 07 should be mounted in easily reachable places. The surfaces can be washed with plain water or pure ETHIL alcohol.
- Mount the instrument so that no shadow will be cast on it at any time of day and of the seasons, from obstructions such as buildings, trees, or any other obstacle.
- In the NORTHERN hemisphere, the net radiometer is normally oriented towards SOUTH, while it should be oriented NORTHWARD, in the SOUTHERN hemisphere.
- The instrument should be mounted at a height of at least 1.5 m above the ground. Please note that the flow on the lower receiver is representative of a circular area with a radius of 10 times the height.
- When installing the net-radiometer avoid, wherever possible, to touch the surfaces of the receiving net-radiometer.

CONNECTION DIAGRAM LP NET 07



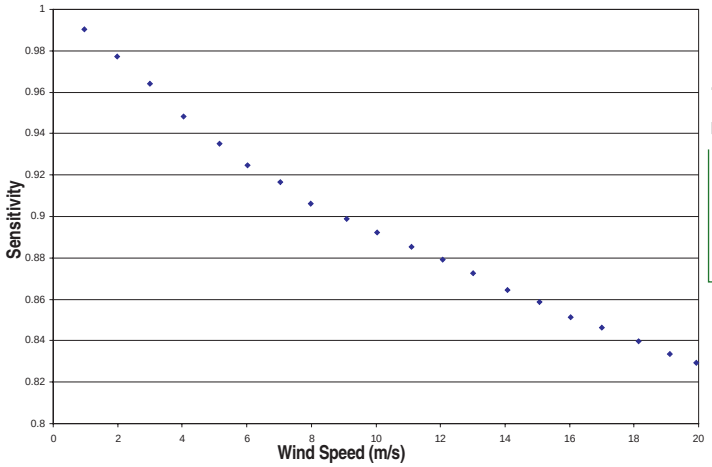


FIG. 2

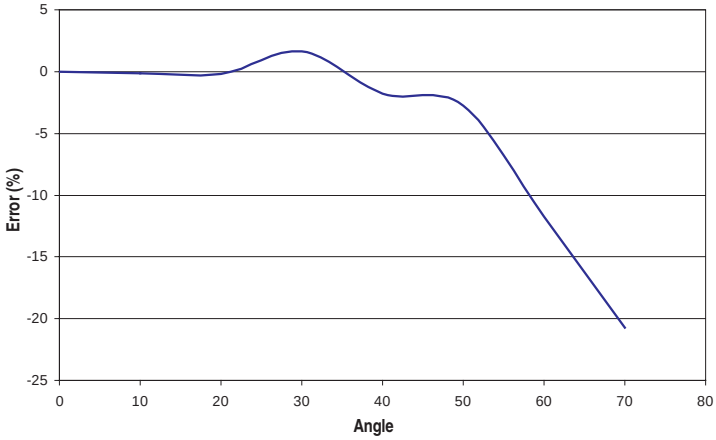


FIG. 3

Electrical Connections and requirements for electronic reading:

- LP NET 07 does not require any power supply.
- It is available with a 5 m output cable
- It is supplied with a PTFE, UV resistant, braided shield and 2-wire cable. The colour code is as follows:
  black → connected to the housing
  red → (+) positive pole of the signal generated by the detector
  blue → (-) negative pole of the signal generated by the detector
  Fig.1 shows the wiring diagram.
- It has to be connected to a millivoltmeter or to a data acquisition system with input impedance higher than 4000 Ω. Normally, the output signal from the net radiometer does not exceed ±20 mV. In order to grant the best performances in measurements, the instrument resolution should be of 1µV.

Maintenance:

In order to ensure a high measurement accuracy, it is necessary to keep the to keep the two receiving surfaces clean, the higher the frequency of cleaning, the best measurement accuracy will be.
Cleaning can be done with normal tissue for the cleaning of lens and water, if not enough, just use pure ethyl alcohol. After cleaning with alcohol it is necessary to clean the domes again with water only.
We strongly recommend to calibrate LP NET 07 annually. The calibration can be carried out by comparison with another net-radiometer sample in the field. The field calibration is less precise than a calibration performed in the laboratory but has the advantage of not having to remove the instrument from its housing.

Calibration and measurements:

Net radiometer sensitivity, indicated as S (or calibration factor), allows determining the net radiant flow passing through a surface. **S factor is measured in µV/(Wm^{-2}).**

• Measured the potential difference (DDP) at the ends of the flow probe is obtained by the following formula E_e

$$E_e = DDP/S$$

where;

E_e: indicates the radiant flux expressed in W/m^2,

DDP: indicates the potential difference expressed in µV and measured by the multimeter,

S: indicates the calibration factor expressed in µV/(W/m^2) and shown on the net radiometer label (calibration factor is also mentioned in the calibration report).

N.B. If the difference of potential (DDP) is positive, the radiation on the upper surface is higher than the radiation on the lower surface (typically during daylight hours); if DDP is negative, the radiation on the lower surface is higher that the one on the upper surface (typically at night).

Each net-radiometer is individually calibrated at the factory and is distinguished by its calibrator factor.

Calibration is performed inside Delta Ohm Metrological Laboratory and **performed with a net radiometer-reference with a solar simulator as the source of light. Calibration is performed with a beam of light in parallel.**

Sensitivity to wind speed:

At the same radiant flux, by increasing the wind speed decreases the net radiometer output signal will (sensitivity decrease by increasing wind speed).
Measurements taken inside the wind tunnel, have shown that S_V sensitivity, related to the wind speed for LP NET 07, can be corrected by using the following functions:

$S_v=S_0(1-0.011\times V)$ per V≤10m/s
$S_v=S_0(0.95-0.006\times V)$ per 10m/s<V<20m/s

Where: S_0 = sensitivity at zero wind speed
V = wind speed in m/s

Fig. 2 shows the calibration factor related with wind speed.

Once we know both the net radiation - calculated through the sensitivity at zero wind speed (F_{net_0}) - and the wind speed in (V) in m/s, the correct data is obtained by using the following formula:

$F_{net}=F_{net\_0}/(1-0.011\times V)$ per V≤10m/s
$F_{net}=F_{net\_0}/(0.95-0.006\times V)$ per 10m/s<V<20m/s

Cosine response/Directional error:

The radiation falling on a surface should be measured with a sensor, whose response related to the light incidence angle, has to be a Lambertian Response. A receiver is known as Lambertian when its sensibility (S_ϑ), related to the incidence angle between the light and the detector surface, has the following behavior:

$$S_\vartheta = S_0 \cos(\vartheta)$$

Where: S_0 is the sensitivity when light strikes perpendicular to the surface, ϑ is the angle between the incident light beam and the line which is normal to the surface.
Fig. 3 shows the typical behaviour of the error related to the angle of incidence.

Technical specifications:

Typical sensitivity:	10 µV/(W/m^2)
Impedance:	2Ω ÷ 4Ω
Measuring range:	±2000 W/m^2
Spectral range:	0.2 µm ÷100 µm
Operating temperature:	-40 °C ÷ 80 °C
Weight:	0.35 Kg
Response time (95%):	<75 sec

ORDERING CODE

LP NET 07: Net radiometer. Connecting cable: 5 m standard length, complete with Ø 16x500 rod for attachment to a mast Different cable lengths upon request.

HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range -10..+60mV. Default setting 0÷20mV. 2-module DIN housing. Minimum measuring range 2mV.

HD978TR5: Wall configurable, signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range –10...+60mV. Default settings 0÷20mV. Minimum measuring range 2mV. Wall mouting, dimensions: 58mmx65mmx35mm height.

HD978TR4: Configurable signal converter amplifier with 0÷10 Vdc (10÷0Vdc) output.
Input measuring range -10..+60mV. Default setting 0÷20mV.
Minimum measuring range 2mV. 2-module DIN housing.

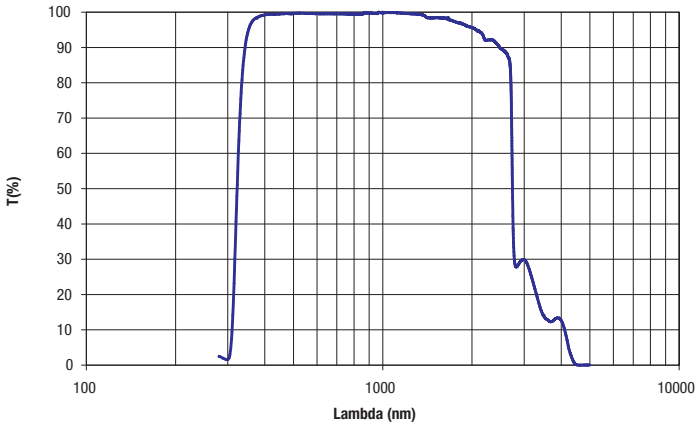
HD978TR6: Wall configurable, signal converter amplifier with 0÷10 Vdc (10÷0Vdc) output. Input measuring range –10...+60mV. Default settings 0÷20mV. Minimum measuring range 2mV. Wall mouting, dimensions: 58mmx65mmx35mm height.

LP NET 14
NET IRRADIANCE METER

LP NET 14 is a 4-component net-radiometer for the measurement of the net radiation between 0.3µm and 45 µm.
The net-radiometer consists of two pyranometers (one for the measurement of the global radiation $E_{sw}\downarrow$ and the other one for the measurement of the reflected solar radiation $E_{sw}\uparrow$) and a pair of pyrgeometers (one for the measurement of the infrared radiation emitted by the sky $E_{FIR}\downarrow$ and the other one for the infrared emitted by the ground surface $E_{FIR}\uparrow$).
The LP NET 14 is equipped with a temperature sensor (NTC). The measurement of the temperature is needed for the measurement with the two pyrgeometers, in fact, the far infrared is derived by measuring the thermopile output and by the knowledge of the instrument's temperature.
The net radiometer is suitable for outdoor use in all weather conditions and requires little maintenance.

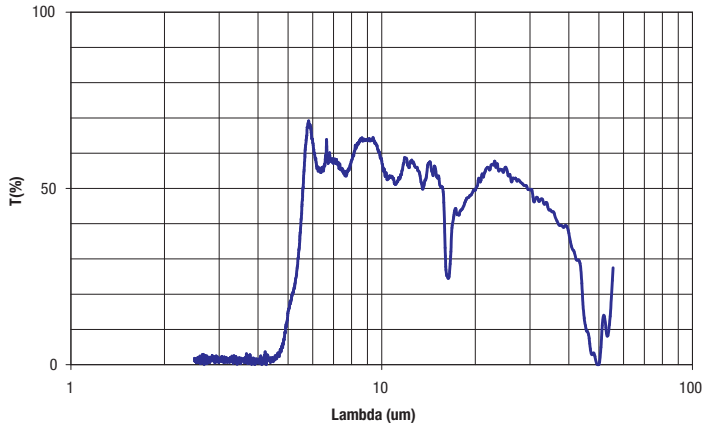
2) Working principle
The pyranometers that make up the LP NET 14 measure the radiation for wave lengths between 0.3µm e 3.0µm, while the pyrgeometers measure the irradiance in the spectral range between 4.5µm and 45µm.

The pyranometers are based on a thermopile sensor which sensitive surface is covered by a matt black paint so to allow the instrument not to be selective at various wavelengths. The pyranometer spectral range is determined by the transmittance of the two glass domes type K5 (See fig. 1).
Radiant energy is absorbed by the thermopile black surface, creating a difference of temperature between the centre 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.



Graphic 1: Relative spectral response of the Delta Ohm pyranometers.

Also the pyrgeometers are based on a thermopile. In this case, to protect the thermopile, silicon discs are used. Silicon is transparent to wavelengths longer than 1.1µm therefore on the inside of the window there is a filter to block radiation up to 4.5- 5 µm. The silicon external surface, which is exposed to weathering, is coated with a scratch-resistant coating (DLC) to ensure strength and durability in all weather conditions. The anti-scratch coating offers the advantage of cleaning the surface without risk of scratching the window. Graphic 2 reports the transmission of the silicon window according to the wavelength variation:



Graphic 2: Transmission of the silicon window.

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 pyrgeometer (cold junction). The temperature difference between hot and cold junction is converted into Potential Difference thanks to the Seebeck effect.
If the pyrgeometer temperature is higher than the radiant temperature of the portion of sky framed by the pyrgeometer, the thermopile will irradiate energy and the output signal will be negative (typical situation of clear sky) vice versa if the pyrgeometer temperature is lower than that portion of sky framed, the signal will be positive (typical situation of cloudy sky).
Therefore, for the calculation of the ground infrared ($E_{FIR}\downarrow$), besides the thermopile output signal, is necessary to know the T temperature of the pyrgeometer, as reported under the formula 1:

$$E_{FIR}\downarrow = E_{term.} + \sigma T_B^4 \qquad 1$$

Where:
E_{term} = net radiation (positive or negative), measured by the thermopile [W m^{-2})], the value is calculated by the sensitivity of the instrument (C) [µV/ (W m^{-2})] and by the output signal (U_{emf}) from formula 2;

$$E_{term.} = \frac{U_{emf}}{C} \qquad 2$$

σ = Stefan-Bolzmann constant (5.6704x10^{-8} W m^{-2} K^{-4});

T_B = pyrgeometer temperature (K), obtained by the reading of the NTC (10kΩ) resistance. In the manual (Table 1) is reported the resistance value according to the temperature for values included between -25°C and +55°C.

The first term of the formula 1 represent the net radiation, that is to say the difference between ground infrared radiation and the pyrgeometer emission, while the second term is the radiation emitted by an object (taken with submissiveness ε=1) at T_B temperature.

3) Installation and mounting of the net-radiometer for the infrared radiation measure:

Before installing the net-radiometer you need to load the cartridge containing silica gel crystals. The silica gel has the function of absorbing humidity present inside the instrument; in particular climatic conditions this humidity can lead to condensation on the inner surface of the silicon window. 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 six screws that fix the inner cap of the net-radiometer.
2- remove (if present) the old cartridge and the marker
3- open the envelope containing the silica gel and the marker
4- insert the cartridge in the salts-compartment
5- insert the marker so that it can easily be checked without opening the salts-compartment
6- tighten the six screws on the lid, make sure that the seal is positioned correctly.
7- the net-radiometer is ready for use

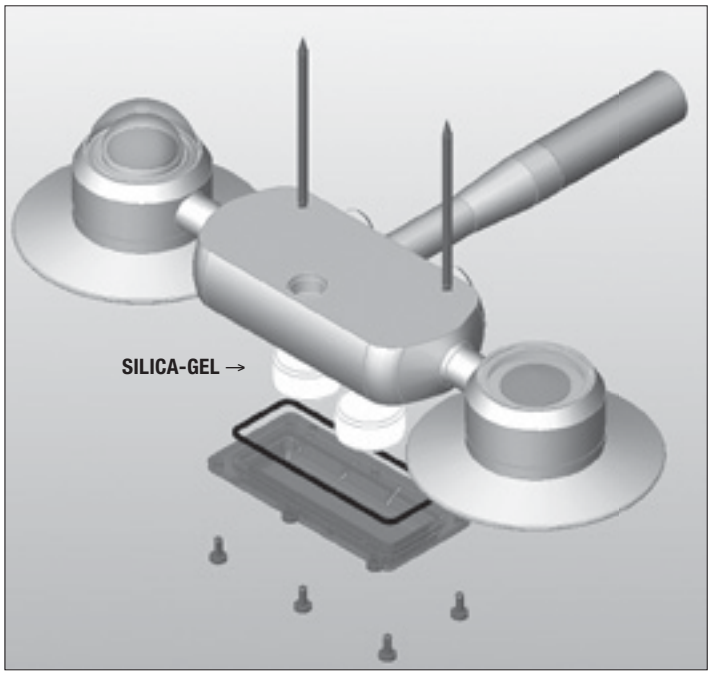


FIG. 3

- The LP NET 14 has 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 lies the instrument. In case this is not possible it is advisable to choose a location where the obstacles are lower than 10 °.
- Usually the instrument is placed so that the cable comes out from the side of the NORTH pole, when it is used in the NORTHERN hemisphere; from the side of the SOUTH pole when it is used in the SOUTHERN hemisphere, according to the standard ISO TR9901 and other WMO recommendations. In any case, it is preferable to comply with these recommendations also when the screen is used.
- For an accurate horizontal positioning, the LP NET 14 has to be fixed on a support pole by using the fixing bracket (see fig. 4).

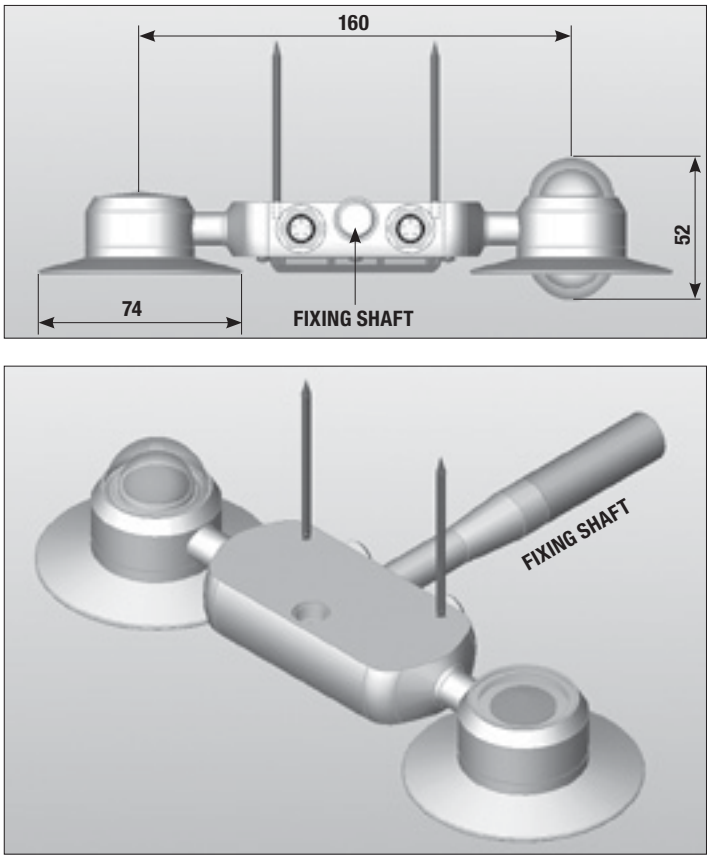


FIG. 4

4) Electrical Connections and requirements for electronic reading:

- The net-radiometer LP NET 14 does not need any power supply.
- The instrument is equipped with two M12 8 pole connectors.
- The optional cables end with an 8 pole connector on one side and open wires at the other side. The cable is made in UV-resistant PTFE and is provided with 7 wires plus braid (screen), the diagram with the correspondence between wire colours and connector poles is the following (figure 5):

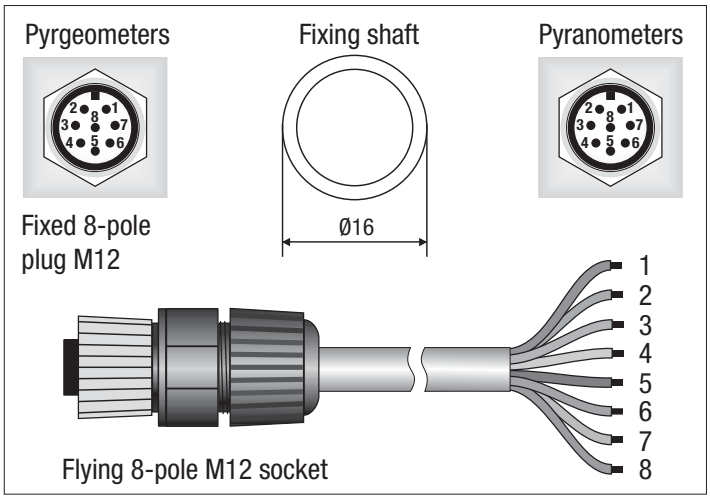


FIG. 5

Connector	Function		Colour
	Pyrgeometers	Pyranometers	
1	V_{out} (+) E_{FIR} ↓	V_{out} (+) E_{SW} ↓	Red
2	V_{in} (-) E_{FIR} ↓	V_{in} (-) E_{SW} ↓	Blue
3	screen (⏚)	screen (⏚)	Screen
4	NOT CONNECTED		
5	V_{out} (-) E_{FIR} ↑	V_{out} (-) E_{SW} ↑	Brown
8	V_{in} (+) E_{FIR} ↑	V_{in} (+) E_{SW} ↑	Green
6	NTC	NOT CONNECTED	White
7	NTC	screen (⏚)	Black

Table 1: correspondence pin-function

In order to obtain a measure, it is necessary to acquire simultaneously the signal of the four thermopiles and the NTC.
To measure the output signals of the four thermopiles, the four channels have to be connected to a millivoltmeter or a data logger. In order to fully exploit the features of the net-radiometer, the recommended resolution of the reading instrument is 1µV.
Moreover, it is necessary to read the NTC resistance so to determine temperature of the two pyrgeometers.

Under figure 6 the electrical connections necessary to read the signal of the four thermopiles and the NTC are reported.

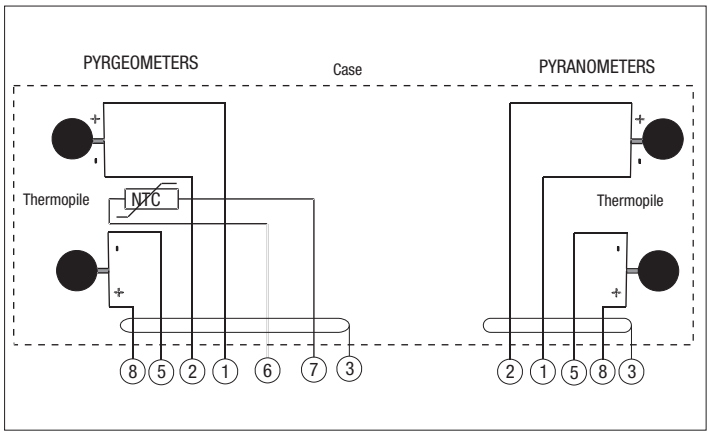


FIG. 6

5) Maintenance
In order to ensure a high measurement accuracy, it is necessary to always keep clean the silicon window and the glass domes of the net-radiometer, so the higher the frequency of cleaning is the best measurement accuracy will be. Cleaning can be done with normal tissues for cleaning photographic objectives and water, if not possible, simply use pure ethyl alcohol. After cleaning with alcohol, it is necessary also to clean the domes again with water only.
Due to the high temperature fluctuations between day and night, it is possible that you get some condensation inside the pyrgeometers and pyranometers (especially on the silicon window); in this case the reading is wrong. To minimize condensation inside the pyrgeometers, a proper cartridge with absorbent material is inside: Silica gel.

The efficiency of silica-gel crystals decreases over time with the absorption of moisture. Typically the duration of silica gel ranges from 4 to 12 months depending on environmental conditions the instrument operates in. In order to evaluate easily the efficiency status of the salt, within each charge there's a marker added, to be placed at the bottom of the salt compartment so that it can be seen. When it indicates the presence of humidity, it is necessary to replace the salts. Hail of particular intensity or dimension may damage the silicon window, therefore, after an intense storm with hail, it is recommended to check the status of the window.

6) Calibration and measurements:
Each pyranometer and pyrgeometer that composes the instrument is calibrated individually
The calibration factor **S** is given in µV/(Wm^{-2}).
- Once the potential difference (DDP) has been measured at sensor ends, E_e irradiance is obtained through the following formula:

$$E_e = DDP/S$$

where;
E_e: indicates the irradiance expressed in W/m²,
DDP: indicates the potential difference expressed in µV and measured by the multimeter.
S: indicates the calibration factor expressed in µV/(W/m²) and shown on the net radiometer label (calibration factor is also mentioned in the calibration report).

Each net radiometer comes factory calibrated and has its own calibration factor.

The measurement with the two pyrgeometers ha to be performed as follows:
According to the NTC $\mathbf{R_{NTC}}$ [ohm] resistance it is possible to trace the pyrgeometer temperature (T_b) back by using the formula 3:

$$\frac{1}{T_b} = a+b\cdot\log(R_{NTC})+c\cdot(R_{NTC})^3 \qquad 3$$

Where:
a=10297.2x10^{-7};
b=2390.6x10^{-7};
c=1.5677x10^{-7}.
Temperature is expressed in Kelvin degrees.
N.B. The values between -25 ° C to +58 ° C are tabulated in Table 2, to obtain the value in degrees Kelvin, use the appropriate conversion

T [°C]	R_{NTC} [Ω]	T [°C]	R_{NTC} [Ω]	T [°C]	R_{NTC} [Ω]
-25	103700	3	25740	31	7880
-24	98240	4	24590	32	7579
-23	93110	5	23500	33	7291
-22	88280	6	22470	34	7016
-21	83730	7	21480	35	6752
-20	79440	8	20550	36	6499
-19	75390	9	19660	37	6258
-18	71580	10	18810	38	6026
-17	67970	11	18000	39	5804
-16	64570	12	17240	40	5592
-15	61360	13	16500	41	5388
-14	58320	14	15810	42	5193
-13	55450	15	15150	43	5006
-12	52740	16	14520	44	4827
-11	50180	17	13910	45	4655
-10	47750	18	13340	46	4489
-9	45460	19	12790	47	4331
-8	43290	20	12270	48	4179
-7	41230	21	11770	49	4033
-6	39290	22	11300	50	3893
-5	37440	23	10850	51	3758
-4	35690	24	10410	52	3629
-3	34040	25	10000	53	3505
-2	32470	26	9605	54	3386
-1	30980	27	9228	55	3386
0	29560	28	8868	56	3271
1	28220	29	8524	57	3161
2	26950	30	8195	58	3055

Table 2: NTC resistance values as a function of temperature.

Once the pyrgeometer temperature in Kelvin degrees and the thermopile output signal are known U_{emf} [µV], irradiance $E_{FIR}\downarrow$ [W/m²] is obtained by the formula 1:

$$E_{FIR}\downarrow = \frac{U_{emf}}{C} + \sigma \cdot T_B^4 \qquad 4$$

Where:

C = pyrgeometer calibration factor [µV /(W/m²)] reported on the calibration report;

σ = Stefan-Bolzmann constant (5.6704×10^{-8} W m^{-2} K^{-4}).

Each pyrgeometer is individually calibrated at the factory and is distinguished by its calibration factor.

Pyrgeometer calibration is performed outdoors, by comparison with a sample pyrgeometer calibrated by the World Radiation Centre (WRC).

The two instruments are kept outdoors for a few days and nights in the presence of clear sky. The data acquired by a data logger is then processed to obtain the calibration factor.

To fully exploit the features of the probe LP NET 14, it is recommended to perform the calibration verification every one or two years (the choice of calibration interval depends both on the accuracy to be achieved and on the installation location).

7) Technical specifications

PYRANOMETERS

II° Class pyranometer according to ISO 9060

Typical sensitivity:	10 µV/(W/m²)
Impedance:	33 Ω ÷ 45 Ω
Measuring range:	0-2000 W/m²
Field of view:	2π sr
Spectral range:	305 nm ÷ 2800 nm (50%)
(dome transmission)	335 nm ÷ 2200 nm (95%)
Working temperature:	-40 °C ÷ 80 °C

PYRGEOMETERS

Typical sensitivity:	5-10 µV/(W/m²)
Impedance:	33 Ω ÷ 45 Ω
Measuring range:	-300 ÷ +300 W/m²
Viewing field:	160°
Spectral range:	5.5 µm ÷ 45 µm (50%)
(silicon window transmission)	
Working temperature:	-40 °C ÷ 80 °C

ORDERING CODES

LP NET 14: Net-radiometer equipped with:
bracket Ø=16 mm length 400 mm, 2 bird spikes, 2 recharges of desiccant (composed of 5 silica-gel cartridges and one marker), level, 2 8-pole M12 connectors and Calibration Report.

ACCESSORIES

LPG2: 2 Recharges composed of 2 silica gel cartridges.
CPM12AA8.5: Cable with 8-pole M12 connector, 5 meters long.
CPM12AA8.10: Cable with 8-pole M12 connector, 10 meters long.

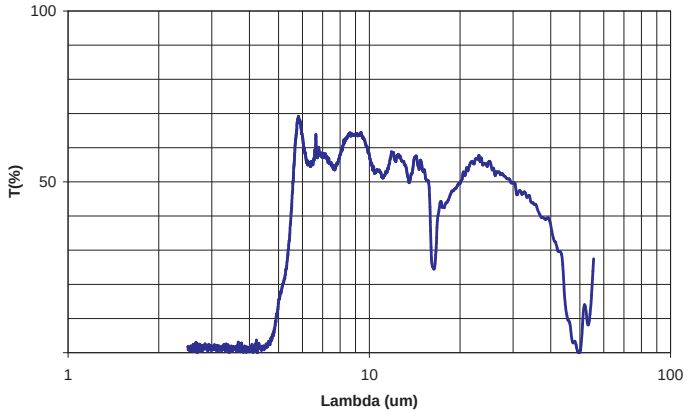
LP PIRG 01
PYRGEOMETER

The pyrgeometer LP PIRG 01 is used to measure the far infrared radiation (FIR). Its use is mainly in the meteorological field. Measures are referred to radiations with wavelength greater than 4.5 µm .
The far infrared radiation derives from the measure of the thermopile output signal and from the knowledge of the instrument temperature. The temperature measure is performed by a 10kΩ NTC which is inside the body of the pyrgeometer.
The pyrgeometer can be used also for the study of energy balance. In this case, besides another pyrgeometer which measures infrared radiation upwards, it is necessary to have an albedometer (LP PYRA 05 or LP PYRA 06) to measure short wavelengths radiation (<3µm) .

2) Working Principle

The pyrgeometer LP PIRG 01 is 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 sensor is covered by silicon window that has two basic purposes:

1- protect the thermopile from the weather;
2- determine the instrument spectral range: silicon is transparent to wavelengths longer than 1.1µm, therefore on the inside of the window there is a filter to block radiation up to 4.5- 5 µm. The silicon external surface, which is exposed to weathering, is coated with a scratch-resistant coating (DLC) to ensure strength and durability in all weather conditions. The anti-scratch coating offers the possibility of cleaning the surface without risk of scratching the window. Graphic 1 reports the transmission of the silicon window according to the wavelength variation:



Graphic 1: Transmission of the silicon window.

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 pyrgeometer (cold junction). The temperature difference between hot and cold junction is converted into Potential Difference thanks to the Seebeck effect.
If the pyrgeometer temperature is higher than the radiant temperature of the portion of sky framed by the pyrgeometer, the thermopile will irradiate energy and the output signal will be negative (typical situation of clear sky) vice versa if the pyrgeometer temperature is lower than that portion of sky framed, the signal will be positive (typical situation of cloudy sky).
Therefore, for the calculation of the ground infrared ($E_{FIR}\downarrow$), besides the thermopile output signal, is necessary to know the T temperature of the pyrgeometer, as reported under the formula 1:

$$E_{FIR}\downarrow = E_{term.} + \sigma \cdot T_B^4 \qquad 1$$

Where:

E_{term} = net radiation (positive or negative) measure by the thermopile [W m^{-2})], the value is calculated by the sensitivity of the instrument (C) [µV/ (W m^{-2})] and by the output signal (U_{emf}) from formula 2;

$$E_{term.} = \frac{U_{emf}}{C} \qquad 2$$

σ = Stefan-Bolzmann constant (5.6704x10^{-8} W m^{-2} K^{-4});

T_B = pyrgeometer temperature (K), obtained by the reading of the NTC (10kΩ) resistance. In the manual (Table 1) is reported the resistance value according to the temperature for values included between -25°C and +55°C.

The first term of the formula 1 represent the net radiation, that is to say the difference between ground infrared radiation and the pyrgeometer emission, while the second term is the radiation emitted by an object (assuming emissivity ε=1) at T_B temperature.

3) Installation and mounting of the pyrgeometer for the infrared radiation measure:

Before installing the pyrgeometer you need to load the cartridge containing silica gel crystals. The silica gel has the function of absorbing humidity present inside the instrument; this humidity can lead to condensation on the inner surface of the silicon window. 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 pyrgeometer) 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 pyrgeometer 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 pyrgeometer is ready to be used

Figure 1 shows the operations necessary to fill the cartridge with the silica-gel crystals.

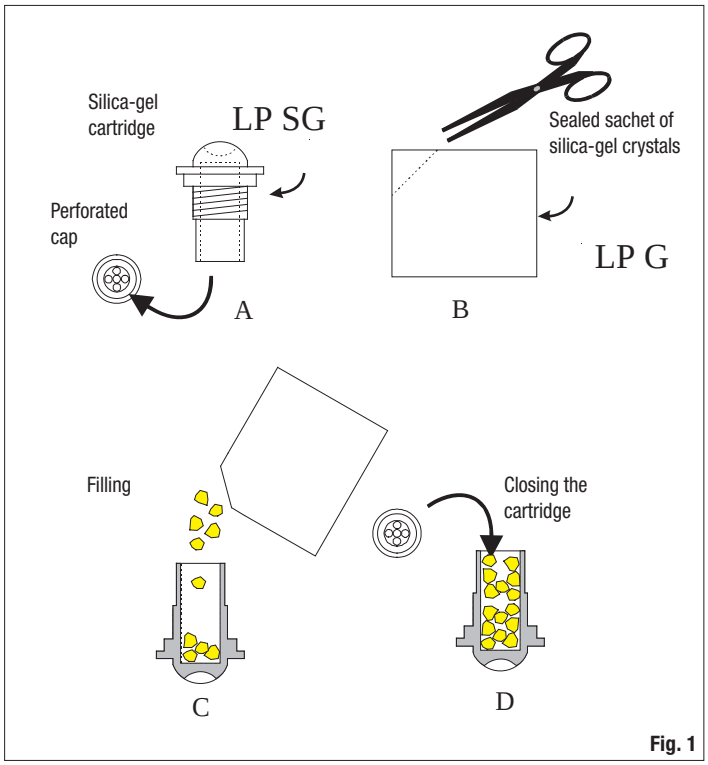


Fig. 1

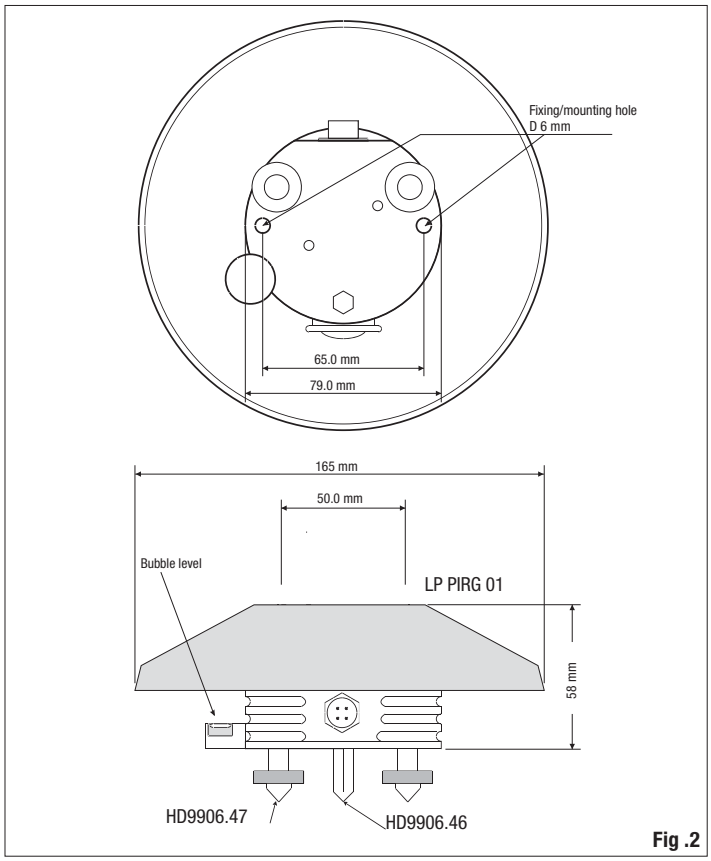


Fig .2

- The LP PIRG 01 has 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 pyrgeometer lies. In case this is not possible it is advisable to choose a location where the obstacles are lower than 10°.
- Usually the instrument is placed so that the cable comes out from the side of the NORTH pole, when it is used in the NORTHERN hemisphere; from the side of the SOUTH pole when it is used in the SOUTHERN hemisphere according to the standard ISO TR9901 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 pyrgeometer LP PIRG 01 is equipped with a spirit level, which adjustment is by two screws with lock nut that allows changing the pyrgeometer 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 2.

- The support LP S1 (figure 3), supplied upon request as an accessory, allows an easy mounting of the pyrgeometer support pole. The maximum diameter of the pole to which the bracket can be secured is 50 mm. To secure the pyrgeometer to the bracket, remove the screen by unscrewing the three screws, fix the pyrgeometer; once the installation is complete, fix the white screen back.

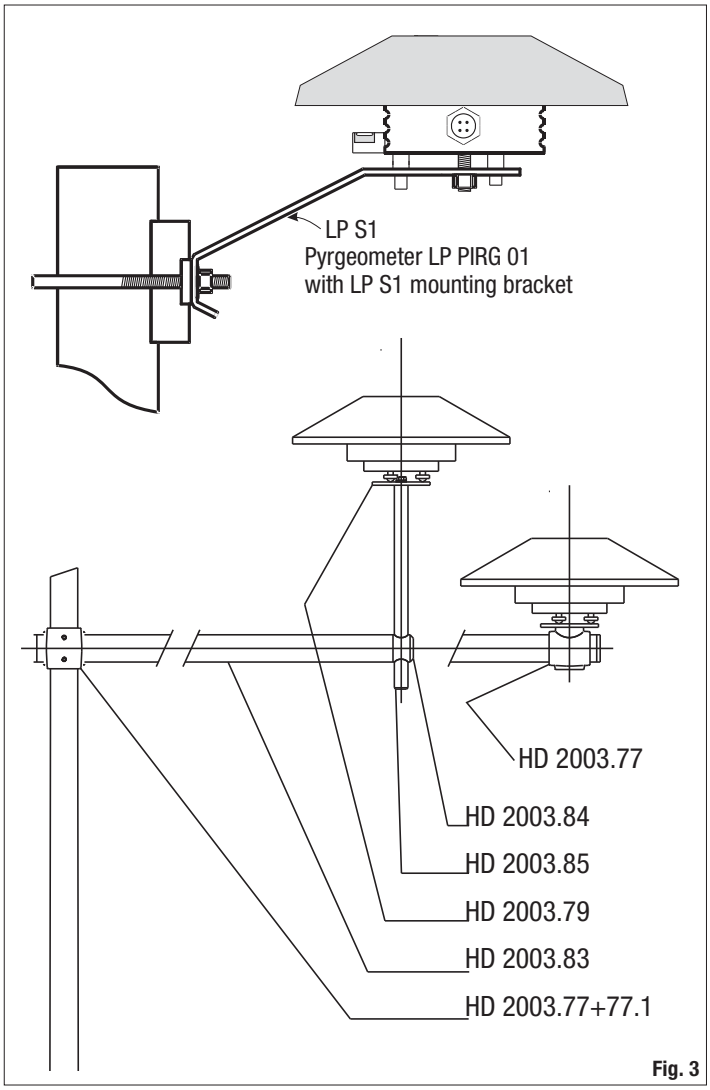


Fig. 3

4) Electrical Connections and requirements for electronic reading:

- The pyrgeometer LP PIRG 01 does not need any power supply.
- The instrument is equipped with an 8-poles M12 output
- The optional cable, ending with a connector by one side, is made in PTFE resistant to UV and is provided with 7 wires plus braid (screen), the diagram with the correspondence between cable colours and connector poles is the following (figure 4):

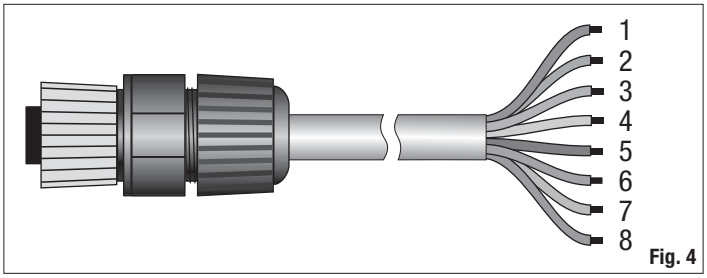


Fig. 4

Connector	Function	Colour
1	V_{out} (+)	Red
2	V_{in} (-)	Blue
3	Housing ($\not\perp$)	White
4	NTC	Green
8		Black
5	Screen ($\perp$)	Brown
6 and 7	NOT Connected	

Figure 4: correspondence pin-function

To measure the output signal from the thermopile (Chapters 1-2) the pyrgeometer has to be connected to a data-logger or digital voltmeter (DVM). Typically the output signal from the pyrgeometer is $|U_{emf}|<4$ mV. In order to fully exploit the features of the pyrgeometer, the recommended resolution of the reading instrument is 1µV. Moreover, it is necessary to read the NTC resistance so to determine the pyrgeometer temperature.
In Figure 5 the electrical connections present inside the pyrgeometer are reported.

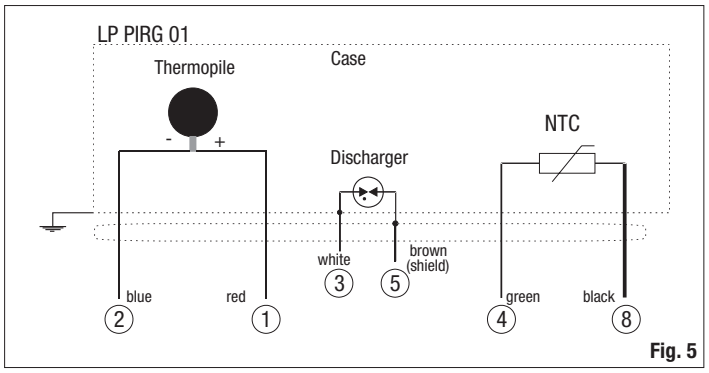


Fig. 5

Under figure 6 you can see a typical example of connection:

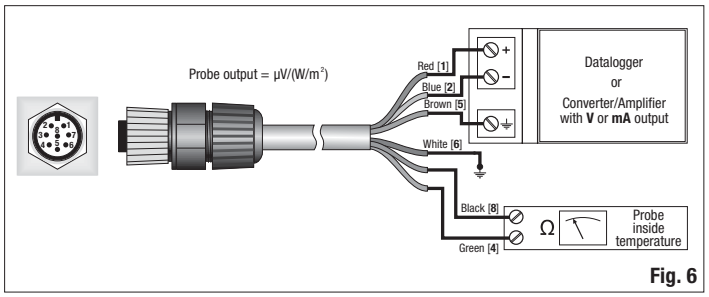


Fig. 6

Figure 6: example of connection of pyrgeometer

5) Maintenance:
In order to ensure a high measurement accuracy, it is necessary to keep clean the silicon window, so the higher the frequency of cleaning, the best measurement accuracy will be. Cleaning can be done with normal tissues for cleaning photographic objectives and water, if not possible, simply use pure ethyl alcohol. After cleaning with alcohol, it is necessary also to clean the silicon window again with water only.
Due to the high temperature fluctuations between day and night, it is possible that you get some condensation inside the pyrgeometer (especially on the silicon window); in this case the reading is wrong. To minimize condensation inside the pyrgeometer, a proper cartridge Silica gel is supplied with the instrument.
The efficiency of silica-gel crystals decreases over time with the absorption of moisture. When crystals of silica gel are efficient their colour is yellow, while when gradually losing efficiency their colour becomes transparent; in order to replace them please refer to the instructions under paragraph 3. Silica gel typically lifetime goes from 4 to 12 months Hail of particular intensity or dimension may damage the silicon window, therefore, after an intense storm with hail, it is recommended to check the status of the window.

6) Calibration and measurements:
According to the NTC $\mathbf{R_{NTC}}$ [ohm] resistance it is possible to trace the pyrgeometer temperature (T_b) back by using the formula 3:

$$\frac{1}{T_b} = a + b \cdot \log(R_{NTC}) + c \cdot \log(R_{NTC})^3 \qquad 3$$

Where:
$a=10297.2x10^{-7}$;
$b=2390.6x10^{-7}$;
$c=1.5677x10^{-7}$.
Temperatura is expressed in Kelvin degrees.
N.B. In table 1 you can get the values between -25°C and +58°C; in order to obtain the value under Kelvin degrees it is necessary to sum 273.15 to the value read in Celsius degrees.

T [°C]	R_{NTC} [Ω]	T [°C]	R_{NTC} [Ω]	T [°C]	R_{NTC} [Ω]
-25	103700	3	25740	31	7880
-24	98240	4	24590	32	7579
-23	93110	5	23500	33	7291
-22	88280	6	22470	34	7016
-21	83730	7	21480	35	6752
-20	79440	8	20550	36	6499
-19	75390	9	19660	37	6258
-18	71580	10	18810	38	6026
-17	67970	11	18000	39	5804
-16	64570	12	17240	40	5592
-15	61360	13	16500	41	5388
-14	58320	14	15810	42	5193
-13	55450	15	15150	43	5006
-12	52740	16	14520	44	4827
-11	50180	17	13910	45	4655
-10	47750	18	13340	46	4489
-9	45460	19	12790	47	4331
-8	43290	20	12270	48	4179
-7	41230	21	11770	49	4033
-6	39290	22	11300	50	3893
-5	37440	23	10850	51	3758
-4	35690	24	10410	52	3629
-3	34040	25	10000	53	3505
-2	32470	26	9605	54	3386
-1	30980	27	9228	55	3386
0	29560	28	8868	56	3271
1	28220	29	8524	57	3161
2	26950	30	8195	58	3055

Table 1: values of NTC resistance according to the temperature.

Once the pyrgeometer temperature in Kelvin degrees and the thermopile output signal are known U_{emf} [µV], irradiation $E_{FIR}\downarrow$ [W/m²] is obtained by the formula 1:

$$E_{FIR}\downarrow = \frac{E_{emf}}{C} + \sigma \cdot T_B^4$$

Where:
C = pyrgeometer calibration factor [µV /(W/m²)] reported on the calibration report;
σ = Stefan-Bolzmann constant ($5.6704x10^{-8}$ W m^{-2} K^{-4}).

Each pyrgeometer is individually calibrated at the factory and is distinguished by its calibration factor.
Pyrgeometer calibration is performed outdoors, by comparison with a reference standard pyrgeometer calibrated by the World Radiation Center (WRC).
The two instruments are kept outdoors for some nights in the presence of clear sky. The data acquired by a data logger is then processed to obtain the calibration factor.
To take full advantage of the LP PIRG 01 features, we recommend to perform the calibration every one, two years (the choice of calibration interval depends both on the accuracy to be achieved and on the installation location).

7) Technical specifications:

Typical sensitivity:	5-10 µV/(W/m²)
Impedance:	33 Ω ÷ 45 Ω
Measuring range:	-300÷+300 W/m²
Field of view:	160°
Spectral range: (transmission from the silica window)	5.5 µm ÷ 45 µm (50%)
Working temperature:	-40 °C ÷ 80 °C
Dimensions:	figure 2
Weight:	0.90 Kg

Technical specifications according to ISO 9060

Response Time (95%):	<28 sec
Off-set Zero (type B):	
response to a change of 5K/h	
of room temperature:	< | ±4 | W/m²
Long-term instability (1 year):	< | ±1.5 | %
Nonlinearity:	< | ±1 | %
Spectral selectivity:	< | ±5 | %
Temperature response:	<3 %
Tilt response:	< | ±2 | %

ORDERING CODES

LP PIRG 01: Pyrgeometer. Equipped with protection, silica-gel crystals cartridge, 2 richarges, level. 8-poles M12 connector and Report of Calibration ISO9001.

LP S1: Kit made of bracket for mounting pyrgeometer LP PIRG 01 to a pole with diameter 50mm

LP SP1: Protection screen made in plastic UV resistant. LURAN S777K della BASF

LP SG: Cartridge for silica-gel crystals equipped with OR and cap

LP RING 02: Base with levelling device and adjustable holder for mounting the LP PIRG 01 pyrgeometer in an inclined position.

LP S6: Kit for the installation of LP PIRG 01. The kit includes: 1 m mast (LP S6.05), base fitting (LP S6.04), graduated support plate (LP S6.01), bracket for HD9007 or HD32MTT.03.C (HD 9007T29.1), bracket for pyranometers (LP S6.03).

HD 2003.77/40: Clamping for mounting the LP PIRG 01 mast Ø 40mm

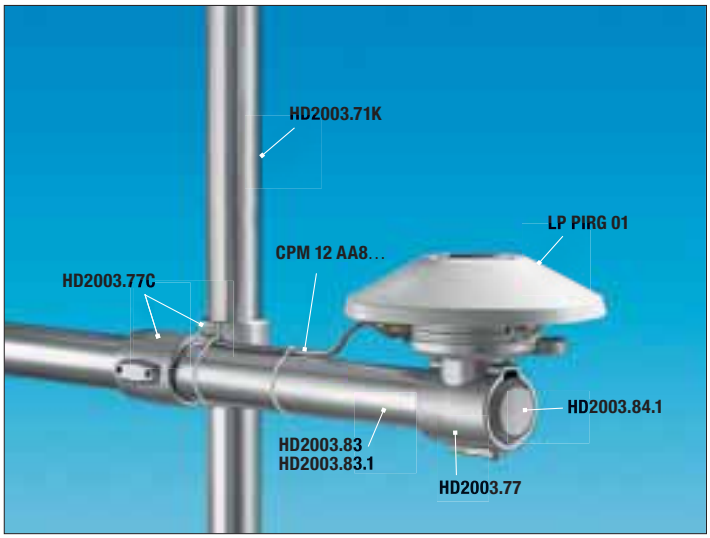
HD 2003.85K: Kit with adjustable height to mount pyranometers on Ø 40mm mast (HD2003.84,HD2003.85,HD2003.79)

LP G: Pack of 5 sachets of silica-gel crystals.

CPM12 AA8.2: 8-pole cable. Length 2m. 8-pole M12 connector on one end, open wires on the other side

CPM12 AA8.5: 8-pole cable. Length 5m. 8-pole M12 connector on one end, open wires on the other side

CPM12 AA8.10: 8-pole cable. Length 10m. 8-pole M12 connector on one end, open wires on the other side.



LP PIRG 01 + HD2003.77C + HD2003.77

LP PYRHE 16
PYRHELIOMETER

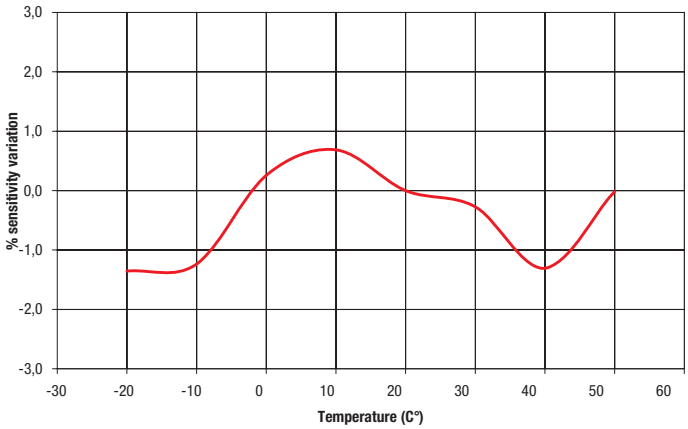
Introduction

The pyrheliometer LP PYRHE 16 (First Class Pyrheliometer according to ISO 9060 classification) is an instrument for direct measurement of solar irradiance (Watt/m^2). The receiving surface must be positioned (via a solar tracker or else) perpendicularly to sun's rays. The use of apposite diaphragms allows only direct light to hit the surface of the sensor. According to WMO (Seventh edition 2008) and ISO 9069 regulations, the pyrheliometer has a field of view of 5°.
The pyrheliometer is produced in three versions:

LP PYRHE 16	PASSIVE
LP PYRHE 16 AC	ACTIVE with 4..20 mA CURRENT output
LP PYRHE 16 AV	ACTIVE with 0..1V or 0..5V o 0..10 V VOLTAGE output **to be defined at the time of the order**
LP PYRHE S	ACTIVE with RS485 serial output with MODBUS-RTU protocol

Working Principle

The pyrheliometer LP PYRHE 16 is based on a new passive thermopile sensor. The sensitive surface of the thermopile is coated with a matt black paint, which makes the instrument not selective to the different wave lengths. The spectral range of the pyrheliometer is determined by the transmission of the quartz window, whose function is to protect the sensor from dust and water. A special quartz allows to perform a 200nm-4000nm non-selective measurement.
The adopted sensor allows the response time to be lower than ISO9060 requirements for the classification of first class pyrheliometers (the response time is under 9 seconds while the standard requires a response time lower than 20 seconds).
Radiant energy is absorbed by the blackened surface of the thermopile, thus creating a difference in temperature between the hot junction and the cold junction of the pyrheliometer, which acts in this case as a cold junction. Thanks to the Seebeck effect, the difference in temperature between hot and cold junction is converted into a Difference of Potential.In order to reduce the variations of sensitivity depending on temperature and to fall within the specifications requested to a secondary pyrheliometer, the LP PYRHE 16 is provided with a passive compensation circuit. Graph 1 shows the typical variation of sensitivity at different temperatures.



Graph 1: % variation of sensitivity of the LP PYRHE 16 pyrheliometer with regard to sensitivity at 20 °C, in the temperature range from -20 to 50°C.

Deviations are calculated starting from sensitivity measured at 20°C.

The LP PYRHE 16 is a sealed instrument, for that reason a cartridge of Silica-gel crystals is provided to dry the air inside the instrument, in order to prevent condensation from forming on the quartz window of the instrument, invalidating the performed measurements.
The angular field of view is 5° in accordance with WMO regulations and the slope angle is 1° (figure 1).

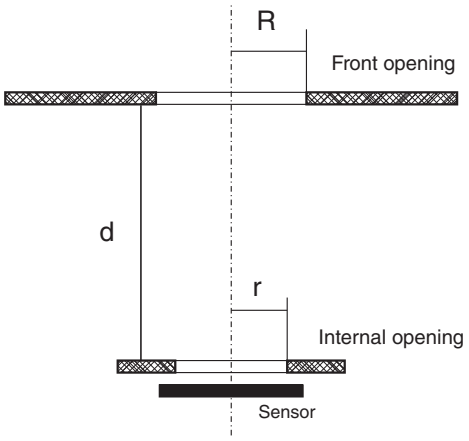


Fig.1: Field of view = 2 * arctan (R/d)
Slope angle = arctan ([R-r]/d)

A light shield can be introduced in order to reduce light scattering contribution when reading the pyrheliometer.
For spectral measurements of direct solar radiance, which are useful for the determination of the spectral thickness in the atmosphere, the pyrheliometer LP PYRHE 16 can be provided with a kit consisting of an appropriate light shield (which allows assemblage of the filter wheel) plus a revolving filter wheel. The filter wheel is equipped with the filters below:

Filter Type	Cutoff wave length [nm]		Average transmission coefficient
	Lambda short waves	Lambda long waves	
OG 530	526	2900	0.92
RG 630	630	2900	0.92
RG 695	695	2900	0.92

It can be ordered separately as an accessory.
The pyrheliometer dimensions are shown in figure 2:

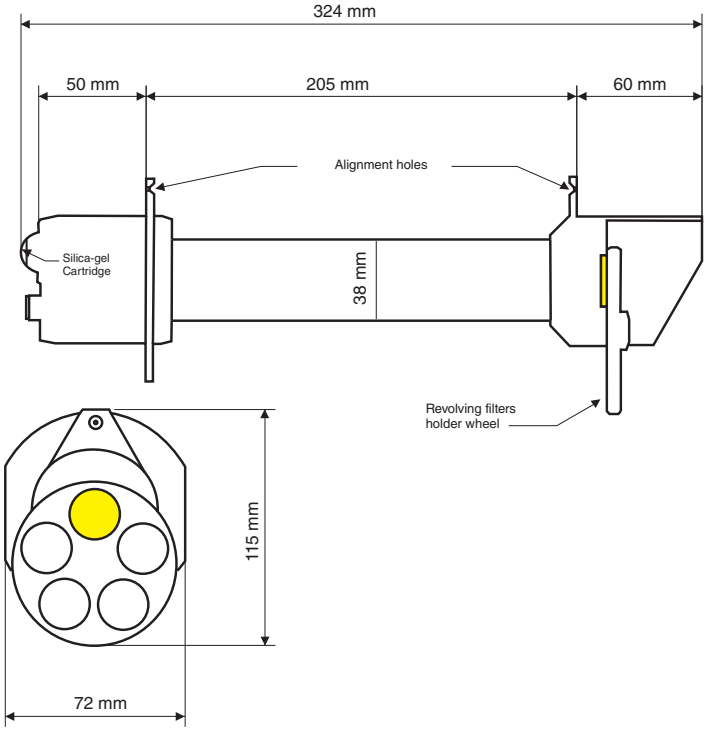


Fig. 2

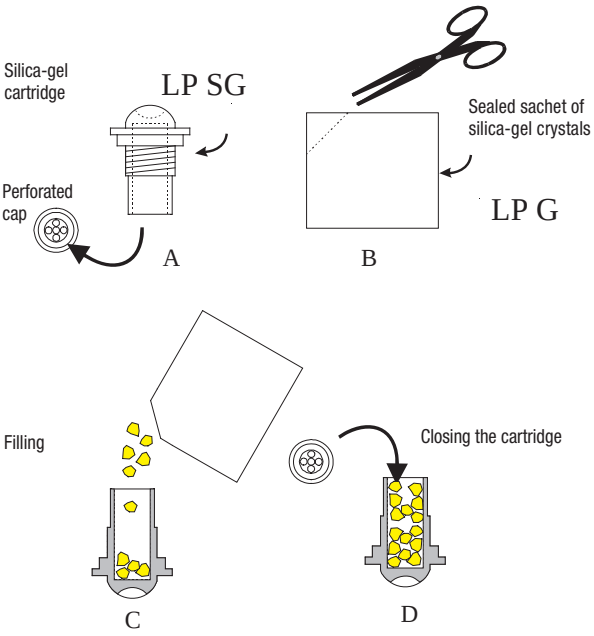


Fig. 3

Installing and assembling the pyrheliometer for the measurement of direct solar radiance:

Before installing the pyrheliometer, refill the cartridge with the silica-gel crystals. Silica-gel is used to absorb humidity inside the instrument, which – under particular climatic conditions – could lead to the formation of condensation on the internal wall of the quartz window, altering in this way the measurement. While refilling the silica-gel cartridge, avoid wetting it or touching it with your hands. The operations to be performed in a dry environment (as far as possible) are as follows:

1- Unscrew the silica-gel cartridge using a coin
2- Remove the perforated cap of the cartridge
3- Open the sachet (supplied with the pyrheliometer) containing the silica-gel
4- Fill the cartridge with the silica-gel crystals
5- Close the cartridge with its own cap, making sure the O-ring is correctly positioned
6- Screw the cartridge to the pyrheliometer body by means of a coin
7- Make sure the cartridge is screwed tight (or else the life of silica-gel crystal will be reduced)
8- the pyrheliometer is ready for use

Figure 3 briefly explains the necessary steps to fill the cartridge with the silica-gel crystals.

LP PYRHE 16 should be mounted in an easily reachable place to allow periodic cleaning of the quartz window and maintenance. At the same time, make sure that no buildings, trees or any other obstacles intercept the sun's path during the day all year long.

To point the pyrheliometer, the two holes in the front and back flange can be used. To properly align the instrument, just make sure that the sun's beams that pass through the first hole (on the front flange of the pyrheliometer) reach the second hole (on the back flange).

Electric connections and electronic readout device requirements:

LP PYRHE 16 is produced in four versions: LP PYRHE 16, LP PYRHE 16 AC, LP PYRHE 16 AV, LP PYRA 16 S

- LP PYRHE 16 version is passive and requires no power supply.
- LP PYRHE 16 AC, AV, S versions are active and require power supply. The requested voltage is :
  10-30 VDC for LP PYRHE 16 AC and LP PYRHE 16 AV versions with 0..1V and 0..5 V output.
  15-30 VDC for LP PYRHE 16 AV version with 0..10V output.
  5-30Vdc for version LP PYRHE 16 S with RS485 MODBUS-RTU output.
- All versions are provided with a 4-pole M12 output connector (8-poles for version S)
- The optional cable, with M12 connector at one end, is in UV-resistant PTFE, it is supplied with 3 wires plus shield, (4 wires plus shield for S version).

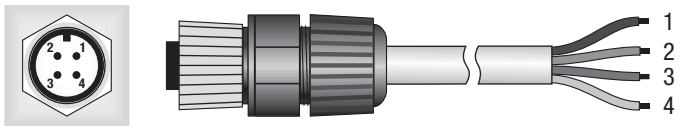


Fig. 4

LP PYRHE 16

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Housing (⏦)	White
4	Shield (⏚)	Black

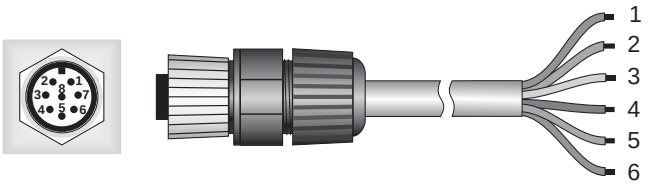
LP PYRHE 16 AC

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Shield (⏚)	White
4	Housing (⏦)	Black

LP PYRHE 16 AV

Connector	Function	Color
1	(+) Vout	Red
2	(-) Vout and (-)Vcc	Blue
3	(+) Vcc	White
4	Shield (⏚)	Black

WIRING DIAGRAM LP PYRHE 16 S



Fixed 8-pole plug M12 **Flying 8-pole M12**

Connector	Function	Color
1	Negative power supply (-) Vcc	Black
2	Positive power supply (+) Vcc	Red
4	RS485 A/-	Brown
5	RS485 B/+	White
6	Not connected	Blue
8	Not connected	Green

- LP PYRHE 16 has to be connected either to a millivoltmeter or to a data acquisition system. Typically, the pyrheliometer output signal does not exceed 20 mV. In order to better exploit the pyrheliometer features, the readout instrument should have a 1µV resolution.

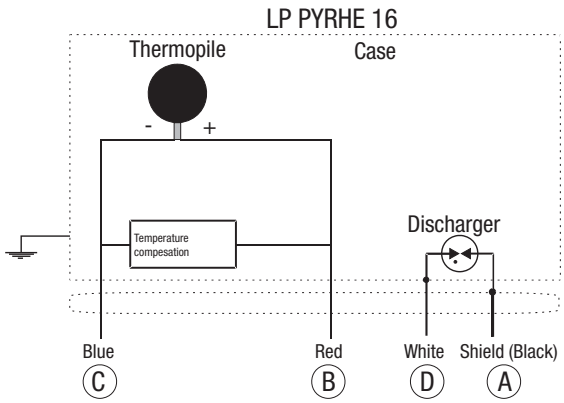


Fig. 5

An example of connection to a readout device is shown in figure 6.

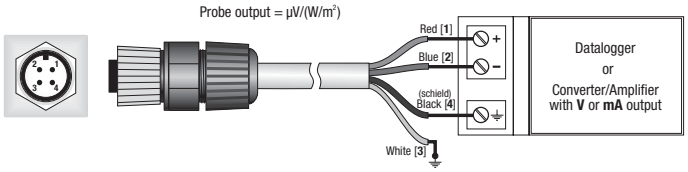


Fig. 6

- LP PYRHE 16 AC should be connected to a power supply device and to a multimeter according to the scheme below (figure 7), the load resistance for signal readout should be ≤ 500 Ω:

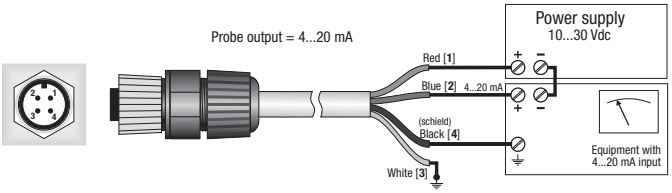


Fig. 7

- LP PYRHE 16 AV should be connected to a power supply device and to a multimeter according to the scheme below (figure 8), the load resistance for signal readout should be ≥ 100 kΩ:

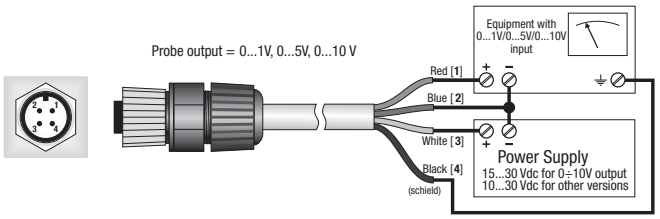


Fig. 8

- LP PYRHE 16 S should be connected according to the following scheme:

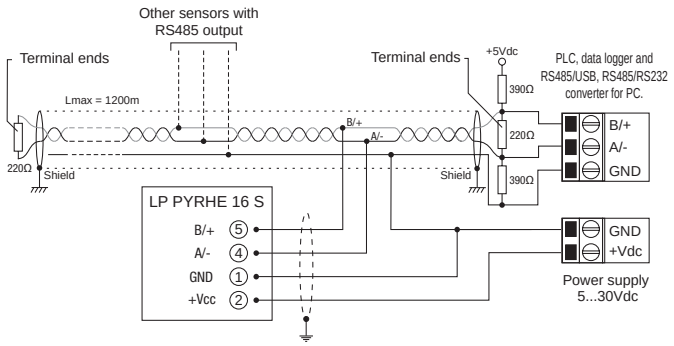


Fig.9

Maintenance:

In order to grant high measuring accuracy, the quartz window should be kept always clean; consequently, the higher is the cleaning frequency, the more measurements will be accurate. Cleaning can be performed with standard lens paper and with water, or alternatively with pure ETHIL alcohol. After alcohol cleaning, the window must be washed again with water.

Due to thermal shocks between day and night, some condensation can form on the access window; in this case, the performed readout will be strongly underestimated. In order to reduce condensation forming, an apposite cartridge filled with absorbent material is introduced inside the pyrheliometer: Silica-gel. The efficiency of silica-gel crystals decreases with time while they absorb humidity. When silica-gel crystals are efficient, their color is **yellow**, while as they loose efficiency, they turn **white/translucent**; see instructions at paragraph **3** for replacement. Typically, silica-gel life varies from 4 to 12 months according to the environmental conditions the pyrheliometer operates in.

Calibration and Measurements:

LP PYRHE 16

The sensitivity **S** of the pyrheliometer (or calibration factor) allows to determine direct irradiance by measuring a signal in Volts at the thermopile ends. The **S** factor is given in μV/(Wm^{-2}).

- Once the difference of potential (DDP) has been measured at the ends of the probe, the E_e irradiance is obtained by applying the formula below:

$$E_e = DDP/S$$

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 calibration factor in μV/(W/m^2) shown on the pyrheliometer label (and mentioned in the calibration report).

LP PYRHE 16 AC

The sensitivity of the pyrheliometer is factory-set so that:

4..20 mA = 0..2000 W/m^2

In order to obtain the direct irradiance value, once the current (I_{out}) absorbed by the instrument is known, the formula below should be applied:

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

where;

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

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

LP PYRHE 16 AV

The sensitivity of the pyrheliometer is factory-set so that, according to the chosen version, we have:

0..1 V = 0.. 2000 W/m^2

0..5 V = 0.. 2000 W/m^2

0..10 V = 0.. 2000 W/m^2

In order to obtain the irradiance value, once the instrument output voltage (V_{out}) is obtained, the formula below should be applied:

$E_e = 2000 \cdot V_{out}$ for 0…1 V version

$E_e = 400 \cdot V_{out}$ for 0…5 V version

$E_e = 200 \cdot V_{out}$ for 0…10 V version

where;

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

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

Each Pyrheliometer is factory calibrated and typified by its own calibration factor. To fully exploit all LP PYRHE 16 features it is recommended to perform an annual calibration check.

The equipment of the DeltaOhm Photo-Radiometry metrological laboratory allows to calibrate pyrheliometers according to WMO specifications and makes measurements referable to the international standards (WRR).

Technical Specifications:

Typical sensitivity:	5 μV/(W/m^2)	LP PYRHE 16, LP PYRA 16 S
	4..20 mA (0-2000 W/m^2)	LP PYRHE 16 AC
	0..1,5,10V (0-2000 W/m^2)	LP PYRHE 16 AV
Impedance:	5 Ω ÷ 50 Ω	
Measuring range:	0-2000 W/m^2	
Field of view:	5° (slope 1°)	
Spectral range:	200 nm ÷ 4000 nm (50%)	
Working Temperature:	-40 °C ÷ 80 °C	
Dimensions:	figure 1	
Weight:	1.5 Kg	

Technical Specifications according to ISO 9060

1	Response time (95%):	<9 sec
2	Zero Off-set: response to ambient temperature change of 5K/h:	<|±3|W/m^2
3a	long term instability (1 year):	<|±1| %
3b	Non-linearity:	<|±0.5| %
3d	Spectral selectivity:	<|±1| %
3e	Response depending on Temperature:	<|±2| %
3f	Response depending on Tilt:	<|±0.5| %

Ordering codes

LP PYRHE 16 : First class Pyrheliometer according to ISO 9060. Equipped with: light shield, cartridge for silica-gel crystals, 3 refills, 4-pole M12 connector and Calibration Report.

LP PYRHE 16 AC: First class Pyrheliometer according to ISO 9060. Equipped with: light shield, cartridge for silica-gel crystals, 3 refills, 4-pole M12 connector and Calibration Report. Current signal output 4..20 mA.

LP PYRHE 16 AV: First class Pyrheliometer according to ISO 9060. Equipped with: light shield, cartridge for silica-gel crystals, 3 refills, 4-pole M12 connector and Calibration Report. Voltage signal output 0..1Vdc, 0..5Vdc, 0..10Vdc, to be defined at the time of the order.

LP PYRHE 16 S: First class Pyrheliometer according to ISO 9060. Equipped with: light shield, cartridge for silica-gel crystals, 3 refills, 8-pole M12 connector and Calibration Report.

CPM12 AA 4.2: 4-pole M12 connector complete with UV-resistant cable, L=2 meters

CPM12 AA 4.5: 4-pole M12 connector complete with UV-resistant cable, L=5 meters

CPM12 AA 4.10: 4-pole M12 connector complete with UV-resistant cable, L=10 meters

CPM12 AA 8P.2: 8-pole cable, L=2 meters, M12 8-pole connector on one end and free wires on the other. Only or LP PYRHE 16 S.

CPM12 AA 8P.5: 8-pole cable, L=5 meters, M12 8-pole connector on one end and free wires on the other. Only or LP PYRHE 16 S.

CPM12 AA 8P.10: 8-pole cable, L=10 meters, M12 8-pole connector on one end and free wires on the other. Only or LP PYRHE 16 S.

CP24: PC connecting cable for the RS485 MODBUS-RTU parameters configuration of the LP PYRHE 16 S. With built-in RS485/USB converter. 8-pole M12 connector on instrument side and A-type USB connector on PC side.With CD-ROM including the USB drivers and a software for the Modbus connection to PC.

Kit 16.16: Kit consisting of revolving filter wheel (5positions) with 3 Shott filters (OG530, RG630, RG695), light shield and accessories to fix the wheel to the pyrheliometer.

LP PHOT 02 - LP PHOT 02AC - LP PHOT 02AV PHOTOMETRIC PROBES

The LP PHOT 02, LP PHOT 02AC, and LP PHOT 02AV probes measure illuminance (lux), defined as the ratio between the luminous flux (lumen) through a surface and the surface area (m^2). The spectral response curve of a photometric probe is equal to the human eye, known as standard photopic curve V(λ). The difference in spectral response between LP PHOT 02 and the standard photopic curve V(λ) is calculated by means of the error f'_1. **LP PHOT 02 is designed and constructed for outdoor installation for long periods.** The photometric measurement for external use is used for the measurement of daylight in climatological and meteorological applications.

Working principle

LP PHOT 02 probe is based on a solid state sensor, whose spectral response corrected by filters to fit the response of the human eye. The typical spectral response curve is shown in fig.1.

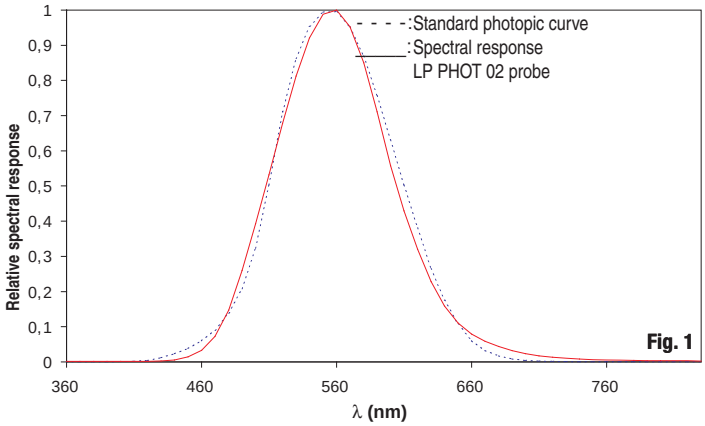


Fig. 1

LP PHOT 02 is provided with a 50 mm diameter transparent glass dome, in order to protect the sensor against atmospheric damage.

The cosine corrected response has been obtained through both the PTFE diffuser and case particular shapes. Deviation between the theoretical response and the real one, is shown in fig.2.

The LP PHOT 02 excellent cosine response allows for use even when the sun elevation is low.

Installing and mounting the LP PHOT 02 probe for global radiation measurements:

Before installation, the silica-gel cartridge must be refilled. Silica-gel crystals absorb humidity in the dome chamber and in case of particular climatic conditions, prevent internal condensation forming on the dome inner wall, with a consequent alteration in measurements. Do not wet or touch the instrument with your hands while refilling the silica-gel cartridge. Carry out the following instructions in a (possibly) dry environment:

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 silica-gel sachet (supplied with the luxmeter)
5- Fill the cartridge with silica-gel crystals
6- Close the cartridge with its own cap, and check that the sealing O-Ring is in the right position.
7- Screw the cartridge to the luxmeter using a coin
8- Make sure the cartridge is tightly screwed (otherwise silica-gel crystal will last for a shorter time)
9- Position the shade and tighten it with the screws
10- The luxmeter is ready for use

Fig.3 shows the operations needed to refill the cartridge with silica-gel crystals

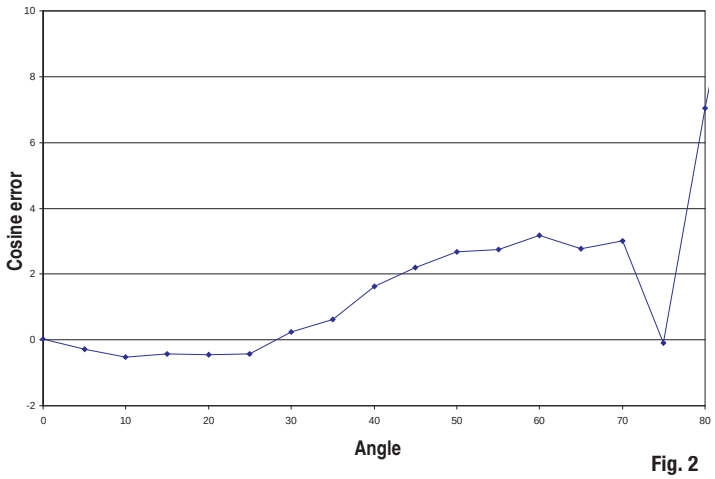


Fig. 2

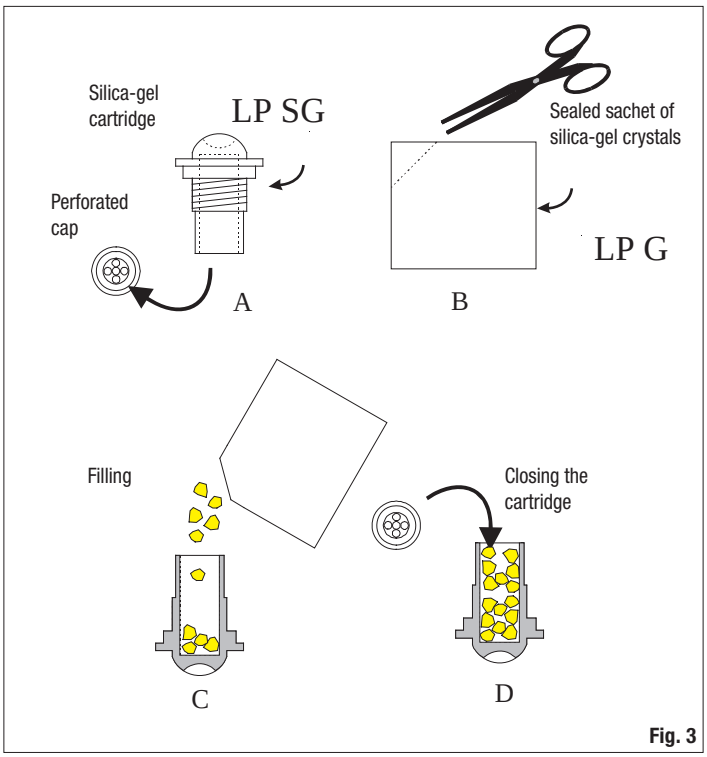


Fig. 3

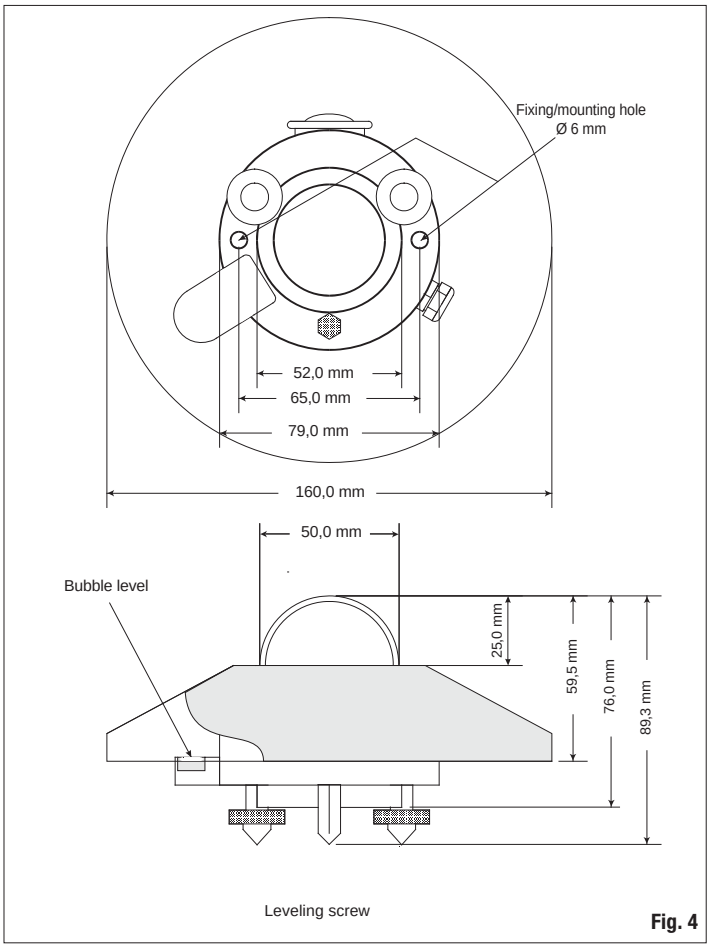
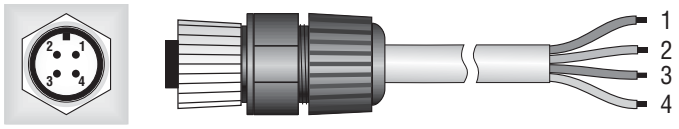


Fig. 4

- For a correct horizontal placing, LP PHOT 02 is provided with a bubble level; inclination adjustment of the luxmeter is made by means of two leveling screws. Use the two 6mm-diameter screw holes with an interaxial distance of 65 mm, to mount the instrument on a plane. To access the holes, remove the shade disk and reposition it after mounting (see fig. 4).
- LP S1 mounting kit is supplied upon demand as an accessory, and allows for an easy mounting of the instrument on a mast. The mast maximum diameter shall not exceed 50 mm. The operator will check that the mast height does not exceed the luxmeter plane, in order to avoid measurement errors due to any reflection or shadow of the mast itself. To fix the luxmeter to the mounting bracket, remove the shade disk by loosening the three screws, then fix the luxmeter to the bracket and mount the white shade disk again.
- The luxmeter should be thermally isolated from the mounting bracket, and the electrical contact with the ground must be properly made.

WIRING DIAGRAM LP PHOT 02



Fixed 4-pole plug M12 **Flying 4-pole M12 connector**

LP PHOT 02

Connector	Function	Color
1	V out (+)	Red
2	V out (-)	Blue
3	Not connected	White
4	Shield (⏚)	Black

LP PHOT 02 AC

Connector	Function	Color
1	Positive (+), +Vdc	Red
2	Negative (-), -Vdc	Blue
3	Not connected	White
4	Shield (⏚)	Black

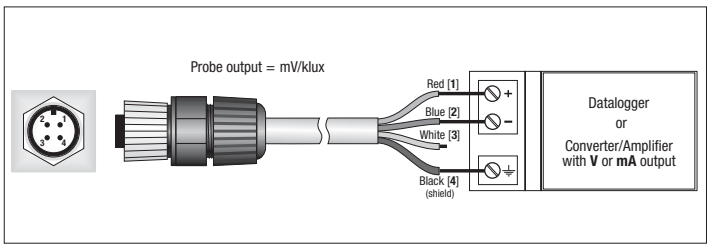
LP PHOT 02 AV

Connector	Function	Color
1	(+) Vout	Red
2	(-) Vout e (-) Vdc	Blue
3	(+) Vdc	White
4	Shield (⏚)	Black

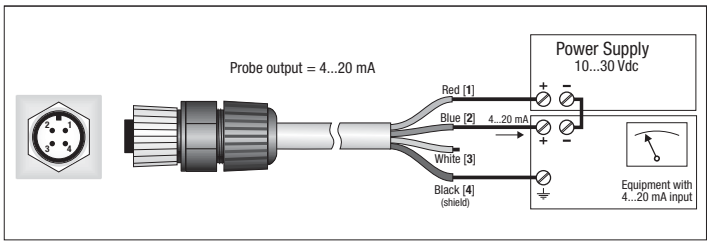
- To allow cleaning the outer dome regularly and carrying out the instrument maintenance, LP PHOT 02 should be mounted in easily reachable places. At the same time, you should check that no building, tree, or any other obstacle exceeds the horizontal plane where the luxmeter is mounted. In case this is not possible, you should find a place where obstacles do not exceed 5 degrees elevation over the path followed by the sun from rising until sunset.
- The luxmeter should be located far from any obstacle which might reflect sunlight (or any shadow) onto the instrument.

WIRING DIAGRAM CONNECTION

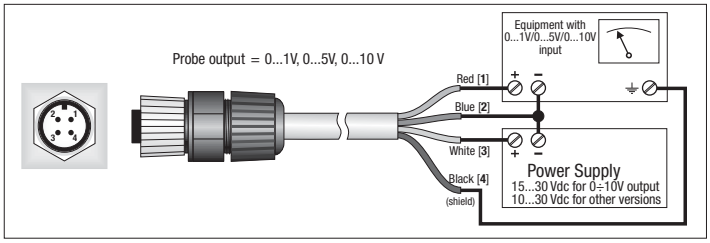
LP PHOT 02



LP PHOT 02 AC



LP PHOT 02 AV



LP PHOT 02 Electrical Connections and requirements for electronic readout devices

- LP PHOT 02 luxmeter is passive and it does not require any power supply.
- LP PHOT 02 is supplied with a flying 4-pole M12 connector
- UV-proof cables are available already assembled, with standard length 2m, 5m or 10m.
- Amplified probes are available, with current output signal 4÷20mA or voltage output 0…1Vdc, 0…5Vdc or 0…10Vdc.
- The **optional** cable is UV-proof, cable colors and connector poles are matched as follows:
  Black → shield braid
  Red → (+) signal generated by the detector
  Blue → (-) negative signal generated by the detector (in contact with the housing)
  See wiring scheme.
- LP PHOT 02 is to be connected to a millivoltmeter or data acquisition unit which input load resistance must be > 100kΩ.

Maintenance:

In order to grant the best precision and accuracy in measurements, the outer dome must be always kept clean; the cleaner you keep the dome, the better the accuracy in measurements will be. Washing can be made with water and standard lens paper; in case this wouldn't work, use pure ETHIL alcohol. After using alcohol, the dome must be washed with water only. Sudden rise and fall in temperature throughout day and night, might cause condensation to appear on the luxmeter dome; in this case the performed reading is highly overestimated. To reduce condensation, the luxmeter is provided with a cartridge containing desiccant material, such as Silica-gel. Silica-gel efficiency decreases in time while absorbing humidity. Active silica-gel crystals are **yellow** colored, while they turn into **white** when they gradually loose power. To replace them, see instructions at paragraph installing and mounting the LP PHOT 02. Silica-gel generally lasts from 2 to 6 months, depending on which climatic conditions you have and where the luxmeter works.

Calibration and measurements:

The Luxmeter sensitivity, indicated as **S** (or calibration factor), allows determining illuminance by measuring a signal in Volts at the probe ends. **S** factor is measured in **V/klux.**

- Once the difference of potential (DDP) has been measured at sensor ends, E_e illuminance is obtained through the following formula:

$$E_e = DDP/S$$

where;

E_e: indicates Illuminance expressed in klux,
DDP: indicates the difference of potential expressed in mV and measured by the multimeter,
S: indicates the calibration factor expressed in mV/klux and shown on the luxmeter label (calibration factor is also mentioned in the calibration report).

Each probe is individually calibrated at the factory and is distinguiched by its calibrator factor. Calibration is carried out by using a standard **illuminant A**, as indicated in CIE publication N°69 "Methods of characterizing illuminance meters and luminance meters: Performance, characteristics and specifications, 1987". Calibration is carried out by comparison with a reference luxmeter, assigned to Delta Ohm Metrological Laboratory. To get the best performances from LP PHOT 02, it is recommended to check calibration annually.

Technical specifications:

Typical sensitivity:	0,5 ÷2,0 mV/klux
Response time:	<0.5 sec (95%)
Impedance:	0.5 ÷ 1 kΩ
Measuring range:	0-150 klux
Viewing angle:	2π sr
Spectral range:	Standard photopic curve
Operating temperature:	-40°C ÷ 80°C
Error f'_1	<9 %
Cosine response/directional error:	< 8 % (between 0° and 80°)
Long term instability (1 year):	< |±3| %
Non-linearity:	<1 %
Temperature response	< 0.1%/°C
Weight:	0.90 Kg
Dimensions:	fig. 4

ORDERING CODES

LP PHOT 02: Photometric probe for outdoor **Illuminance** measurements (0÷150klux), CIE photopic filter, diffuser for cosine correction, complete with LP SP1 protection and silica gel cartridge, bubble level, 4-pole M12 plug and Calibration Report. **Cable has to be ordered separately.**

LP PHOT 02AC: Photometric probe for outdoor **Illuminance** measurements (0÷150klux), CIE photopic filter, diffuser for cosine correction. **4÷20mA output**, integrated transmitter amplifier. **Power supply 10…30Vdc**. Complete with LP SP1 protection and silica gel cartridge, bubble level, 4-pole M12 plug and Calibration Report. **2m, 5m or 10m cables with connectors available on request.**

LP PHOT 02AV: Photometric probe for outdoor **Illuminance** measurements (0÷150klux), CIE photopic filter, diffuser for cosine correction. **0÷1Vdc, 0÷5Vdc, 0÷10Vdc output**, integrated transmitter amplifier. **Power supply 10…30Vdc (15..30Vdc for 0…10Vdc output).** Complete with LP SP1 protection and silica gel cartridge, bubble level, 4-pole M12 plug and Calibration Report. **2m, 5m or 10m cables with connectors available on request.**

LP S1: Mounting kit for LP PHOT 02: bracket for attachment to a mast, including fasteners and levelling screws.

LP SP1: UV resistant plastic shade disk (BASF LURAN S777K).

LP SG: Desiccant sachet with silica gel crystals, complete with inner O-ring and cap.

LP G: Packet with 5 silica gel spare cartridge.

LP RING 02: Base with levelling device and adjustable holder for mounting the LP PHOT 02 in an inclined position.

LP S6: Kit for the installation of LP PHOT 02. The kit includes: 1 m mast (LP S6.05), base fitting (LP S6.04), graduated support plate (LP S6.01), bracket for HD9007 or HD32MTT.03.C (HD 9007T29.1), bracket for pyranometers (LP S6.03).

CPM12 AA4.2: 4-pole cable. Length 2m. 4-pole M12 connector on one end, open wires on the other side.

CPM12 AA4.5: 4-pole cable. Length 5m. 4-pole M12 connector on one end, open wires on the other side.

CPM12 AA4.10: 4-pole cable. Length 10m. 4-pole M12 connector on one end, open wires on the other side

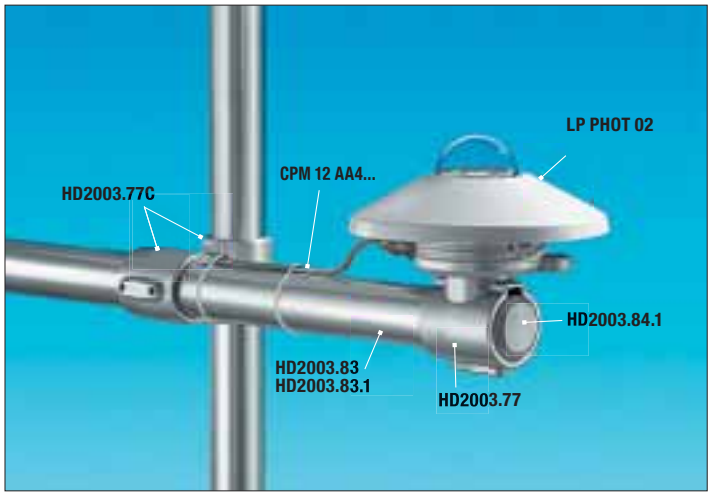
HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input range -10 ..+60mVdc. **Standard configuration 0÷20mVdc**. Minimum measuring range 2mVdc. 2- DIN modules for 35mm rail. **Configurable with HD778 TCAL**

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 Wall Mount installation.**

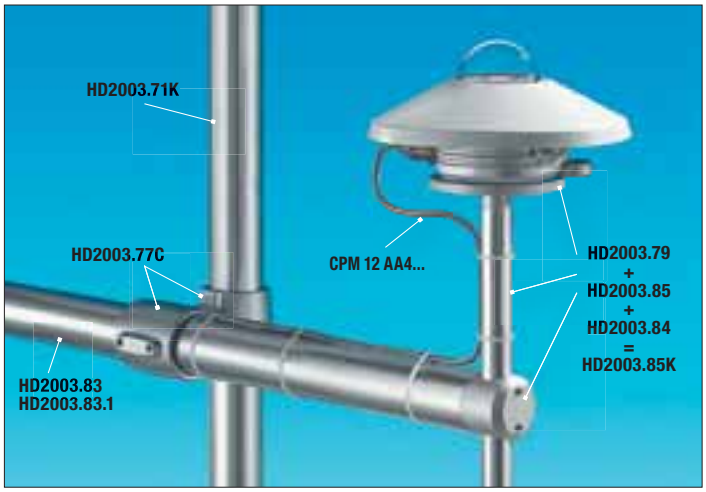
HD978TR4: Configurable signal converter amplifier with 0÷10Vdc (10÷0Vdc) output. Input range -10 ..+60mVdc. **Standard configuration 0÷20mVdc**. Minimum measuring range 2mVdc. 2- DIN modules for 35mm rail.. **Configurable with HD778 TCAL**

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 HD978TR3, HD978TR4, HD978TR5, HD978TR6 converters.



LP PHOT 02



LP PHOT 02

LP UVA 02

LP UVA 02 - LP UVA 02AC - LP UVA 02AV
RADIOMETRIC PROBES

The radiometric LP UVA 02, LP UVA 02AC, and LP UVB02AV probes measure the global irradiance in the UVA on a flat surface (Watt/ m^2). The irradiance is the sum of direct solar irradiance and of diffuse irradiance from the sky.
The radiometer can also be used for monitoring UVA irradiance indoor.

Working Principle
LP UVA 02 radiometer is based on a solid state sensor, the spectral match with the desired curve is obtained using special filter. The relative spectral response is reported on figure 3.
In order to protect the diffuser from the dust, LP UVA 02 is equipped with a 50mm glass dome. The cosine low response is obtained with a particular shaped PTFE diffuser. In figure 5 the cosine error versus angle of incident is reported.
The excellent cosine law response of LP UVA 02 allow to use the radiometer at any sun's zenith angle. (The diffused component of the UVA increases as the sun moves away from the zenith, so the error on direct component due to imperfect response according to the cosine becomes negligible on the measurement of global irradiance).

Installation and Mounting of the Radiometer for the Measurement of Global Radiation:
Before installation, refill the cartridge containing silica-gel crystals. Silica gel absorbs humidity in the dome chamber and prevents (in particular climatic conditions) internal condensation forming 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 dry 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 radiometer)
5- Replace 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 radiometer 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 radiometer is ready for use.

Figure N.1 shows the operations necessary to fill the cartridge with the silica gel crystals.

- The LP UVA 02 radiometer has to be mounted in a readily accessible location to clean the dome regularly and to carry out maintenance. At the same time, check that no building, construction, tree or obstruction exceeds the horizontal plane where the radiometer lays. If this is not possible, select a site where obstructions do not exceed 5 degrees of elevation, in the path followed by the sun, between earliest sunrise and latest sunset.
- The radiometer has to be located far from any kind of obstruction, which might reflect sunlight (or sun shadow) onto the radiometer itself.
- The LP UVA 02 radiometer is provided with a spirit level for carrying out an accurate horizontal leveling. The adjustment is made by means of two leveling screws that allow to adjust the radiometer inclination. Use the two 6mm-diameter holes and a 65mm interaxial distance to mount the instrument on a plane. Remove the shade disk to access the holes and reposition it after mounting (see fig. 2).
- The LP S1 mounting kit, supplied on demand as an accessory, allows an easy mounting of the radiometer on a mast. The mast maximum diameter shall not exceed 50 mm. The operator shall take care that the mast height does not exceed the radiometer plane to avoid measurement errors caused by any reflection or shadow of the mast itself. To fix the radiometer to the mounting bracket, remove the shade disk loosening the three screws, fix the radiometer, and mount the white shade disk again.
- It is suggested to thermally isolate the radiometer from its mounting brackets, and to check that the electrical contact with the ground be done properly

Electrical Connection and Requirements for Electronic Readout Devices:

- LP UVA 02 radiometer does not require any power supply.
- LP UVA 02 is supplied with a 4-pole M12 connector
- UV-proof cables are **available on request**. Cable colors are as follows:
  Black →shield braid
  Red →(+) signal generated by the detector
  Blue →(-) negative signal generated by the detector
- LP UVA 02 is to be connected either to a millivoltmeter or data acquisition unit which input load resistance must be > 5MΩ. Typically, the radiometer output signal does not exceed 5÷10mV. In order to better exploit the radiometer features, the readout instrument should have a 1µV resolution.

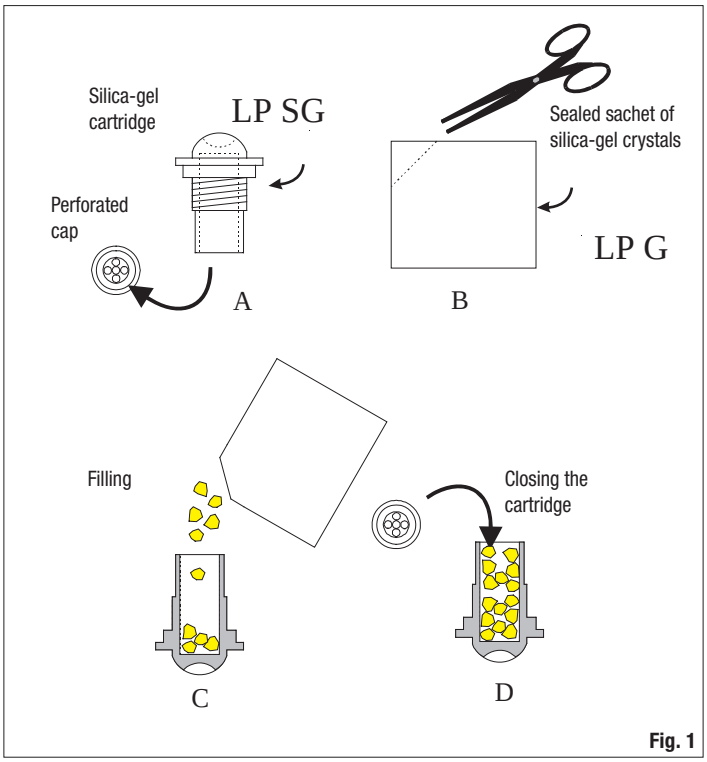


Fig. 1

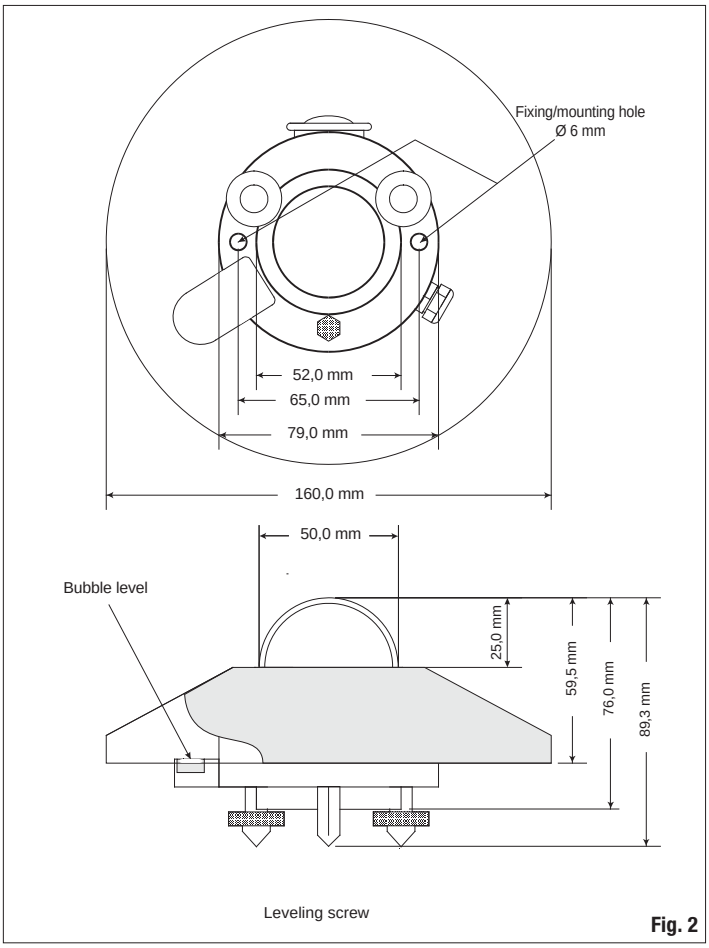


Fig. 2

active when their color is **yellow**, while they turn **white** as soon as they loose their power. Read instructions on how to replace them. Silica gel typical lifetime goes from 2 to 6 months depending on the environment where the radiometer works.

Calibration and Measurements:

The radiometer sensitivity **S** (or calibration factor) allows to determine the irradiance by measuring a signal in Volts at the ends of the resistance which short-circuits the terminals of the photodiode ends. The **S** factor is measured in μV/(Wm^{-2}).

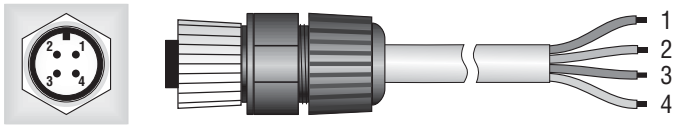
- Once the difference of potential (DDP) has been measured at the ends of the sensor, the E_e irradiance is obtained applying the following formula:

$$E_e = DDP/S$$

Where:

E_e: is the Irradiance expressed in W/m^2,
DDP: is the difference of potential expressed in μV and measured by the multimeter,
S: is the calibration factor in μV/(W/m^2) (shown on the radiometer label (and mentioned in the calibration report).

WIRING DIAGRAM LP UVA 02



Fixed 4-pole plug M12 **Flying 4-pole M12 connector**

LP UVA 02

Connector	Function	Color
1	V out (+)	Red
2	V out (-)	Blue
3	Not connected	White
4	Shield (⏚)	Black

LP UVA 02 AC

Connector	Function	Color
1	Positive (+), +Vdc	Red
2	Negative (-), -Vdc	Blue
3	Not connected	White
4	Shield (⏚)	Black

LP UVA 02 AV

Connector	Function	Color
1	(+) Vout	Red
2	(-) Vout e (-) Vdc	Blue
3	(+) Vdc	White
4	Shield (⏚)	Black

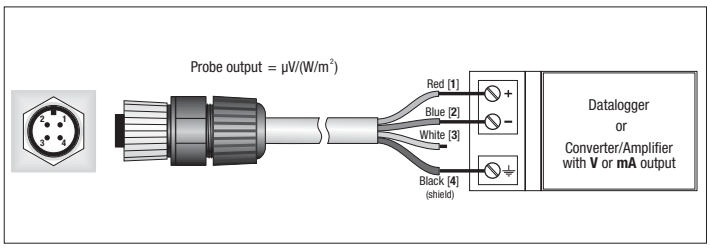
Maintenance:

It is important to keep the outer glass dome clean to grant measurement best accuracy. Consequently, the more the dome will be kept clean, the more measurements will be accurate. Washing can be made using water and standard papers for lens, or, in some cases, using pure ethyl alcohol. After using alcohol, clean again the dome with water only.

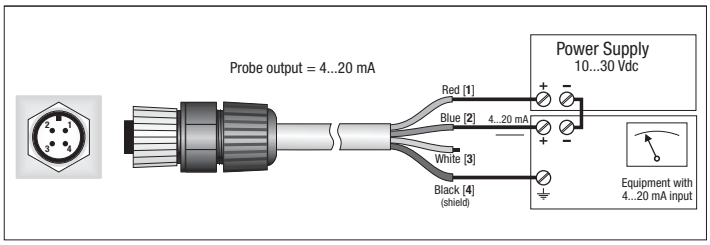
Because of the high rise/fall in temperature between day and night, some condensation might appear on the radiometer dome. To minimize the condensation growth, the radiometer is provided with a cartridge containing desiccant material: Silica gel. The efficiency of the Silica gel crystals decreases in the course of time while absorbing humidity. Silica gel crystals are

CONNECTION DIAGRAMS

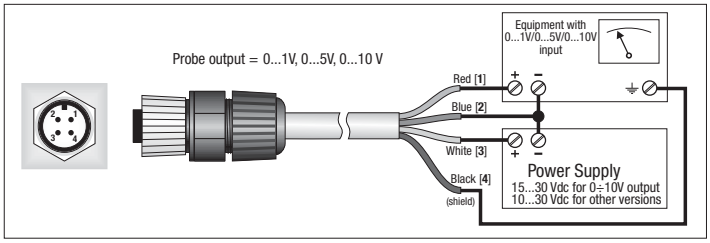
LP UVA 02



LP UVA 02 AC



LP UVA 02 AV



Each radiometer is individually calibrated at the factory and is distinguished by its calibrator factor.
The calibration is carried out following procedure N° DHLF-E-59. This procedure is used in the ACCREDIA LAT calibration center N° 124 for the calibration of UVA radiometers.
The calibration was performed by reference to Delta Ohm srl primary standard with monochromatic light at 365 nm. To get best performances from your LP UVA 02 it is strongly recommended that the calibration be checked annually.
Note: currently no international calibration standards for this type of radiometer exist; therefore, the calibration coefficient only makes sense if the procedure followed to obtain it has been specified. Therefore the user has to consider that the same radiometer calibrated with different procedures can have different sensitivity factors, as explained in the article "*Source of Error in UV Radiation Measurements*", T. C. Larason, C. L. Cromer issued in the "*Journal of Research of the National Institute of Standards and Technology*" Vol. 106, Num. 4, 2001. (The article is available free of charge on the NIST web site at the following address: http://www.nist.gov/jers)

Technical Specifications:

Typical sensitivity:	70 ÷ 200µV/(W/m²)
Response time	<0.5 sec (95%)
Impedance:	3 kΩ
Measuring range:	0-200 W/m²
Viewing angle:	2π sr
Spectral range:	327 nm ÷ 384 nm (1/2) 312 nm ÷ 393 nm (1/10) 305 nm ÷ 400 nm (1/100)
Operating temperature	-40 °C ÷ 80 °C
Cosine response:	< 8 % (between 0° and 80°)
Long-term non-stability: (1 year)	< |±3| %
Non-linearity:	<1 %
Temperature response:	< 0.1%/°C
Dimensions:	figure 2
Weight:	0.90 Kg

ORDERING CODES

LP UVA 02: Radiometric probe for the outdoor measurement of UVA irradiance (315…400nm), complete with LP SP1 protection, silica gel cartridge, 2 spare sachets with silica gel crystals, bubble level, M12 4-pole connector and Calibration Report. **Cable has to be ordered separately.**

LP UVA 02AC: Amplified radiometric probe for the outdoor measurement of UVA irradiance (315…400nm), **4÷20mA output (0…200W/m²)**, integrated transmitter amplifier, **power supply 10…30Vdc**. Complete with M12 4-pole connector and Calibration Report. **Cable has to be ordered separately.**

LP UVA 02AV: Amplified radiometric probe for the outdoor measurement of UVA irradiance (315…400nm), **0÷1Vdc, 0÷5Vdc, 0÷10Vdc output (0…200W/m²)**, integrated transmitter amplifier, **power supply 10…30Vdc**. **(15..30Vdc for 0…10Vdc output).** Complete with M12 4-pole connector and Calibration Report. **Cable has to be ordered separately.**

LP S1: Mounting kit for LP UVA 02: bracket for attachment to a mast, including fasteners and leveling screws.

LP SP1: UV resistant plastic shade disk (BASF LURAN S777K).

LP SG: Desiccant sachet with silica gel crystals, complete with inner O-ring and cap.

LP G: Packet with 5 silica gel spare cartridge.

CPM12 AA4.2: 4-pole cable. Length 2m. 4-pole M12 connector on one end, open wires on the other side. For LP UVA 02, LP UVA 02AC, LP UVA 02AV.

CPM12 AA4.5: 4-pole cable. Length 5m. 4-pole M12 connector on one end, open wires on the other side. For LP UVA 02, LP UVA 02AC, LP UVA 02AV.

CPM12 AA4.10: 4-pole cable. Length 10m. 4-pole M12 connector on one end, open wires on the other side For LP UVA 02, LP UVA 02AC, LP UVA 02AV

LP RING 02: Base with levelling device and adjustable holder for mounting the LP UVA 02 in an inclined position.

LP S6: Kit for the installation of LP UVA 02. The kit includes: 1 m mast (LP S6.05), base fitting (LP S6.04), graduated support plate (LP S6.01), bracket for HD9007 or HD32MTT.03.C (HD 9007T29.1), bracket for pyranometers (LP S6.03).

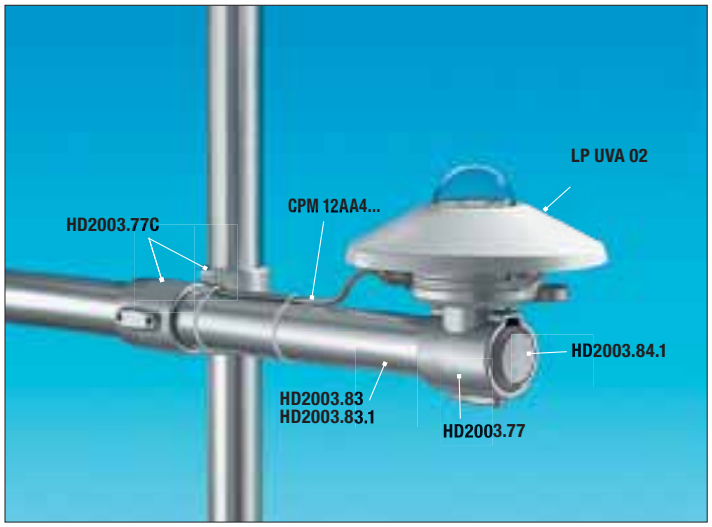
HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input range -10 ..+60mVdc. **Standard configuration 0÷20mVdc**. Minimum measuring range 2mVdc. 2- DIN modules for 35mm rail. **Configurable with HD778 TCAL**

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 Wall mount installation.**

HD978TR4: Configurable signal converter amplifier with 0÷10Vdc (10÷0Vdc) output. Input range -10 ..+60mVdc. **Standard configuration 0÷20mVdc**. Minimum measuring range 2mVdc. 2- DIN modules for 35mm rail.. **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 HD978TR3, HD978TR4, HD978TR5, HD978TR6 converters.



LP UVA 02

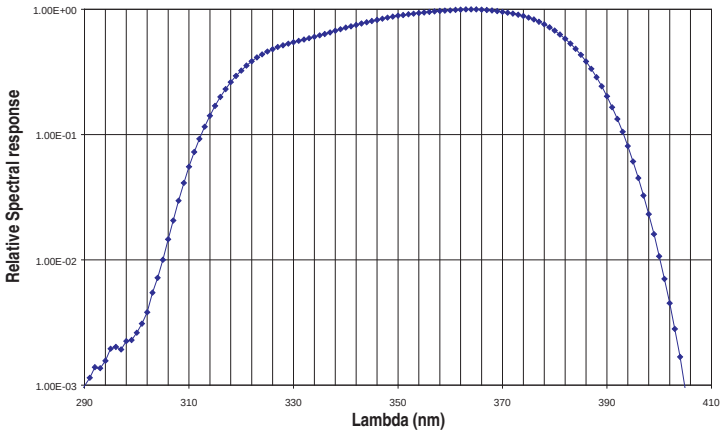


Fig. 3

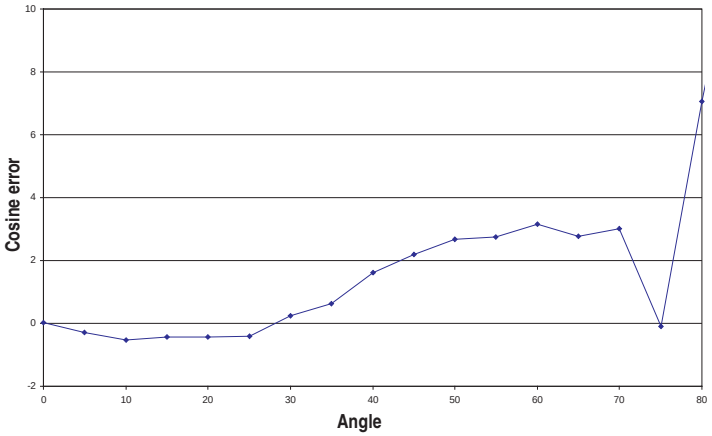


Fig. 4

LP UVB 02
RADIOMETRIC PROBE FOR ENVIRONMENTAL USE

The LP UVB 02 radiometer measures the global irradiance in the UVB spectral region on a flat surface (Watt/m^2). In particular, the instrument's spectral sensitivity is centered at 305nm with a 5nm band width (FWHM). The global irradiance is the sum of the direct solar irradiance and the sky diffuse irradiance on a surface parallel to the ground. In contrast to the visible spectrum where the direct component prevails over the diffuse component, in the UVB spectral region light is strongly diffused by atmosphere and thus the two components are equivalent. Therefore it is of primary importance for the instrument to be capable of measure both components accurately.

The LP UVB 02 probe is typically used in the following sectors:

- Monitoring the ozone layer. Indeed, the radiation around 295nm–315nm is strongly absorbed by ozone located in the stratosphere, therefore each small variation of the ozone layer corresponds to an increase or decrease of the radiation reaching the ground.
- Effects of UVB radiation (the most harmful to human health) on living beings.
- UVB radiation measurement in work spaces.

The LP UVB 02 radiometer needs power to function. Power is required to amplify the weak signal generated by the photodiode. Indeed, the radiometer is a current/voltage amplifier (transimpedance amplifier). This choice measures sun-produced UVB irradiance. Indeed, the need to use sophisticated filters (partially attenuating the signal concerned) and the relatively weak sun-produced irradiation in this spectral area, in the best case, make the photodiode-generated current in the order of hundreds of pAmpere. So it is not possible to use cable meters or tens of meters long as the noise might be greater than the signal itself. Therefore the signal must be amplified.

LP UVB 02 is robust and was manufactured to operate for long periods without maintenance (if powered correctly). This characteristic makes it suitable for location in meteorological stations. A platinum-resistance thermometer (Pt100) is inserted inside the LP UVB 02 in order to control its temperature. Internal temperature must remain within its functioning range, otherwise measurements could be affected by higher systematic errors than those asserted in the manual. Exposure to temperature higher than +60°C can alter the interferential-filters spectral characteristics.

Working Principle

The LP UVB 02 radiometer is based on an innovative solid state photodiode, the spectral response of which was adapted to that desired by using special interferential filters. In particular, the used photodiode and filters have exceptional stability characteristics, both for temperature and through time. This allowed manufacturing of an instrument that does not need heating, thus reducing energy consumption.

Particular attention has been given to filter design so as to make the instrument completely blind to wavelengths outside the concerned pass-band. The solar energy within the 302nm–308nm spectral band is only 0.01% of the total energy from the sun reaching Earth's surface. The relevant spectral response curve is shown in Fig. 1A (in linear scale) and Fig. 1B (in logarithmic scale).

The LP UVB 02 is provided with a 50mm-external-diameter dome in order to supply a suitable protection of the sensor to the atmospheric agents. Quartz was chosen due to its optimum transmission in the UV range.

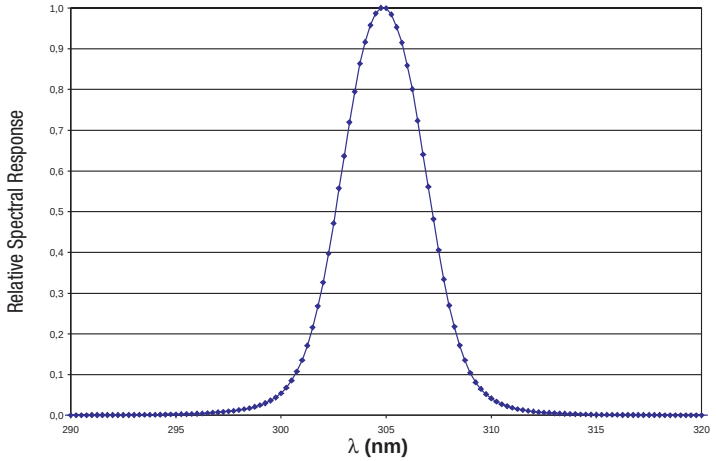


Fig. 1A

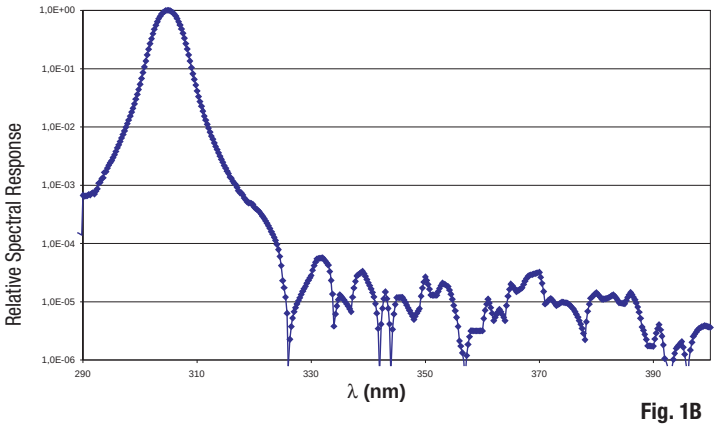


Fig. 1B

The response in accordance with the cosine law has been obtained thanks to the particular shape of the diffuser and of the housing. The departure between a theoretical response and the measured one is shown in the Fig. 2.

The excellent relation between the response of the LP-UVB-02 and the cosine law allows to use the instrument also when the sun has a very low raising (the UVB diffuse radiation increases as the sun is leaving the zenith, therefore the error on the direct radiation, owing to the imperfect response according to the cosine law, becomes negligible referred to the measurement of the global radiation).

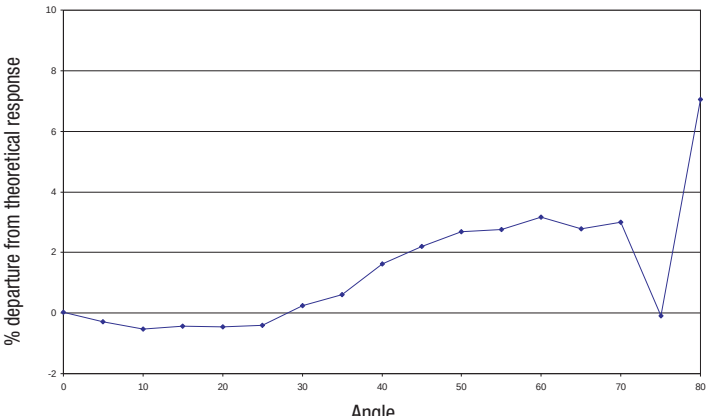


Fig. 2

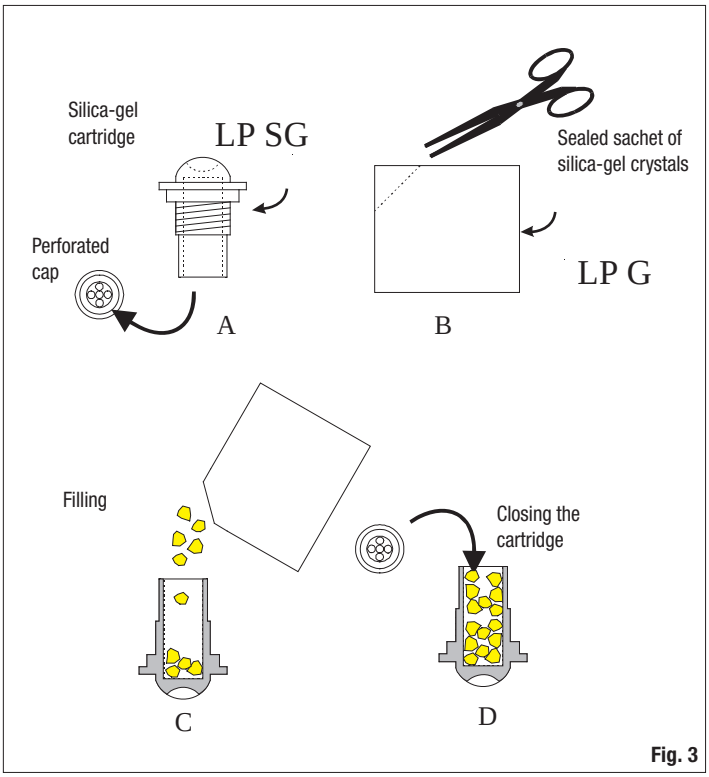


Fig. 3

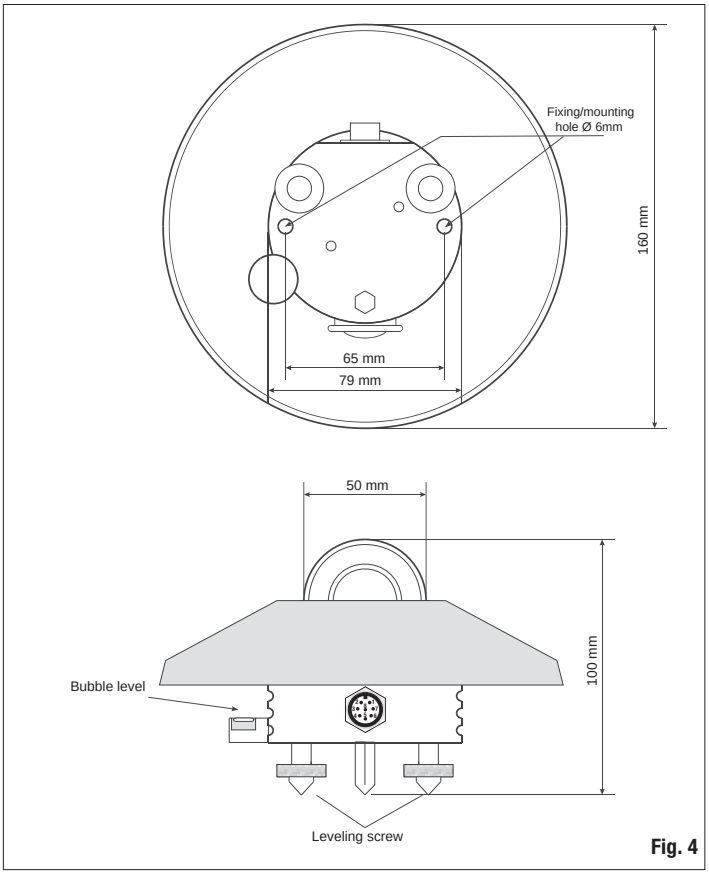


Fig. 4

Installation and Mounting of the Radiometer for the Measurement of the Global Radiation
Before installing the radiometer refill the cartridge containing the silica-gel crystals. Silica gel absorbs humidity in the dome chamber; in case of particular climatic conditions this humidity can cause condensation on the internal side of the dome and then modify the measurement. Do not touch the silica gel crystals with your hands and do not wet them while refilling the cartridge. Carry out the following instructions in an environment as dry 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 the silica gel (supplied with the radiometer)
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 and undamaged
7- screw the cartridge to the radiometer body using a coin
8- **check that the cartridge is screwed tightly** (if not, the silica-gel life will be reduced)
9- position the shade disk and tighten it with the screws
10- the radiometer is ready for use

Fig. 3 shows the operations necessary to fill the cartridge with the silica-gel crystals.

• The LP UVB 02 has to be mounted in a readily accessible location to be able to provide for a periodic cleaning of the external dome and for the maintenance. Check also that no building, construction, tree or obstruction exceeds horizontal plane where the radiometer lays. If this is not possible, select a site where obstructions do not exceed 5 degrees of elevation, in the path followed by the sun, between earliest sunrise and latest sunset.
• The radiometer has to be located far from any kind of obstruction, which might throw the solar radiation (or its shade) on the radiometer.
• The LP UVB 02 radiometer is provided with a spirit level for carrying an accurate horizontal leveling. The adjustment is made by means of two leveling screws that allow to adjust the radiometer inclination. Use the two 6mm-diameter and 65mm-interaxial-distance holes to mount the instrument on a plane. Remove the shade disk to access the holes and reposition it after mounting (see Fig. 4).

• The LP S1 mounting kit (Fig. 5), supplied on demand as an accessory, allows an easy mounting of the radiometer on a mast. The mast maximum diameter shall not exceed 50 mm. The operator shall take care that the mast height does not exceed the radiometer plane to avoid measurement errors caused by any reflection or shadow of the mast itself. To fix the radiometer to the mounting bracket, remove the shade disk loosening the three screws, fix the radiometer and mount the white shade disk again.
• It's suggested to thermally isolate the radiometer from its mounting brackets and to check that the electrical contact with the ground be done properly.

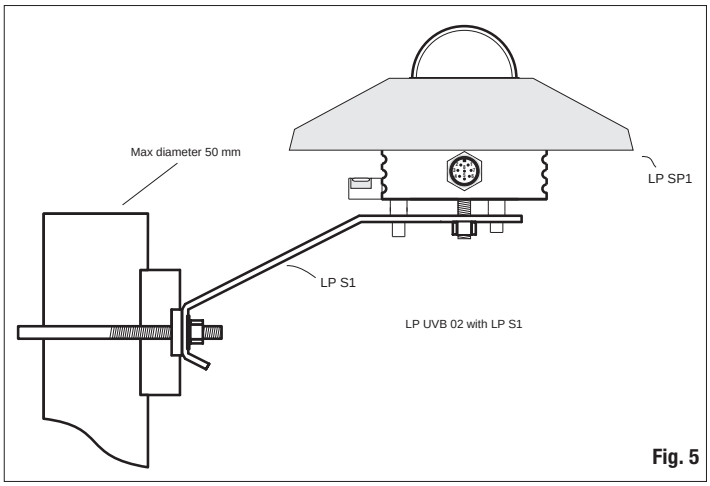


Fig. 5

Electrical Connections and Requirements for Electronic Readout Devices
The connections on the output connector are indicated below:

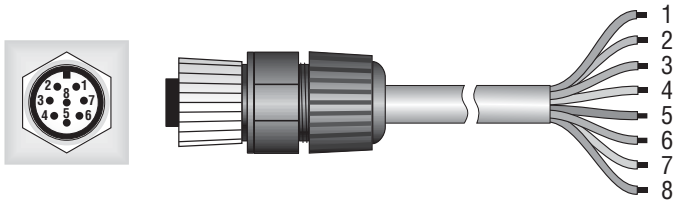
Pin8: V+, positive supply voltage for LP UVB 02 internal electronics.
7Vdc < V+ <30Vdc
Pin6: VoutTemp+, output signal for temperature measurement.
0V (-40°C) < Vout Temp+ < 1V (+60°C)
Pin2: VoutUV+, output signal for irradiance measurement in the UVB band.
0V < VoutUV+ < 5Vdc.
Pin1: Ground of the two output signals, VoutTemp+, VoutUV+
Pin7: Housing.
Pin5: Power supply grounding.

• The LP UVB 02 has to be connected either to a voltmeter or to a data acquisition system with input impedance greater than 10kΩ. Typically, the radiometer output signal, when exposed to the sun, does not exceed 1 volt. In order to better exploit the radiometer features, the readout instrument should have 0.1mV resolution.

N.B. The input load resistance of the data acquisition system must be greater than 10kΩ. The connection scheme is shown in figure 6.
The UV-resistant cable (supplied on request) has 5 wires plus the braid (screen); the colour code is shown in fig. 6.

Maintenance
It is important to keep the outer domes clean to grant the best measurement accuracy. Consequently, cleaning the dome more often will give more accurate measurements. Cleaning can be carried out using water and standard papers for lens, or, if not sufficient, using pure ETHYL alcohol. After using alcohol, clean again the dome with water only. Because of the high rise/fall in temperature between day and night, some condensation might appear on the

WIRING DIAGRAM LP UVB 02



Fixed 8-pole plug M12 **Flying 8-pole M12 socket**

LP UVB 02

Connector	Function	Color
1	Signal GND	Red
2	V out UV (+)	Blue
3	Not connected	
4	Shield	Braid
5	Power GND (-)	Brown
6	Vout Temp. (+)	White
7	Housing	Black
8	Power(+) 7-30Vdc	Green

LP UVA 02 CONNECTION DIAGRAMS

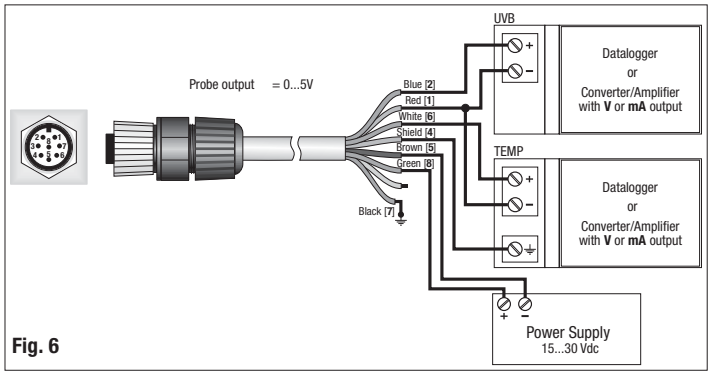


Fig. 6

radiometer dome. In this case the performed reading is highly overestimated. To minimize the condensation growth, the radiometer is provided with a cartridge containing desiccant material: Silica gel. The efficiency of the Silica gel crystals decreases in time with humidity absorption. Silica-gel crystals are active when their colour is **yellow**, and they turn **white** when they loose their power. Read the instructions of paragraph **3** on how to replace them. Silica gel typical duration goes from 2 to 6 months depending on the environment where the radiometer works.

We recommend to calibrate the instrument annually. Calibration can be performed by DeltaOhm Metrological Laboratories, or by connecting it to an identical instrument calibrated with reference to a Primary Metrological Institute having a known calibration factor.

Calibration and Measurements

The radiometer **S** sensitivity (or calibration factor) allows to determine the irradiance by measuring a signal in Volts generated by the internal amplification circuit. It is possible that an offset be present on the output signal of some fractions of millivolts (0.3-0.4mV), in which case it is also recommended that the data be acquired at night and subtract the night-measurement offset from the performed measurements. Once the difference of potential (VoutUV+) has been measured at the ends of the resistance, the E_e irradiance is obtained applying the following formula:

$$E_e = [VoutUV+] / S$$

where:

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

VoutUV+: is the difference of potential measured by the multimeter and expressed in V,

S: is the calibration factor in V/(W/m^2), shown on the radiometer label (and mentioned on the calibration report).

In the presence of a possible offset of OF Volts, the previous calculations must be modified as follows:

$$E_e = ([VoutUV+] - OF)/S$$

Similarly, to know the instrument internal temperature once the "VoutTemp+" voltage in volts is known, we get:

$$T=100 \cdot [VoutTemp+] - 40 \ °C$$

Supposing a voltage VoutTemp+=0.532V is read, the previous formula gives the radiometer internal temperature:

$$T=(100 \bullet 0.532) - 40 \ °C = 13.2 \ °C$$

Radiometers are individually calibrated at factory. Calibration is carried out by measuring the radiometer-produced output signal when hit by a parallel and homogeneous light-beam of 304nm monochromatic light.

Note: currently no international calibration standards for this type of radiometer exist; therefore, the calibration coefficient only makes sense if the procedure followed to obtain it has been specified. Therefore the user has to consider that the same radiometer calibrated with different procedures can have different sensitivity factors, as explained in the article "*Source of Error in UV Radiation Measurements*", T. C. Larason, C. L. Cromer issued in the "*Journal of Research of the National Institute of Standards and Technology*" Vol. 106, Num. 4, 2001. (The article is available free of charge on the NIST web site at the following address: http://www.nist.gov/jers)

Technical characteristics

UV MEASUREMENT

Typical sensitivity:	≈5V/(W/m^2)
Response time:	<0.5 sec (95%)
Min. load impedance:	10 kΩ
Measurement range:	0-1 W/m^2
Viewing range:	2π sr
Spectral range:	305nm Peak 302.5nm ÷ 307.5 nm (1/2) 301nm ÷ 309 nm (1/10) 297.5nm ÷ 311.75nm (1/100) 292.5nm ÷ 316.255nm (1/1000)
Working temperature:	-40 °C ÷ +60 °C
Response according to the cosine law:	< 8 % (between 0° and 80°)
Long-term instability (1 year):	< |±3| %
Non linearity:	<1 %
Response according to temperature:	< 0.01%/°C

TEMPERATURE MEASUREMENT

Measurement range	-40°C +60°C
Accuracy	÷0.2°C
Min. load impedance:	10 kΩ

POWER SUPPLY

Vdc+	7÷30 V DC
Typical consumption:	3 mA
Dimensions:	Fig. 4
Weight:	0.90 Kg.

ORDERING CODES:

LP UVB 02: Radiometer for outdoor measurements, complete with LP SP1 protection, 2 spare sachets with silica gel crystals, bubble level, 8-pole M12 connector and Calibration Report. **Cable has to be ordered separately.**

LP S1: Mounting kit for LP UVB 02: bracket for attachment to a mast, including fasteners and leveling screws

LP SP1: UV resistant plastic shade disk (BASF LURAN S777K).

LP SG: Desiccant sachet with silica gel crystals, complete with inner O-ring and cap.

LP G: Packet with 5 silica gel spare cartridge.

CPM12 AA 8.2: 8-pole UV resistant cable L=2 m.

CPM12 AA 8.5: 8-pole UV resistant cable L=5 m.

CPM12 AA 8.10: 8-pole UV resistant cable L=10 m.

LP RING 02: Base with levelling device and adjustable holder for mounting the LP UVB 02 in an inclined position.

LP S6: Kit for the installation of LP UVB 02. The kit includes: 1 m mast (LP S6.05), base fitting (LP S6.04), graduated support plate (LP S6.01), bracket for HD9007 or HD32MTT.03.C (HD 9007T29.1), bracket for pyranometers (LP S6.03).

LP 471 PYRA 02.5
LP 471 PYRA 02.10
LP 471 PYRA 03.5
LP 471 PYRA 03.10
LP 471 PYRA 10.5
LP 471 PYRA 10.10

LP 471 Silicon-PYRA

LP 471 PYRA 02.5 / LP 471 PYRA 02.10 - LP 471 PYRA 03.5 LP 471 PYRA 03.10 - LP 471 PYRA 10.5 / LP 471 PYRA 10.10 LP 471 SILICON-PYRA PROBES

The LP 471 PYRA… probes consist of a LP PYRA 03, LP PYRA 02, or LP PYRA 10 pyranometer and a SICRAM module with a 5 or 10-meter cable that connects the pyranometer to the portable instruments 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 LP PYRA 03 is a second class, LP PYRA 02 is a first class, and the LP PYRA 10 Is a Secondary Standard pyranometer according to ISO 9060. Both instruments are supplied with calibration report and M12 4-pole output connector.

The manuals of the pyranometers LP PYRA 02, 03, 10 are available at the section 'Environmental Analysis' of the website http://www.deltaohm.com

The SICRAM module of the LP 471 PYRA .. 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.

CODE DESCRIPTION

LP PYRA 10.5: The probe consists of a Secondary Standard pyranometer LP PYRA 10, 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 HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 10)

LP PYRA 10.10: The probe consists of a Secondary Standard pyranometer LP PYRA 10, 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 HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 10)

LP 471 Pyra 02.5: The probe consists of a first class pyranometer LP PYRA 02, 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 HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 02)

LP 471 Pyra 02.10: The probe consists of a first class pyranometer LP PYRA 02, 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 HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 02)

LP 471 Pyra 03.5: The probe consists of a second class pyranometer LP PYRA 03, 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 HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 03)

LP 471 Pyra 03.10: The probe consists of a second class pyranometer LP PYRA 03,10 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 HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 03)

LP 471 Silicon-PYRA: Pyranometer with silicon photodiode with 5m cable and SICRAM module. The probe can be connected to the instruments HD2302.0, HD2102.1, HD2102.2 and DO9847.

LP 471 PYRA 03.5

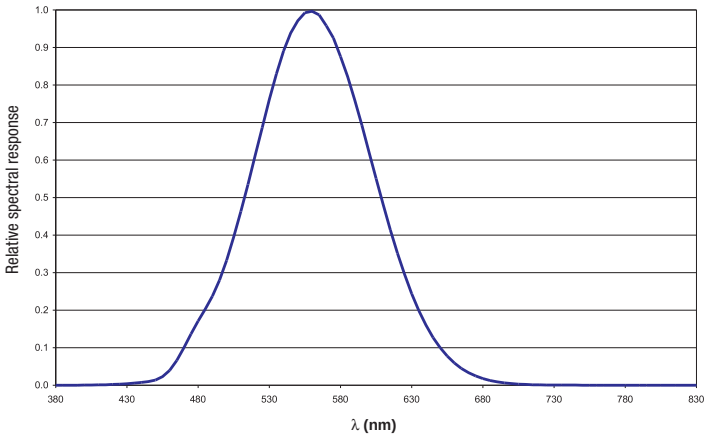
LP 471 PYRA 02.5
LP 471 PYRA 10.5

LP PHOT 03
LP RAD 03
LP PAR 03
LP UVA 03
LP UVB 03
LP PHOT 03S

TECHNICAL SPECIFICATIONS:

Typical sensitivity:	0.5 ÷1.5 mV/(klux)
Spectral range:	V(λ)
Calibration uncertainty:	< 4%
f'_1 (agreement with the standard curve V(λ)):	<6%
f_2 (Cosine response)	<3%
f_3 (linearity)	<1%
Operating temperature:	-20°C ÷ +60°C
Impedance:	0.5 ÷ 1.0 kΩ non-normalized version
Version with normalized output 4÷20mA:	4mA = 0 klux, 20mA = 150 klux
Version with normalized output 0÷10Vdc	0V = 0 klux, 10V = 150klux
Power supply:	10…30Vdc for version with normalized output 4÷20mA
	15…30Vdc for version with normalized output 0÷10Vdc

Typical spectral response curve of **LP PHOT 03:**



LP PHOT 03 - LP RAD 03 - LP PAR 03 - LP UVA 03 - LP UVB 03 - LP PHOT 03S PHOTOMETRIC AND RADIOMETRIC PROBES WITH OUTPUT SIGNAL IN mV OR NORMALIZED 4÷20mA OR 0÷10Vdc OR RS485 MODBUS-RTU OUTPUT

Photo-radiometric probes with output signal in mV or standard output 4÷20mA or 0÷10Vdc. The probes of the series LP…03 **for outdoor use** allow to measure photometric and radiometric quantities such as: illuminance (lux), irradiance (W/m²) in the near ultraviolet spectral region VIS-NIR, UVA, UVB, and the photon flow across the PAR region (400nm...700nm). The probes with mV output do not require any power supply. The output signal is obtained from a resistance that short-circuits the terminal of the photodiode. The ratio of generated photocurrent to incident light power is converted into a Difference of Potential that can be read by a voltmeter. Once the DDP (Difference of Potential) is known, the measured value can be calculated through the calibration factor. **All probes are individually calibrated and the calibration factor is also shown on the probe housing**. The probes with normalized output current 4÷20mA or voltage 0÷10Vdc or RS485 MODBUS RTU output require external power supply. The probe LP UVB 03 is available only with standard output voltage 0÷5Vdc and requires external power supply. All probes of the series LP…03 are equipped with diffuser for cosine correction and protection dome. **M12 male 4-pole connector.** Cables with female connectors and with 2, 5 or 10m length available on request.

LP PHOT 03

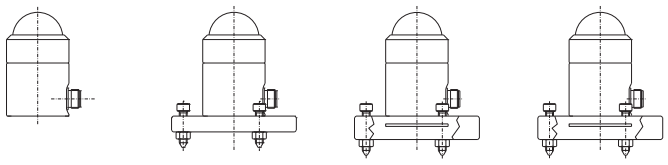
The probe LP PHOT 03 measures illuminance (lux), defined as the ratio between the luminous flux (lumen) passing through a surface and the surface area (m²).
The spectral response curve of a photometric probe is similar to the human eye curve, known as standard photopic curve V(λ). The difference in spectral response between LP PHOT 03 and the standard photopic curve V(λ) is calculated by means of the error f'_1. Calibration is carried out by comparison with a reference luxmeter, calibrated by a Primary Metrological Laboratory. The Calibration Procedure complies with the CEI publication No.69 "Methods of characterizing illuminance meters and luminance meters: Performance characteristics and specifications, 1987". The photometric measurement probe is designed **for outdoor readings**. CIE photopic filter. Cosine correction filter and K5 glass dome. Output, according to the chosen configuration, mV or normalized output 4÷20mA or 0÷10Vdc.

ORDERING CODE

LP PHOT 03: Photometric probe for the measurement of illuminance, complete with K5 dome, silica gel cartridge, female 4-pole connector, calibration report. **Cable with female connector has to be ordered separately.** Cables: **CPM12 AA4** …with cable length 2, 5 or 10 meters.

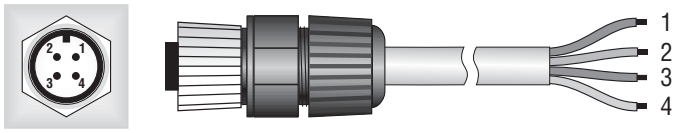
LP PHOT ☐
- **03** = mV / klux
- **03BL** = mV / klux output, base with levelling device
- **03BLAC** = base with levelling device output 4÷20 mA
- **03BLAV** = base with levelling device output 0÷10 mA

CABLE:
CPM12 AA4 ☐
- **2** = length 2m
- **5** = length 5m
- **10** = length 10m



LP PHOT 03 **LP PHOT 03BL** **LP PHOT 03BLAC** **LP PHOT 03BLAV**

WIRING DIAGRAM
4-pole wire CPM12AA4…



Fixed 4-pole plug M12 **Flying 4-pole M12 connector**

LPPHOT 03, LP PHOT 03BL

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Not connected	White
4	Shield	Black

LP PHOT 03BLAV

Connector	Function	Color
1	(+) V out	Red
2	(-) V out and (-) Vdc	Blue
3	(+) Vdc	White
4	Shield	Black

LP PHOT 03BLAC

Connector	Function	Color
1	Positive (+), (+) Vdc	Red
2	Negative (-), (-) Vdc	Blue
3	Not connected	White
4	Shield	Black

LP RAD 03

LP RAD 03 probe measures irradiance (W/m²) defined as the ratio between the radiant flux (W) passing through a surface and the surface area (m²) in the VIS-NIR (400nm- 1050nm) spectral range. The probe is designed **for outdoor readings.**
Cosine correction filter and K5 glass dome. Output, according to the chosen configuration, in µV per µW/cm² or 4÷20mA or 0÷10Vdc normalized output.

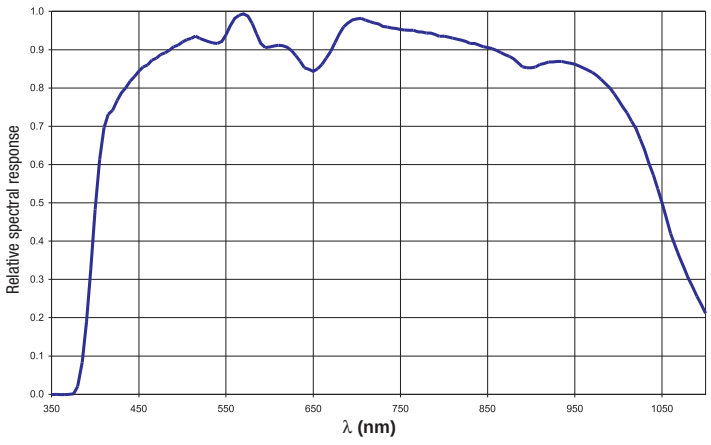
TECHNICAL SPECIFICATIONS

Typical sensitivity:	1÷2.5 µV/(µW/cm²)
Spectral range:	400nm ÷1050nm
Calibration uncertainty:	<5%
f_2 (cosine response):	<3%
f_3 (linearity)	<1%
Operating temperature:	-20°C ÷ +60°C
Impedance:	0.5 ÷ 1.0 kΩ (non-normalized version)

Version with normalized output 4÷20mA: 4mA = 0 W/m², 20mA = 2000 W/m²
Version with normalized output 0÷10Vdc 0V = 0 W/m², 10V = 2000 W/m²

Power supply: 10…30Vdc for version with normalized output 4÷20mA
15…30Vdc for version with normalized output 0÷10Vdc

Typical spectral response curve **LP RAD 03**



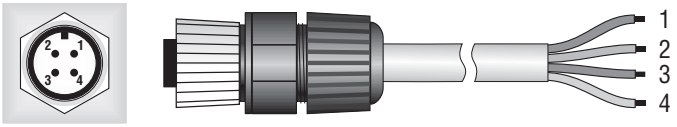
ORDERING CODE

LP RAD 03: Radiometric probe for the measurement of irradiance, complete with K5 dome, silica gel cartridge, 4-pole connector. Cable with female connector has to be ordered separately
Cables: **CPM12 AA4**…with cable length 2, 5 or 10 meters.

LP RAD ☐
- **03** = µV/(µW/cm²) output
- **03BL** = µV/(µW/cm²) output, base with levelling device
- **03BLAC** =µV/(µW/cm²), base with levelling device output 4÷20 mA
- **03BLAV** = µV/(µW/cm²), base with levelling device output 0÷10 mA

CABLE:
CPM12 AA4 ☐
- **2** = length 2m
- **5** = length 5m
- **10** = length 10m

WIRING DIAGRAM
4-pole wire CPM12 AA4…



Fixed 4-pole plug M12 **Flying 4-pole M12 connector**

LP RAD 03, LP RAD 03BL

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Not connected	White
4	Shield	Black

LP RAD 03BLAV

Connector	Function	Color
1	(+) V out	Red
2	(-) V out and (-) Vdc	Blue
3	(+) Vdc	White
4	Shield	Black

LP RAD 03BLAC

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Not connected	White
4	Shield	Black

LP PAR 03

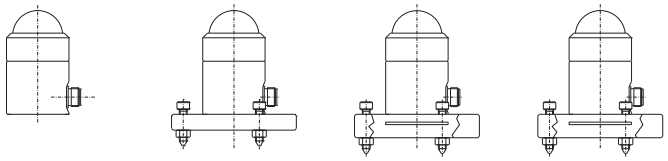
The probe LP PAR 03 measures the ratio between the number of photons that strike a surface in one second, in the 400nm-700nm spectral range and the surface area (m²).
This quantity is defined as PAR: Photo-synthetically Active Radiation.
The probe calibration is carried out by using an halogen lamp, with a known spectral irradiance in a specific spectral range. Temperature slightly affects the probe spectral response.
The probe is **designed for outdoor readings**. Cosine correction filter and K5 glass dome.
Output, according to the chosen configuration, in µV per µmol $m^{-2}s^{-1}$ or normalized outputs 4÷20mA or 0÷10Vdc.

TECHNICAL SPECIFICATIONS

Typical sensitivity:	1÷2.5 µV/(µmol($m^{-2}s^{-1}$))
Typical spectral range:	400 nm ÷ 700 nm
Calibration uncertainty:	<5%
f_2 (cosine response):	<3%
f_3 (linearity)	<1%
Operating temperature:	-20°C ÷ +60°C
Impedance:	0.5 ÷ 1.0 kΩ non-normalized version

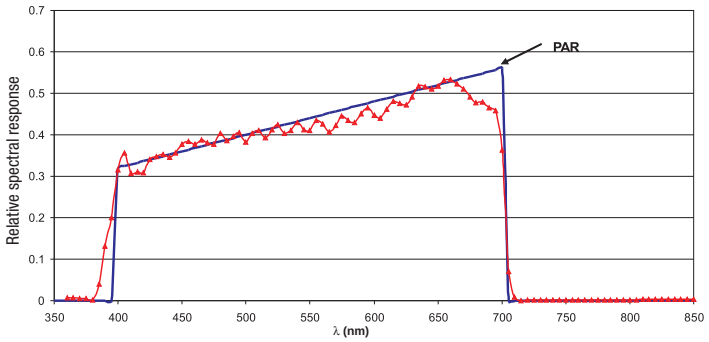
Version with normalized output 4÷20mA: 4mA = 0 µmol($m^{-2}s^{-1}$), 20mA = 5000 µmol($m^{-2}s^{-1}$)
Version with normalized output 0÷10Vdc: 0V = µmol($m^{-2}s^{-1}$), 10V = 5000 µmol($m^{-2}s^{-1}$)

Power supply: 10…30Vdc for version with normalized output 4÷20mA
15…30Vdc for version with normalized output 0÷10Vdc



LP RAD 03 **LP RAD 03BL** **LP RAD 03BLAC** **LP RAD 03BLAV**

Typical spectral response curve **LP PAR 03:**



ORDERING CODE

LP PAR 03 Radiometric probe for the measurement of the Photon flux in the PAR action spectra, complete with K5 dome, silica gel cartridge, 4-pole connector. **Cable with female connector has to be ordered separately.** Cables: **CPM12 AA4** …with cable length 2, 5 or 10 meters

LP PAR ☐

- **03** = µV/(µmol $m^{-2}s^{-1}$) output
- **03BL** = µV/(µmol $m^{-2}s^{-1}$) output, base with levelling device
- **03BLAC** = base with levelling device, output 4÷20 mA
- **03BLAV** = base with levelling device, output 0÷10 mA

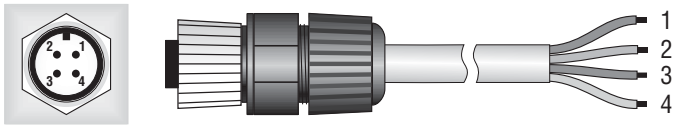
CABLE:

CPM12 AA4 ☐

- **2** = length 2m
- **5** = length 5m
- **10** = length 10m

WIRING DIAGRAM

4-pole wire CPM12 AA4…



Fixed 4-pole plug M12 **Flying 4-pole M12 connector**

LP PAR 03, LP PAR 03BL

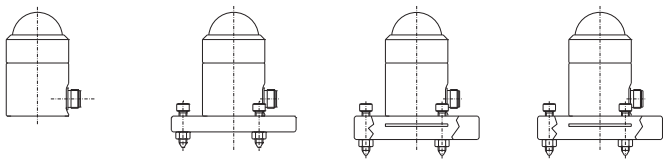
Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Not connected	White
4	Shield	Black

LP PAR 03BLAV

Connector	Function	Color
1	(+) V out	Red
2	(-) Vout and (-) Vdc	Blue
3	(+) Vdc	White
4	Shield	Black

LP PAR 03BLAC

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Not connected	White
4	Shield	Black



LP PAR 03 **LP PAR 03BL** **LP PAR 03BLAC** **LP PAR 03BLAV**

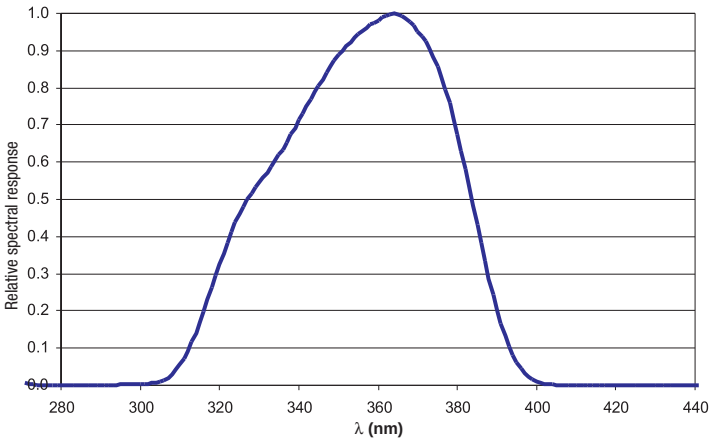
LP UVA 03

The LP UVA 03 probe measures irradiance (W/m²) defined as the ratio between the radiant flux (W) passing through a surface and the surface area (m²) in the UVA (315 nm –400 nm) spectral range. Thanks to a new type of photodiode, LP UVA 03 is blind to visible and infrared light. Probe calibration is carried out by using a 365 nm line of a Xe-Hg, filtered through a special interferential filter. Measurement is carried out by comparison with the primary standards, assigned to Delta Ohm Metrological Laboratory. The probe is designed for **outdoor readings.** Cosine correction filter and K5 glass dome. Output, according to the chosen configuration, in µV per µW/cm² or 4÷20mA or 0÷10Vdc normalized output.

TECHNICAL SPECIFICATIONS

Typical sensitivity:	70÷200 µV/(W/m²)
Measuring range:	327÷384nm (1/2) 312÷393nm (1/10) 305÷400nm (1/100) Peak: 365nm
Calibration uncertainty:	<6%
f_2 (cosine response):	<6%
f_3 (linearity)	<1%
Operating temperature:	-20°C ÷ +60°C
Impedance:	0.5 ÷ 1.0 kΩ non-normalized version
Version with normalized output 4÷20mA:	4mA = 0 W/m² 20mA = 200W/m²
Version with normalized output 0÷10Vdc :	0V = 0 W/m² 10V = 200W/m²
Power supply:	10…30Vdc for version with normalized output 4÷20mA 15…30Vdc for version with normalized output 0÷10Vdc

Typical spectral response curve **LP UVA 03:**



ORDERING CODE

LP UVA 03: Radiometric probe for the measurement of the UVA irradiance, complete with K5 dome, silica gel cartridge, 4-pole connector . **Cable with female connector has to be ordered separately**. Cables: **CPM12 AA4** …with cable length 2, 5 or 10 meters.

LP UVA ☐

- **03** = µV/(µW/cm²) output
- **03BL** = µV/(µW/cm²) output, base with levelling device
- **03BLAC** = base with levelling device output 4÷20 mA
- **03BLAV** = base with levelling device output 0÷10 V

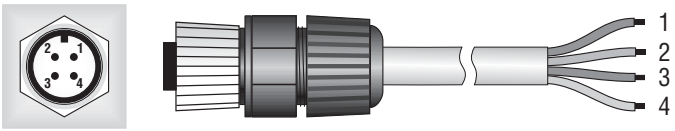
CABLE:

CPM12 AA4 ☐

- **2** = length 2m
- **5** = length 5m
- **10** = length 10m

WIRING DIAGRAM

4-pole wire CPM12 AA4…



Fixed 4-pole plug M12 **Flying 4-pole M12 connector**

LP UVA 03, LP UVA 03BL

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Not connected	White
4	Shield	Black

LP UVA 03BLAV

Connector	Function	Color
1	(+) V out	Red
2	(-) Vout and (-) Vdc	Blue
3	(+) Vdc	White
4	Shield	Black

LP UVA 03BLAC

Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Not connected	White
4	Shield	Black

LP UVB 03BLAV

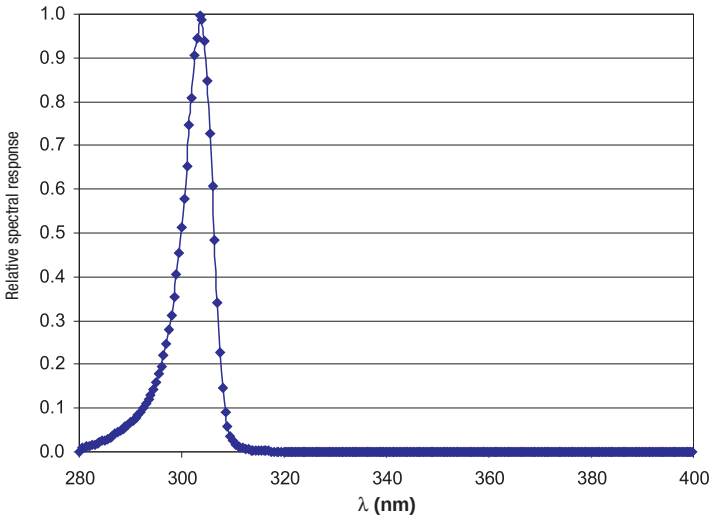
The LP UVB 03BLAV probe measures global irradiance (W/m²) defined as the ratio between the radiant flux (W) passing through a surface and the surface area (m²) in the UVB (280 nm ÷315 nm) spectral region. In particular, the spectral sensitivity is focused at 305 nm, with a bandwidth (FWHM) of 5nm. The global irradiance is the result of the sum of direct solar irradiance and of diffused irradiance incident on a planar surface. In the UVB spectral region, unlike in the visible portion where the direct component prevails over the direct component, the light is strongly diffused by the atmosphere and thus the two components are equivalent, therefore is very important that the instrument is capable of measuring accurately both the components. The probe is designed for **outdoor readings.** Cosine correction filter and Quartz dome.

Typical output 0÷5Vdc.

TECHNICAL SPECIFICATIONS

Typical sensitivity:	≈6V/(W/m²)
Typical spectral range:	301nm ÷ 306nm (1/2)
	295 ÷ 308.5nm (1/10)
	290 ÷ 311.5nm (1/100)
	Peak at 304nm
Calibration uncertainty:	<6%
f_2 (cosine response):	<6%
f_3 (linearity)	<1%
Working temperature:	-20 ÷ +60°C
Output:	0÷1W/m²
Power supply:	15..30Vdc

Typical spectral response curve **LP UVB 03BLAV**



PURCHASING CODE

LP UVB 03BLAV: Radiometric probe for the measurement of the UVB irradiance, complete with Quartz dome, 3 silica gel cartridges, 8-pole M12 connector, calibration report. **Cable with female connector has to be ordered separately**. Cables: **CPM12 AA8** …, with cable lengths 2, 5 or 10 meters.

LP UVB [ ] — **03BLAV** = 0÷5 V, complete with levelling device

CABLE:

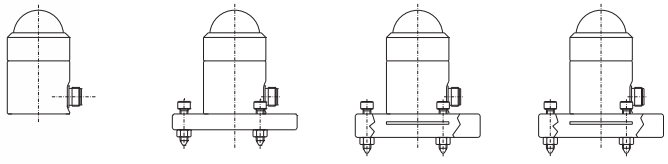
CPM12 AA8 [ ]

2 = length 2m
5 = length 5m
10 = length 10m

LP RAD 03 BLAC

LP RAD 03

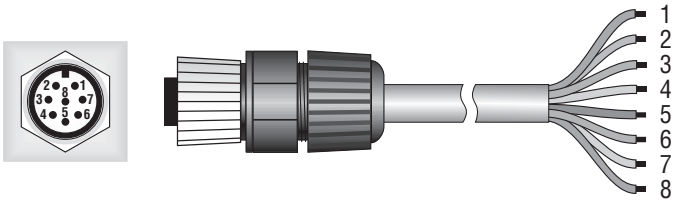
LP RAD 03 BL



LP UVA 03 **LP UVA 03BL** **LP UVA 03BLAC** **LP UVA 03BLAV**

WIRING DIAGRAM

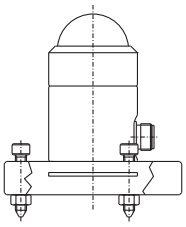
8-pole wire CPM12 AA8…



Fixed 8-pole plug M12 **Flying 8-pole M12 socket**

LP UVB 03BLAV

Connector	Function	Color
1	Signal GND	Red
2	V out UV (+)	Blue
3	Not connected	
4	Shield	Braid
5	Power GND (-)	Brown
6	V out Temp. (+)	White
7	Housing	Black
8	Power (+) 7-30Vdc	Green



LP UVB 03BLAV

ACCESSORIES

CPM12 AA4.2: 4-pole cable. Length 2m. 4-pole M12 connector on one end, open wires on the other side.

CPM12 AA4.5: 4-pole cable. Length 5m. 4-pole M12 connector on one end, open wires on the other side.

CPM12 AA4.10: 4-pole cable. Length 10m. 4-pole M12 connector on one end, open wires on the other side

CPM12 AA8.2: 8-pole cable. Length 2m. 8-pole M12 connector on one end, open wires on the other side.

CPM12 AA8.5: 8-pole cable. Length 5m. 8-pole M12 connector on one end, open wires on the other side.

CPM12 AA8.10: 8-pole cable. Length 10m. 8-pole M12 connector on one end, open wires on the other side

HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input range -10 ..+60mVdc. **Standard configuration 0÷20mVdc**. Minimum measuring range 2mVdc. 2- DIN modules for 35mm rail. **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 Wall Mount installation.**

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

HD 778 TCAL: 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 HD978TR3, HD978TR4, HD978TR5, HD978TR6 converters.

LP PHOT 03S

Transmitter with RS485 MODBUS-RTU output for LP PHOT 03 probe

The **LP PHOT 03S** transmitter converts the mV analog signal generated by the LP PHOT 03 illuminance probe in a digital signal suitable to be transmitted over a RS485 serial line with MODBUS- RTU protocol. The connections are made via the screw terminals accessible by unscrewing the top cover of the transmitter. The casing is designed for wall mounting.

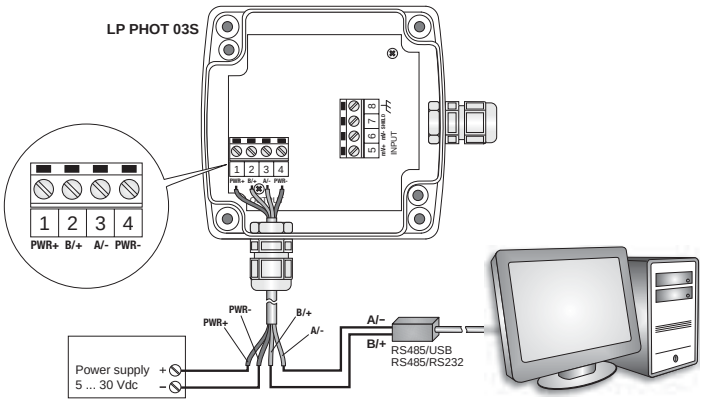
Technical characteristics

Measuring range with LP PHOT 03 probe	Low range: 0…10,000 lux (default) High range: 0…200,000 lux
Resolution	1 lux (low range) / 10 lux (high range)
Output	RS485 (1 Unit Load) with MODBUS- RTU protocol, not isolated
Power supply	5…30 Vdc
Casing dimensions	80 x 84 x 44 mm
Protection degree	IP 66
Operating temperature/humidity	-30…+70 °C / 0…90% R.H. not condensing
Storage temperature	-40…+80 °C

Setting the RS485 communication parameters of the transmitter

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

The parameters setting is performed by connecting the transmitter to the PC by using the **optional RS48** cable, with built- in RS485/USB converter. To use the cable, it is necessary to install the related USB drivers in the PC. Alternatively, a generic RS485/RS232 or RS485/USB converter can be used instead of the RS48 cable.



USB drivers installation notes:

With Windows 7 and 8 operating systems, before installing the drivers it is necessary to restart the PC disabling the drivers signature request. When Windows restarts, press F8 to display the "Advanced Boot Options" menu, then select the "Disable Driver Signature Enforcement" option.

With 64-bit operating systems, even after installation it is necessary to disable the drivers signature request every time the PC is restarted.

Procedure for setting the parameters

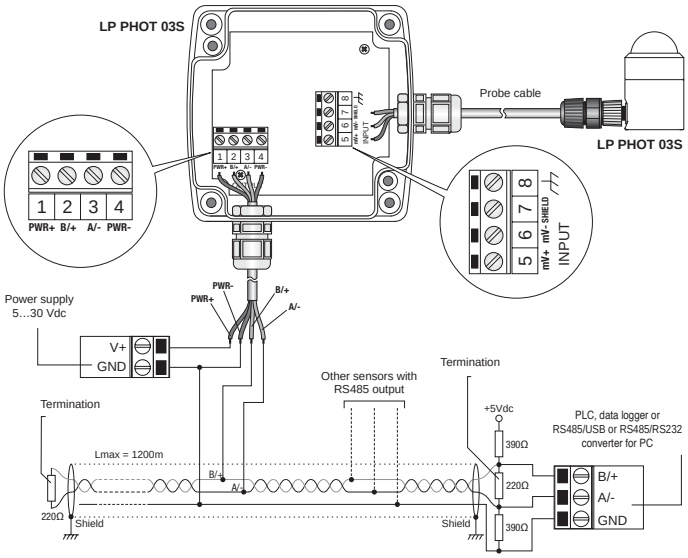
1. Start with the transmitter not powered.
2. Start a standard serial communication program, such as Hyperterminal. Set the COM port number to which the transmitter will be connected, set the Baud Rate to 57600 and the communication parameters as follows:
   Data Bits: 8 Parity: None Stop Bits: 2
3. Switch the transmitter on and wait to receive the & character, then send (within 10 s from power on) the @ command and press Enter.
   Note: if the transmitter 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 transmitter.
4. Send the command CAL USER ON.
   Note: the command CAL USER ON is disabled after 5 minutes of inactivity.
5. Send the serial commands in the following table to set the RS485 MODBUS parameters:

Command	Response	Description
CMAnnn	&I	Set RS485 address to nnn Ranging from 1 to 247 Preset on 1
CMBn	&I	Set RS485 Baud Rate n=0 ⇒ 9600 n=1 ⇒ 19200 Preset on 1 ⇒ 19200
CMPn	&I	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
CMWn	&I	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

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

Command	Response	Description
RMA	Address	Read RS485 address
RMB	Baud Rate (0,1)	Read RS485 Baud Rate 0 ⇒ 9600 1 ⇒ 19200
RMP	Tx Mode (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	Rx Mode (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

Operating mode connection



Terminal	Symbol	Function
1	PWR+	Power supply positive
2	B/+	RS485 B/+
3	A/-	RS485 A/-
4	PWR-	Power supply negative
5	mV+	mV input signal positive
6	mV-	mV input signal negative
7	SHIELD	Shield of the probe cable
8	⏚	Earth connection

For best accuracy, it is advisable not to extend the length of the shielded cable supplied with the LP PHOT 03S probe. It is also recommended not to pass wiring near power cables (electric motors, induction furnaces, inverters, etc.).
In the RS485 connection, the instruments are connected through a twisted-pair shielded cable for signals and a third wire for ground. Line terminations should be placed at the two ends of the network. To polarize the line during non-transmission periods, resistors connected between signal lines and power supply are used.
The maximum number of devices that can be connected to the RS485 line (Bus) depends on the load characteristics of the devices to be connected. The RS485 standard requires that the total load does not exceed 32 unit loads. The load of an LP PHOT 03S transmitter is equal to 1 unit load. If the total load is greater than 32 unit loads, divide the network into segments and add a signal repeater between a segment and the successive one. Line termination should be applied at both ends of each segment.

Operating mode

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

Reading of the measures with the MODBUS-RTU protocol

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

Address	Quantity	Format
2	Illuminance in lux (low range) or lux/10 (high range)	16-bit Integer
3	Status register bit 0 = 1 ⇒ illuminance measurement error bit 2 = 1 ⇒ configuration data error bit 3 = 1 ⇒ program memory error	16-bit Integer
4	Average illuminance in lux (low range) or lux/10 (high range) The average refers to the last 4 measures	16-bit Integer
5	Input signal value in µV (low range) or µV/10 (high range)	16-bit Integer

Setting the probe sensitivity and the measuring range

The measuring range preset in the transmitter is 0…10,000 lux (low range), normally suitable for indoor measurements. If higher values should be measured, for example in the case of outdoor measurements, the measuring range 0…200,000 lux (high range) can be set. Different resolutions correspond to the two measuring ranges: 1 lux for the low range, 10 lux for the high range.
The setting of the probe sensitivity is required when replacing the probe connected to the transmitter with a new probe having different sensitivity.
To set the probe sensitivity and the measuring range, proceed as follows:

1. Start with the transmitter not powered.
2. Connect the transmitter to the PC by using the optional RS48 cable.
3. Start a standard serial communication program, such as Hyperterminal. Set the COM port number to which the transmitter will be connected, set the Baud Rate to 57600 and the communication parameters as follows:
   Data Bits: 8
   Parity: None
   Stop Bits: 2
4. Switch the transmitter on and wait to receive the & character, then send (within 10 s from power on) the @ command and press Enter.
   Note: if the transmitter 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 transmitter.
5. Send the command CAL START.
   Note: the command CAL START is disabled after 5 minutes of inactivity.
6. Send the following serial commands:

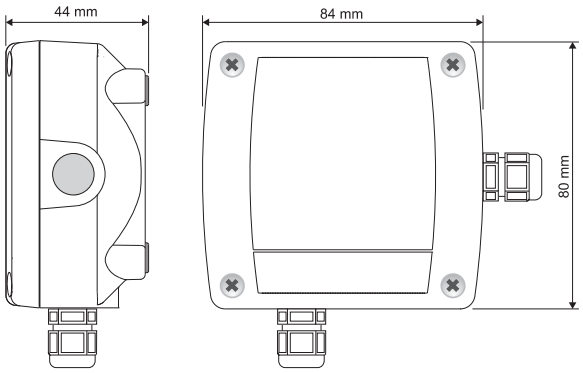
Command	Response	Description
CLSnnn	&|	Set the probe sensitivity to the value nnn in µV/klux nnn indicates a 3 or 4-digit integer number between 500 and 2500
02E	&|	Set low range (0…10,000 lux, 1 lux resolution)
02D	&|	Set high range (0…200,000 lux, 10 lux resolution)

7. You can check the probe sensitivity and the measuring range setting by sending the following serial commands:

Command	Response	Description
RLS	& nnn|	Read the set sensitivity in µV/klux
RO	hh|	Read the configuration byte bit 2 = 0 ⇒ high range (0…200,000 lux, 10 lux resolution) bit 2 = 1 ⇒ low range (0…10,000 lux, 1 lux resolution) The bit 2 is the third bit from the right of the configuration byte

Note: it is not required to send the CAL START command to read the settings with the RLS and RO commands.
When the settings are completed, switch the transmitter off and then back on to activate the RS485 MODBUS- RTU operating mode.

Dimensions



Ordering codes

LP PHOT 03S: Transmitter with RS485 MODBUS- RTU output for the LP PHOT 03 illuminance probe. Measuring range: 0…10,000 lux with 1 lux resolution or 0…200,000 lux with 10 lux resolution. Connections via screw terminals. Wall mount casing. Power supply 5…30 Vdc. Supplied with LP PHOT 03 illuminance probe.
RS48: PC connection cable for the configuration of the MODBUS parameters. With built- in RS485/USB converter. Open wires on the instrument side and USB A- type connector on the PC side.

LP SD 18...
SUNSHINE DURATION SENSOR

Introduction

The Sunshine Duration sensor LP SD18 measures sunshine status and duration. The WMO (World Meteorological Organization) defines the sunshine duration as the time during which the direct solar radiation exceeds the level of 120 W/m^2.
The LP SD18 performs the measure of radiation with an array of photodiodes arranged in a particular geometry which allows to obtain an accurate measurement in any weather conditions. This solution avoids the use of mechanical moving parts and ensures high reliability in the time.
The instrument, besides indicating the presence of sun as required by WMO, measures also direct radiation (SRD), therefore it can be used as a low cost alternative to a pyrheliometer, which use is bound to a solar tracker.
The instrument is available in three versions, which difference depends on the type of output:

LP SD18.1 RS485 MODBUS-RTU output and volt-free contact output (contact closed = SRD ≥ 120 W/m^2, contact open = SRD < 120 W/m^2)

LP SD18.2 RS485 MODBUS-RTU output, analog voltage output 0…1 Vdc, which corresponds to 0…2000 W/m^2 of direct radiation, and digital output voltage (digital voltage output: 1V = SRD ≥ 120 W/m^2, 0V = SRD < 120 W/m^2)

LP SD18.3 SDI- 12 output and volt-free contact output (contact closed = SRD ≥ 120 W/m^2, contact open = SRD < 120 W/m^2)

The LP SD18 is equipped with a heating element separately powered and galvanically isolated, which prevents the formation of condensation on the glass surface onto which the sensitive elements are. For harsh climates, the above-mentioned versions are available with a second heating element (option R, LP SD18.x**R**), which prevents the formation of ice and prevents snow from settling.
The instrument does not need any positioning adjustment during the year and it can be installed on a mast or on a proper fixing base (optional).
The application fields are multiple: from the agronomy (agricultural science) to the study the growth of crops, to photovoltaic systems for verifying their performance, to building automations for automatic opening/closing of blinds, shutters and, in general, to all those areas where it is necessary to monitor the presence of sunlight.

Operating Principle

The Sunshine Duration LPSD18 is based on the use of 16 sensors arranged in such a way that, in the presence of sun, at least one of the photo-detectors is exposed to sun light directly from the sun (besides the diffusion component).
Those sensors which are not directly illuminated by the sun are used for the measurement of the diffused light that is subtracted from the measurement of the sensor which sees the sun directly to get direct radiation.
The cylindrical glass protects the sensors and the internal circuits of the instrument from the weather and at the same time provides an excellent transparency to sunlight.
In order to avoid the formation of condensation inside the instrument, in addition to the heating element, the LPSD18 is supplied with a cartridge that must be loaded with desiccant material in colloidal silica (Silica-gel).

Technical specifications

Sensitive elements	16 Silicon photodiodes
Spectral range	360…1100 nm
Direct radiation SRD measuring range	0…2000 W/m^2
Accuracy of the measurement of direct radiation	Better than 90% on the monthly total
Accuracy of the measurement of the sunshine duration sensor	Better than 90% on the monthly total
Response time	<1 second
Threshold value	120 W/m^2
Sunshine duration resolution	1 sec
Power supply Consumption	7…30 Vdc 5mA @ 12V
Heating system Anti-condensation device consumption Antifreeze device consumption	12…15 Vdc 1W @ 12V 5W @ 12V ON for internal Temp. < 6 °C, OFF for internal Temp > 10 °C
Internal temperature Measuring range Accuracy	 -40…+80 °C ± 0.5 °C
Operating temperature	-40…+80 °C
Weight	0.9 kg
Protection degree	IP66
Outputs LP SD18.1 LP SD18.2 LP SD18.3 	 • RS485 MODBUS-RTU • Galvanically isolated contact closed = SRD ≥ 120 W/m^2 open = SRD < 120 W/m^2 • RS485 MODBUS-RTU • Analog output 0…1V (0…2000 W/m^2) Digital output 0…1V 1V = SRD ≥ 120 W/m^2 0V = SRD < 120 W/m^2 • SDI-12 • Galvanically isolated contact closed = SRD ≥ 120 W/m^2 open = SRD < 120 W/m^2

Installation of the sunshine duration sensor

The sunshine duration sensor should be installed in a place easy to be reached for the periodical cleaning of the glass and the maintenance. At the same time, it should be avoided that buildings, trees or obstructions of any kind exceed the horizontal plane on which the sunshine duration is placed. It is acceptable to choose a location where obstacles in the path of the sun from sunrise to sunset is less than 5° from the horizontal plane of the sunshine duration sensor. It should be also checked that there are no reflective elements that may alter the measure.
The LP SD18 does not need any positioning adjustment during the year.

Three installation methods are possible:

LP SD18.xB: basic version for installation on a flat base by using the support included. The Sunshine Duration Sensor has a fixed inclination of 45° with respect to the fixing plane.

LP SD18.x0: version for installation on the base **LP SD18.0**. The base allows the inclination of the sensor up to 80° respect to the vertical, so to fit it to the position of the sun to the latitude of the place of installation. Two adjustable feet and one fixed foot allow to put the sensor on an horizontal plane (Fig. 2).

LP SD18.xV: version for installation on a vertical Ø 40 mm mast by using the **LP SD18.V** support. This support allows to tilt the sensor up to 80° respect to the vertical, so to fit it to the position of the sun to the latitude of the place of installation (Fig.1).

Fig. 1: Support for installation of the sunshine duration sensor on a mast, LP SD 18.xV.

Fig. 2: Base for installation of the sunshine duration sensor on a horizontal plane, LP SD 18.x0

- Before orienting the Sunshine Duration Sensor to its final position, place it vertically and verify that the mast or the support base are levelled with the spirit level placed on the upper side of the instrument (Fig. 3).

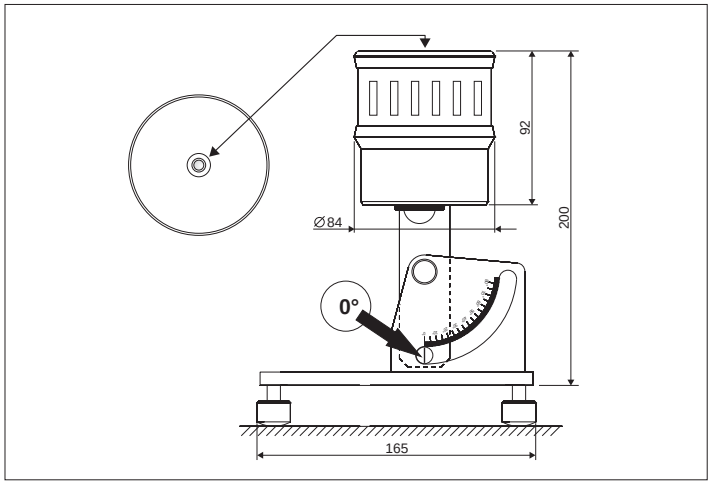


Fig. 3: levelling of the instruments.

- Orient the Sunshine Duration Sensor so that the index of the graduated scale of the support matches the value (90° - Latitude) and the top (where the spirit level is placed) is directed towards the NORTH pole, if used in the northern hemisphere, or towards south, if used in the southern hemisphere (Fig. 4-5).

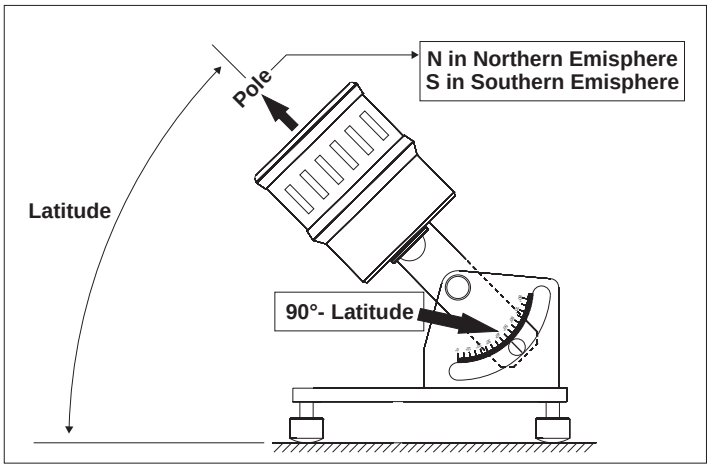


Fig. 4: Orienting of the Sunshine Duration Sensor

The angle that instrument axis should make with respect to the ground is equal to the latitude of the installation site, this way the axis of the instrument will be parallel to the earth axis North-South (Fig. 5).

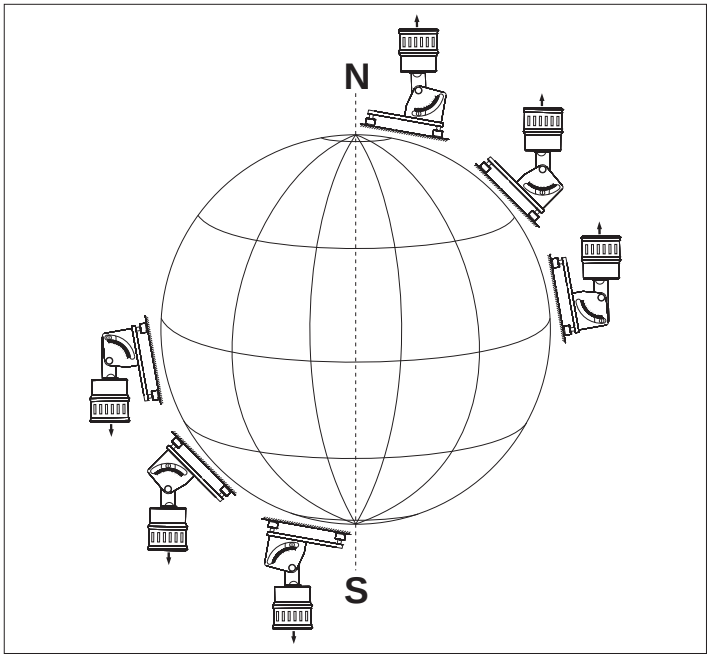
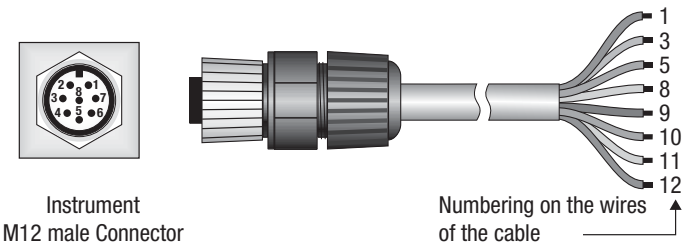


Fig. 5: Orientation of the Sunshine Duration Sensor

Electrical Connections

All the versions of the Sunshine Duration Sensor are equipped with an 8-pin M12 connector. **Upon request, cables with 8-pin M12 female connector with 5 or 10 m standard length are available (other lengths available upon request)**.



LP SD18.1 and LP SD18.1R

Connector Numbering	Function	12-pin cable Numbering
1	Power supply negative	12
2	Power supply positive	1
3	Heating (*)	3
4	RS485 A/-	9
5	RS485 B/+	5
6	Volt-free contact output	8
7	Heating (*)	10
8	Volt-free contact output	11

LP SD18.2 and LP SD18.2R

Connector Numbering	Function	12-pin cable Numbering
1	Power supply negative; 0-1V analog output negative 0-1V digital output negative	12
2	Power supply positive	1
3	Heating (*)	3
4	RS485 A/-	9
5	RS485 B/+	5
6	0-1V digital output positive	8
7	Heating (*)	10
8	0-1V analog output positive	11

LP SD18.3 and LP SD18.3R

Connector Numbering	Function	12-pin cable Numbering
1	Power supply negative	12
2	Power supply positive	1
3	Heating (*)	3
4	NC	
5	SDI-12	5
6	Volt-free contact output	8
7	Heating (*)	10
8	Volt-free contact output	11

(*) The connection of the heating is not polarized, the two wires can be reversed.

Maintenance:

In order to ensure the declared high accuracy of the measures it is necessary that the protective glass is kept clean. Cleaning can be performed with optical microfiber cloths for camera lenses and with some water, if not enough, use pure ethyl alcohol. After cleaning with alcohol it is necessary to wash the surface with water and dry thoroughly.

In order to avoid the formation of condensation, a heating element is present inside the instrument (1W @ 12 Vdc when connected); moreover a special cartridge with desiccant material is included, that prevents the condensation also in the case where it is not possible to use the heating (for example, to reduce consumption). The efficiency of Silica-gel decreases over time due to moisture absorption. When crystals of silica gel are efficient their colour is **yellow**; when gradually losing their efficiency the colour turns **blue**. The user manual of the instrument describes the procedure for replacing them. Typically, the duration of the silica gel varies from 2 to 6 months depending on the environmental conditions in which the sunshine duration sensor is working.

Serial communication

Both **LP SD18.1**… and **LP SD18.2**… are equipped with a RS485 MODBUS-RTU protocol output. The measured values and the status of the instrument can be read in MODBUS-RTU mode by using the 04h function code (Read Input Registers). The following table lists the MODBUS registers available:

MODBUS Registers

Register number	Register address	Datum	Format
1	0	Internal temperature °C [x10]	16-bit integer
2	1	Internal temperature °F [x10]	16-bit integer
3	2	Direct radiation (SRD, "Direct Sunshine") in W/m²	16-bit integer
4	3	Status register Bit0=1 > error in the measure of radiation Bit1=1 > error in the measure of temperature	16-bit integer
5	4	Number of seconds in the last minute with radiation higher than 120 W/m² (number between 0 and 60)	16-bit integer
6	5	Number of tens of seconds in the last 10 minutes with radiation ≥ 120 W/m² (number between 0 and 60: for each interval of 10 s, in the last 10 minutes, is counted a 1 if SRD ≥ 120 W/m² for at least 5 s) For a higher resolution use the register number 5.	16-bit integer
7	6	Status of the sun presence/absence contact 0 = SRD < 120 W/m² (open contact) 1 = SRD ≥ 120 W/m² (closed contact)	16-bit integer
8	7	Status of heating: 0 = off, 1 = on	16-bit integer
9	8	Temperature in °C [x10] below this value the heating turns on	16-bit integer

The **LP SD18.3**… is equipped with an SDI-12 communication interface compliant with the version 1.3 of the protocol, which allows the connection to SDI-12 sensor networks. The commands available are described in detail in the operating manual supplied with the instrument.

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

LP SD18. [ ][ ][ ]

HEATING:
Blank = no heating
R = with heating

INSTALLATION:
B = basic version
O = version for installation on the horizontal base
V = version for installation on a vertical mast

OUTPUT:
1 = RS485 MODBUS-RTU output and volt-free contact output.
2 = RS485 MODBUS-RTU output, 0…1 Vdc voltage analog output and 0/1 V voltage digital output.
3 = SDI-12 output and volt-free contact output.

Ordering codes

LP SD18.1: Sensor for measuring sunshine duration, referred to the 120 W/m² threshold of direct radiation, according to WMO indications. This sensor has no moving parts. RS485 MODBUS- RTU output and volt-free contact output (closed= radiation above the threshold, open = radiation below the threshold). Power supply 7…30 Vdc. It can be fixed on a mast (option **V**) with a suitable accessory or installed on an horizontal surface (option **O**) by using the optional mounting base. Built- in spirit level for levelling. The sensor does not require any adjustment of its position during the year. Equipped with anti-condensation system (1W @ 12 Vdc). 8-pin M12 connector included. 5 or 10 m standard cables with 8-pin M12 female connector are available upon request.
Available with heating option (option **R**) for installation in harsh climates, for the removal of ice and snow. Activation of heating below +6°C. Power absorbed by heating: 5W @ 12 Vdc.

LP SD18.2: Sensor for measuring sunshine duration, referred to the 120 W/m² threshold of direct radiation, according to WMO indications. This sensor has no moving parts. RS485 MODBUS- RTU output, 0…1 Vdc voltage analog output corresponding to 0…2000 W/m² of direct radiation, voltage digital output (1V = radiation below the threshold, 0V = radiation below the threshold). Power supply 7…30 Vdc. It can be fixed on a mast (option **V**) with a suitable accessory or installed on an horizontal surface (option **O**) by using the optional mounting base. Built- in spirit level for levelling. The sensor does not require any adjustment of its position during the year. Equipped with anti-condensation system (1W @ 12 Vdc). 8-pin M12 connector included. 5 or 10 m standard cables with 8-pin M12 female connector are available upon request.
Available with heating option (option **R**) for installation in harsh climates, for the removal of ice and snow. Activation of heating below +6°C. Power absorbed by heating: 5W @ 12 Vdc.

LP SD18.3: Sensor for measuring sunshine duration, referred to the 120 W/m² threshold of direct radiation, according to WMO indications. This sensor has no moving parts. SDI-12 output and volt-free contact output (closed= radiation above the threshold, open = radiation below the threshold). Power supply 7…30 Vdc. It can be fixed on a mast (option **V**) with a suitable accessory or installed on an horizontal surface (option **O**) by using the optional mounting base. Built- in spirit level for levelling. The sensor does not require any adjustment of its position during the year. Equipped with anti-condensation system (1W @ 12 Vdc). 8-pin M12 connector included. 5 or 10 m standard cables with 8-pin M12 female connector are available upon request.
Available with heating option (option **R**) for installation in harsh climates, for the removal of ice and snow. Activation of heating below +6°C. Power absorbed by heating: 5W @ 12 Vdc.

LP SD18.xB: basic version of the sunshine duration sensor for installation on a flat base by using the support included. The Sunshine Duration Sensor has a fixed inclination of 45° with respect to the fixing plane.

LP SD18.0: Base for installation of the sunshine duration sensor on a horizontal plane. Two adjustable feet and one fixed foot. Allows the inclination of the sensor up to 80° from the vertical, to suit the position of the sun to the latitude of the place of installation.

LP SD18.V: Support for installation of the sunshine duration sensor on a mast Ø 40 mm. Allows the inclination of the sensor up to 80° from the vertical, to suit the position of the sun to the latitude of the place of installation.

HD 2003.83: 40 mm mast, 1.5 m length for version **V**. M37x2 mm thread.

HD 2003.83.1: 40 mm mast, 750 mm length for version **V**. M37x2 mm thread.

LP SG: Cartridge for containing crystals of silica gel with O-ring.

LP G Pack of 5 cartridges of the silica-gel.

CP 18.5: 12-conductor cable. 5 m long. 8-pin M12 connector on one side, free wires on the other side.

CP 18.10: 12-conductor cable. 10 m long. 8-pin M12 connector on one side, free wires on the other side.

RS 48: RS485 connection cable with built- in USB/RS485 converter. The cable is equipped with a USB connector for the connection to a PC on one side and 3 separated wires on the instrument side.

R: Heating option for installation in harsh climates, for the removal of ice and snow. Activation of heating below +6 °C. Power absorbed by heating: 5W @ 12 Vdc.

HD 2003
HD 2003.1

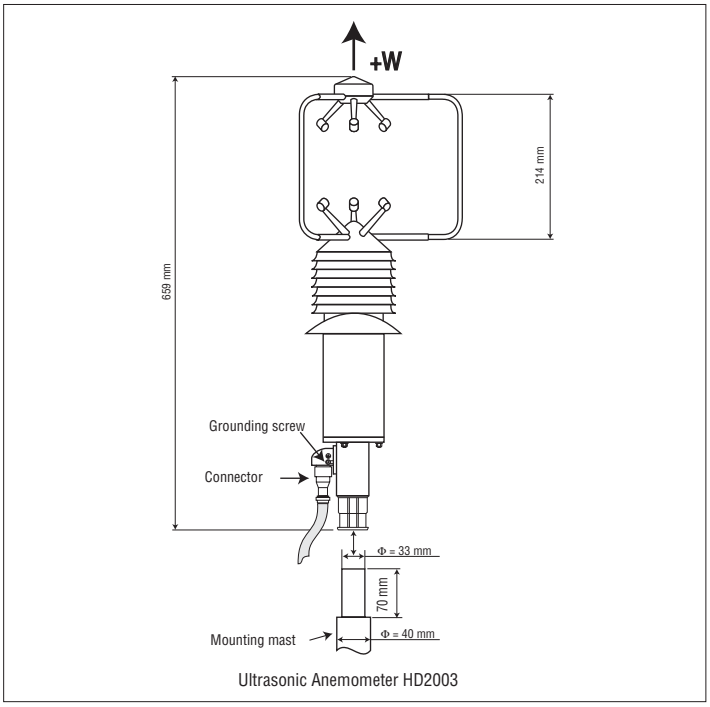
HD 2003, HD 2003.1
THREE AXIS ULTRASONIC ANEMOMETER

HD2003 and HD2003.1 are three axis ultrasonic anemometers, they measure the speed and direction of wind, the U-V-W Cartesian components of speed, sound speed and sonic temperature. **The HD2003 allows also to detect temperature and relative humidity of the air and barometric pressure.**

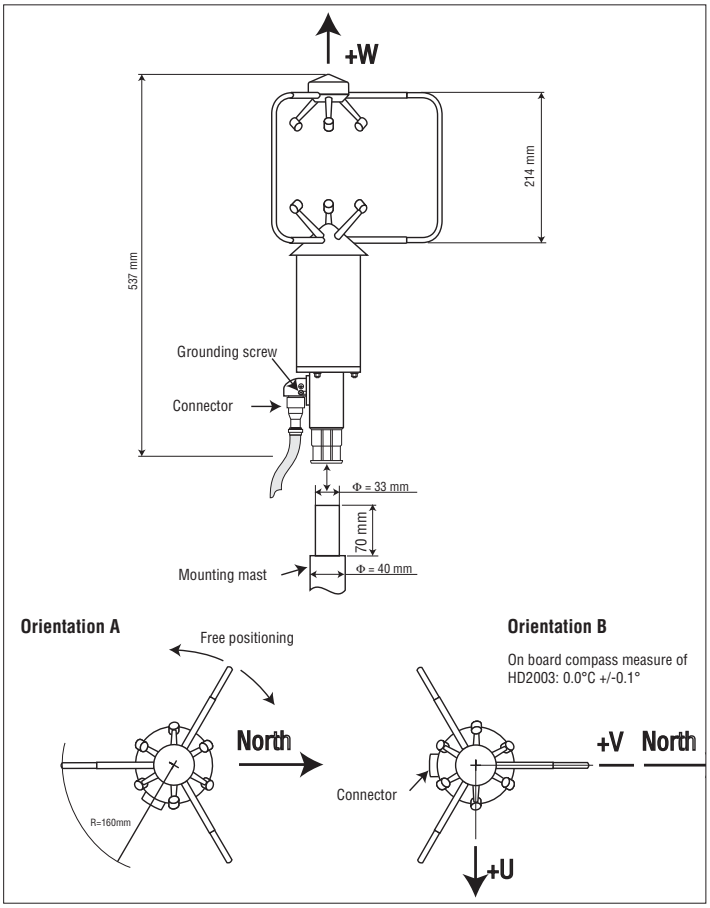
The HD2003 main features are:
- Determination of the anemometric quantities represented in diverse measurement units: wind speed and direction, U-V-W Cartesian components of speed, sound speed, sonic temperature.
- **(HD2003 Model)** additional output quantities: Temperature, Relative Humidity and Pressure.
- 5 analogue voltage or current outputs, with different measuring ranges.
- Up to 12 further analogue current or voltage outputs, with diffrent measuring ranges.
- 4 Serial Communication interfaces: RS232, RS422, Multidrop RS485 and AoXnd
- Configurable output rate of digital output data string.
- Configurable average periods 1÷60sec and 1÷60min. for all output quantities.
- Algorithmic raw date processing and validation, assuring ± 1% precision to anemometric quantities.
- Digital high frequency data acquisition mode with 50Hz data output, or high frequency analogue data acquisition within 5Hz and 20Hz.
- Self-diagnosis with error checking and report.
- Reliability and precision on whole measuring range, no additional calibration required.
- Flexible, easy-to use **demo software**, configurable according to the user's needs through Computer interface.
- User interface for 'Setup' management and software upgrade through RS232 or RS485.
- Automatic alignment to the magnetic North through built in compass.
- No moving part, with reduced maintenance and service costs.
- Rugged and reliable structure, suitable for continuous operation even in severe environmental conditions.
- Low power consumption.
- **(On request) Heaters Option**: built-in heating device of sonic transducers, to prevent ice and snow formation. Assures correct measurements even in presence of sleet or snow.
- **(On request) RS422 Option:** full duplex 4-wire integrated circuit for RS422 communication.

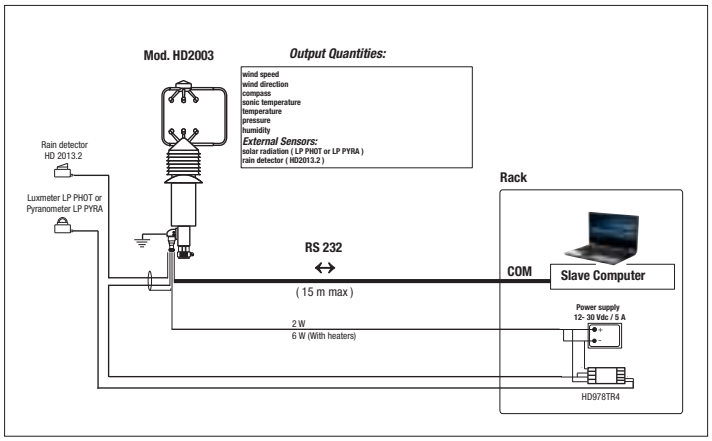
Typical applications:
- Meteorology
- Aviation and Navigation
- Tunnels, Highways
- Climatology
- Sport and winter stations
- Safety in yards
- Construction/Crane safety
- Industrial buildings

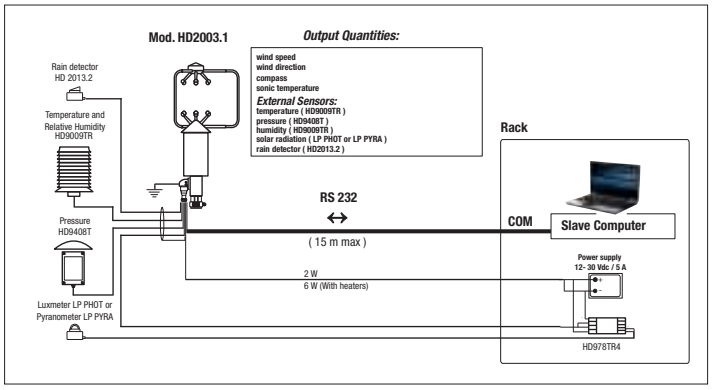
Technical specifications
Output quantities
- Anemometric parameters — Wind speed and direction, Sound Speed, Sonic Temperature, U-V-W Components
- Meteorological parameters — **Model HD2003** Pressure, Temperature, Relative Humidity
- Heading — Compass with magnetic Azimuth
- Moving Averages — 1÷60 sec. / 1 ÷ 60 min.
- Output rate — 1÷3600 sec. or 1/50 sec. (RS232, RS422 or RS485)

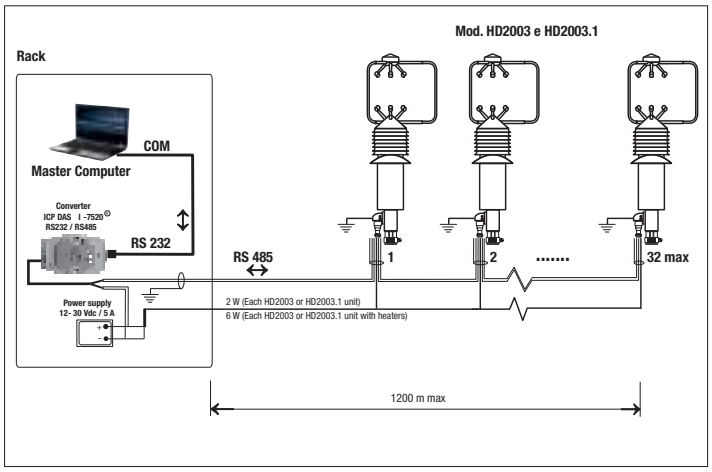


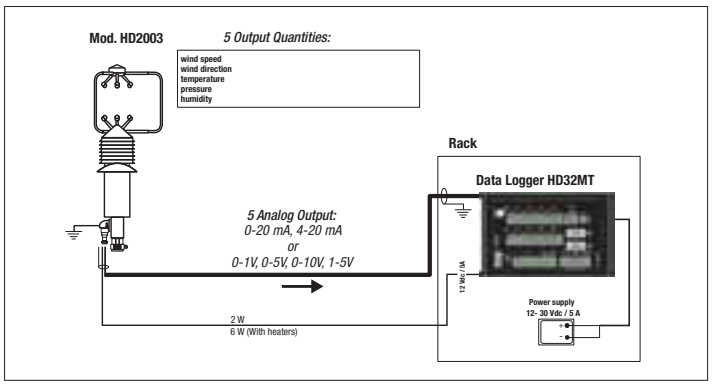
Ultrasonic Anemometer HD2003

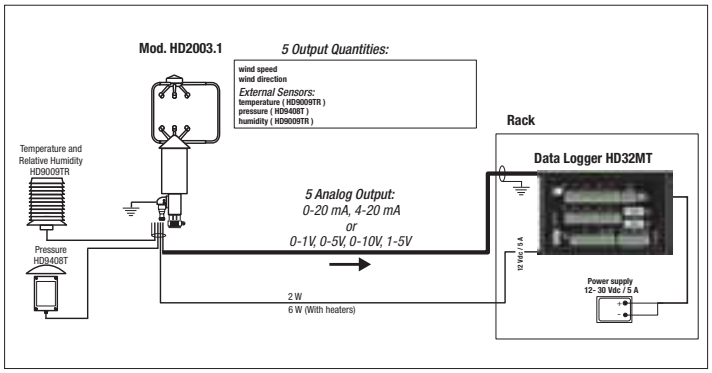












Wind Speed

• Measuring unit	m/s, cm/s, km/h, knots, mph
• Range	0÷70 m/s (252 km/h)
• Resolution	0.01 m/s
• Accuracy	± 1% of reading

Wind Direction

• Range	Azimuth: 0÷360° Elevation: ± 60°
• Resolution	0. 1°
• Accuracy	± 1°

Sound speed

• Range	300 ÷ 380 m/s
• Resolution	0.01 m/s
• Accuracy	± 1% of reading

Sonic Temperature

• Range	-40 + 60°C
• Resolution	0.1 °C
• Accuracy	± 1°C

Compass

• Range	0 ÷ 360° (measurement in tenths of degree)
• Resolution	0.1 °
• Accuracy	± 1°

Digital Outputs

• Communications	RS232 and RS422 full duplex, Multidrop RS-485 and AoXand half duplex
• Baud Rate	9600 ÷ 115200 bit/sec.
• Output Rate	Normal functioning mode: 1 ÷ 3600 sec Digital high frequency: 1/50 sec
• Measured data	Digital string of anemometric quantities and compass **(Model HD2003)** Pressure, temperature, relative humidity

Analog Outputs

• Number	5, selectable between all available output quantities
• Range	0÷20mA, 4÷20mA, 0÷1V, 0÷5V, 1÷5V, 0÷10V
• Resolution	14 bit max

Extended Analog Outputs (with ICP DAS I-7024 ® module - on request when placing the order)

• Number	max 12, selectable between all available output quantities
• Range	0÷20mA, 4÷20mA, 0÷5V, 0÷10V
• Resolution	14 bit max
• Output rate	Normal mode (slow): 1 ÷ 3600s Analogical High frequency (fast): from 5Hz to 20Hz, depending on the baud rate

Power supply

• Range	12 ÷ 30 VDC
• Power	<2W (typically 110mA @ 15Vdc) <6W Models with heaters and environment temperature not lower than -10°C

Heaters Option (On request, when placing the order)
Heating with automatic temperature control on sonic transducers, to prevent ice and snow formation.

RS422 Option
Integrated circuit for 4-wire RS422 full duplex communication

Temperature, Relative Humidity, and Pressure Sensors (Model 2003)

Temperature
Pt100 sensor
Analog output 0÷20mA, 4÷20mA, 0÷1V, 0÷5V, 1÷5V, 0÷10V
Extended analog output (AoXand): 0÷20mA, 4÷20mA, 0÷5V, 0÷10V
Range: -40 + 60°C
Resolution 0.1°C
Accuracy ± 0.2°C ± 0.15% of reading

Relative Humidity
Capacitive sensor
Analog output (0 ÷ 100% RH): 0÷20mA, 4÷20mA, 0÷1V, 0÷5V, 1÷5V, 0÷10V
Extended analog output (AoXand): 0÷20mA, 4÷20mA, 0÷5V, 0÷10V
Range: 0 ÷ 100% RH
Resolution 0.1 % RH
Accuracy ± 2% RH @ 23°C in the range 5÷90%RH, 2.5% in the remaining range.

Pressure
Piezoresistive sensor
Analog output: 0÷20mA, 4÷20mA, 0÷1V, 0÷5V, 1÷5V, 0÷10V
Extended analog output (AoXand): 0÷20mA, 4÷20mA, 0÷5V, 0÷10V
Range 800 ÷ 1100 mbar (On request: 600 ÷ 1100 mbar)
Resolution 0.1mbar
Accuracy ± 0.4mbar @ 20°C
Thermic effects ± 0.8mbar from -40°C up to +60°C
Long-term stability < 0.2% f.s. in 6 months @ 20°C

ORDER CODES:

HD2003: Static anemometer for measuring the speed and direction of wind, air temperature, relative humidity and barometric pressure. Wind speed and direction, U-V-W Cartesian Components of speed, sound speed, sonic temperature. Five different analogue voltage or current outputs for different ranges. Communication software for bi-directional links for net connection of different anemometers, interfaces available RS232, RS485, RS422 Different measuring units and average periods are available. Ultrasonic transducers heating as optional. 12..30 Vdc power supply, 120mA consumption at 15Vdc. To be mounted on a mast diam.33mm. Flying connector included.

HD2003R: Transducers heating option for HD 2003 against ice or snow.

HD2003.1: Static anemometer for measuring the speed and direction of wind. Wind speed and direction, U-V-W Cartesian Components of speed, sound speed, sonic temperature. Five different analogue voltage or current outputs for different ranges. Communication software for bi-directional links for net connection of different anemometers, interfaces available RS232, RS485, RS422. Different measuring units and average periods are available. Transducers heating as optional. 12..30 Vdc power supply, 120mA consumption at 15Vdc. To be mounted on a mast diam.33mm. Flying connector included.

HD2003.1R: Transducers heating option for HD 2003.1 against ice or snow.

CP2003/5: 26-pole shielded cable diam. 8mm, length 5m. complete with watertight connector at one side and free at the other end.

CP2003/10: 26-pole shielded cable diam. 8mm, length 10m. complete with watertight connector at one side and free at the other end.

CP2003/C: Watertight 26-pole connector Tyco 62IN- 16A – 16 – 265 – 4 0445

RS2003: Cable with USB connector at one side and watertight connector 26-pole connector at the other end, with 12Vdc power inlet for mains supply.

ICP DAS I-7024CR®: Module for extended analog oputput mode**.** Indicate how many modules (up to a maximum of 3) and which configuration is required.

ICP DAS I-7520CR®: Module for RS232/RS485 conversion for RS485 Multidrop mode and extended analog output mode.

C.205M: USB/RS232 converter cable, with USB connector at one side and 9-pole male connector at the other end.

HD2003.77: Clamping for mast Ø 40mm

HD2003.77C: 2 crossed sleeves for tube Ø 40mm

HD2003.1.14: Crossed clamping for mast Ø 40mm with 6 inputs Ø 16mm

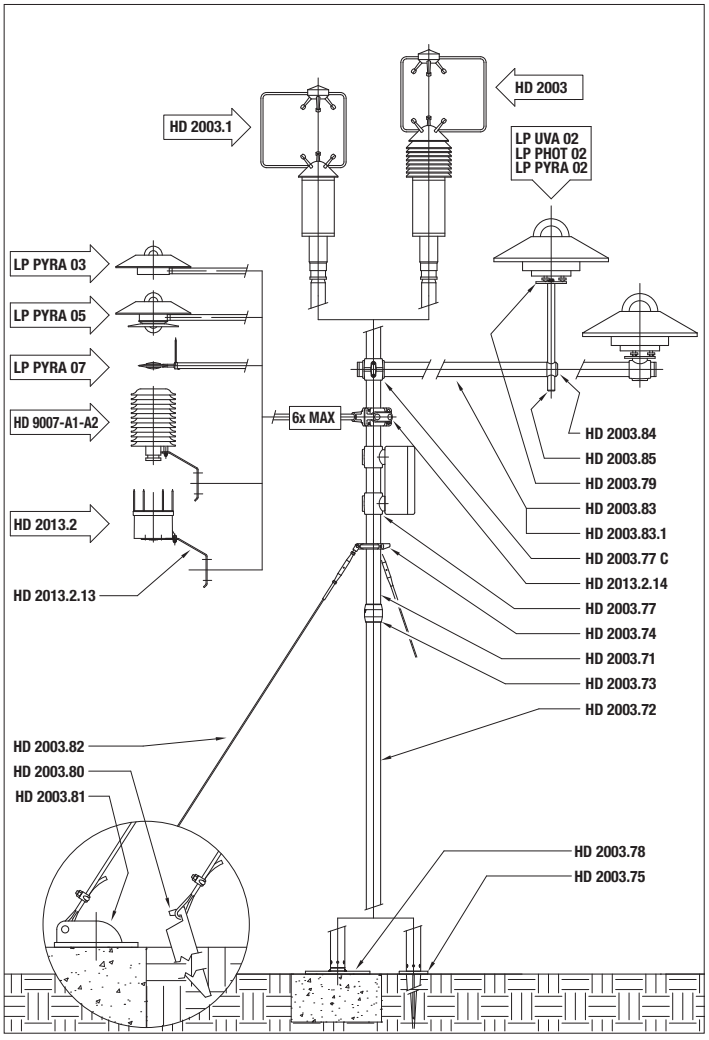
HD2003.2.17: Support rod for sensors Ø 16mm, length 500mm

HD2003.71K: Mast kit Ø 40mm, height 2m, in two pieces, Ø 33mm tapered tip (HD2003.71, HD2003.72, HD2003.73)

HD2003.74: Clamping with bubble level for Ø 40mm mast with 3 bracing tie rods

HD2003.75: Flange for Ø 40mm mast with grounding rod.

HD2003.75K: Accessories kit for bracing the mast, to fix on the ground (HD2003.80, HD2003.82 - stainless steel strings). 2m fixing diameter.



HD2003.78: Flange plate for Ø 40mm mast to fasten on the floor

HD2003.78K: Accessories kit for bracing the mast, to fasten on the floor (HD2003.81, HD2003.82- stainless steel strings). 2m fixing diameter.

HD2003.79K: Fixing kit to mount pyranometers on clamping Ø 40mm (HD2003.77C - HD2003.79)

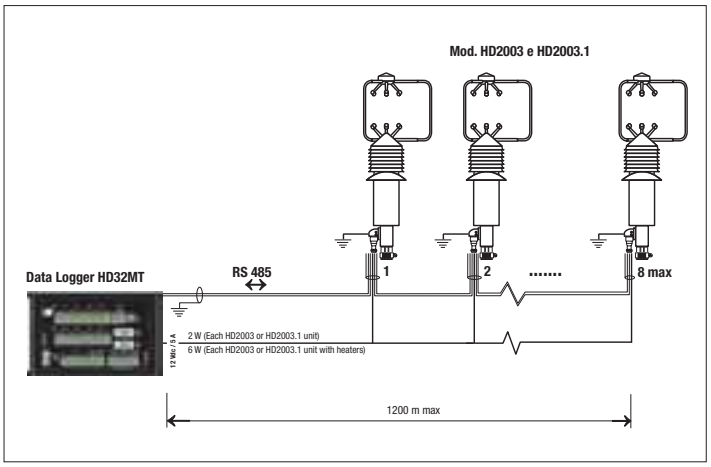
HD2003.83: Transverse mast L=150 cm

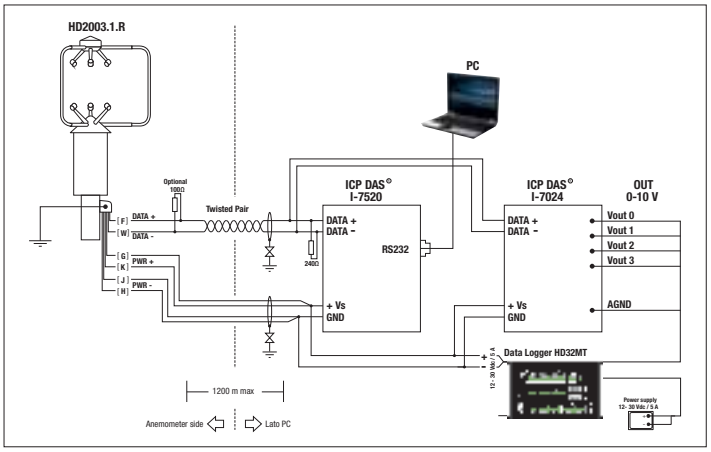
HD2003.83.1: Transverse mast L=75 cm

HD2003.85K: Fixing kit with adjustable height to mount pyranometers on Ø 40mm mast (HD2003.84 – HD2003.85 – HD2003.79)

Please specify also the following (depending on the selected model):

- **Model HD2003 and HD2003.1:** integrated circuit for 4-wire full duplex RS422 communication.
- **Model HD2003**: if the extension of the analog outputs is required, by additional external sensors with **0÷1V analog output**. In order to linearize their range on the scale **0÷1V**, it is necessary to specify in this case the number of sensors that you intend to employ (max. two), and their physical range.
- **Model HD2003.1**: if the extension of the analog outputs is required by additional external sensors with **0÷1V analog output**. In order to linearize their range on the scale **0÷1V**, it is necessary to specify in this case the number of sensors that you intend to employ (max. five), and their physical range.





HD52.3D
2 AXES ULTRASONIC ANEMOMETERS

2 axes ultrasonic Anemometers series HD 52.3D….
The instruments of the series HD52.3D… are 2 axes ultrasonic static anemometers for measuring:

- Wind speed and direction, U-V Cartesian components of wind speed,
- Relative Humidity and Temperature **(optional, code '17'),**
- Diffuse Solar Radiation **(optional, code 'P'),**
- Barometric pressure **(optional, code '4').**

All models are equipped with compass.
RS232, RS485, RS422 and SDI-12 serial interfaces are available with **NMEA**, **MODBUS-RTU** and **SDI-12** communication protocols.
All versions have two analogical outputs, both for wind speed and for direction, factory configurable among 4÷20mA **(standard),** 0÷1V, 0÷5V, 0÷10V (**to be specified when ordering**).
Optionally available, (ACCREDIA) **ILAC-MRA** traceable factory calibration.

Advantages:

- The absence of moving parts minimizes maintenance;
- High sensitivity for detecting very low speeds, which are not detectable by traditional methods;
- The low power of the instrument allows installation in remote sites, with power from solar panel and battery;
- The heating option '**R**' prevents the accumulation of snow and ice from forming, allowing accurate measurements in all environmental conditions;
- Fast and easy installation (on 40mm diameter pole, optional installation kit HD2004.20), alignment facilitated by built-in compass;
- The available measurement options join together in one single, compact and lightweight instrument, the main variables of interest in weather stations;
- MODBUS-RTU output allows instrument networking.

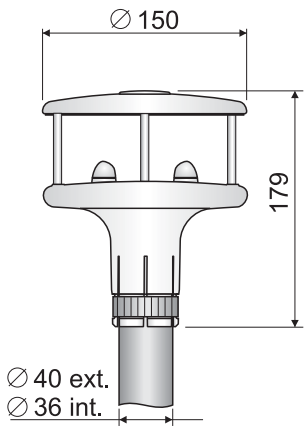
Typical applications:

- Weather stations
- Environmental monitoring
- Agriculture
- Sports facility
- Marine and Harbour applications
- Airports
- HVAC
- Construction
- Renewable energy
- Building automation

Technical specifications:

Wind speed	
Employed sensor type	Ultrasonic
Measuring Range	0…60 m/s
Resolution	0.01 m/s
Accuracy	Whichever is greater ± 0,2 m/s or ± 2%, (0…35 m/s) ± 3% (> 35 m/s)
Wind direction	
Employed sensor type	Ultrasonic
Measuring Range	0…360°
Resolution	0.1°
Accuracy	± 2° RMSE from 1.0 m/s
Compass	
Employed sensor type	Magnetic
Measuring Range	0…360°
Resolution	0.1°
Accuracy	± 1°
Air temperature (*option 17 is requested*)	
Employed sensor type	Pt100
Measuring Range	-40…+60 °C
Resolution	0.1 °C
Accuracy	± 0,15°C ± 0,1% of the measure
Relative Humidity (*option 17 is requested*)	
Employed sensor type	Capacitive
Measuring Range	0…100%RH
Resolution	0.1%
Accuracy (@ T = 15…35 °C)	± 1,5%UR (0..90%RH), ± 2%RH (remaining field)
Accuracy (@ T = -40…+60 °C)	± (1,5 + 1,5% of the measure)%RH
Barometric Pressure (*option 4 is requested*)	
Principle	Piezoresistive
Measuring Range	600…1100 hPa
Resolution	0.1 hPa
Accuracy	± 0,5 hPa @ 20°C
Solar Radiation (*option P is requested*)	
Employed sensor type	Thermopile
Measuring Range	0…2000 W/m^2
Resolution	1 W/m^2
Accuracy	2nd class Pyranometer
General features	
Power supply	10…30 Vdc
Power Consumption	26mA @ 12Vdc without heater, 6W with heater
Serial Outputs	RS232, RS485, RS422 and SDI-12
Communication Protocols	NMEA, MODBUS-RTU, SDI-12
Analog Outputs	2 analog outputs for wind speed and direction. Output type to be specified when ordering among 4…20mA **(standard)**, 0…1V, 0…5V and 0…10V **(option 0…10V requires power supply 15…30Vdc)**
Electrical connection	male connector M23 19 poles
Working temperature	-40…+60 °C
Dimensions	H=179mm, Ø =150mm (HD52.3D, HD52.3D4) H=200mm, Ø =150mm (HD52.3DP, HD52.3DP4) H=336mm, Ø =150mm (HD52.3D17, HD52.3D147) H=357mm, Ø =150mm (HD52.3DP17, HD52.3DP147)
Weight	about 1 Kg (full version, HD52.3DP147)
Housing	Plastic material: LURAN®S (ASA) Metallic parts made of AISI 316
Protection degree	IP66

DIMENSIONS (mm)

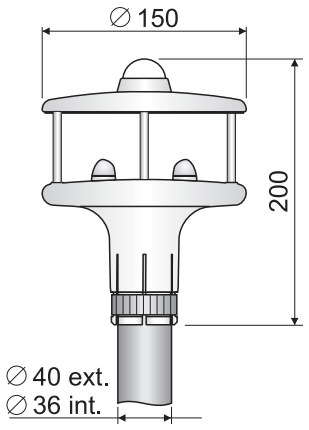


HD 52.3D

Wind speed and direction.

HD 52.3D4

Wind speed, wind direction and barometric pressure.

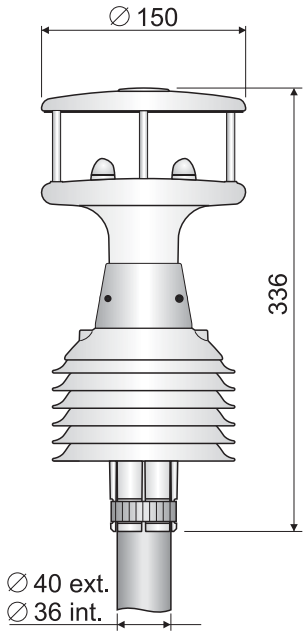


HD 52.3DP

Wind speed, wind direction and solar radiation.

HD 52.3DP4

Wind speed, wind direction, solar radiation and barometric pressure.

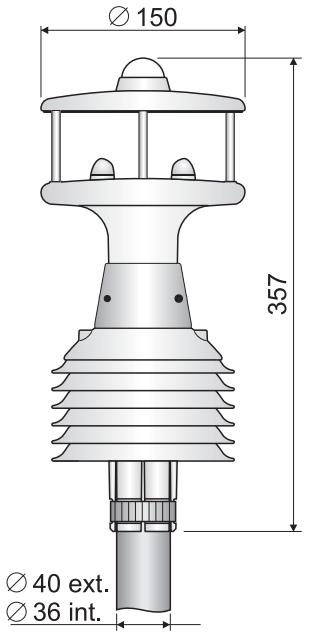


HD 52.3D17

Wind speed, wind direction, temperature and relative humidity.

HD 52.3D147

Wind speed, wind direction, temperature, relative humidity and barometric pressure.



HD 52.3DP17

Wind speed and direction, solar radiation, temperature, relative humidity.

HD 52.3DP147

Wind speed, wind direction, solar radiation, temperature, relative humidity and barometric pressure.

ORDERING CODES

HD 52.3D ☐☐

R = heater option
Blank = not heated

P = solar **radiation option** (pyranometer)
4 = barometric pressure option
17 = **relative humidity and temperature** option
P4 = **solar radiation and barometric pressure** option
P17 = **solar radiation, relative humidity and temperature** option
147 = **barometric pressure, relative humidity and temperature** option
P147 = **solar radiation, barometric pressure, relative humidity and temperature** option
No characters = basic version: **wind speed and direction**

Analog outputs for wind speed and direction: 4…20mA standard; to be requested: 0…1V, 0…5V or 0…10V (**0…10V option requires power supply 15…30Vdc**).

HD52.3D…: 2 axes ultrasonic static anemometers for the measure of wind speed and direction, U-V Cartesian components of wind speed, relative humidity and temperature (**optional**), diffuse solar radiation (**optional**) and barometric pressure (**optional**). A compass is supplied. RS232, RS485, RS422 and SDI-12 serial outputs, **NMEA**, **MODBUS-RTU** and **SDI-12** communication protocols. Two analogical outputs, for wind speed and direction, factory configurable among 4÷20mA **(standard)**, 0÷1V, 0÷5V or 0÷10V (**to be specified when ordering**). **Heater option** is available. Power supply: 10…30Vdc (15…30Vdc for 0÷10V analog outputs). Installation on a pole: external Ø 40mm and internal Ø 36mm. Input with M23 19-pin male connector and M23 19-pin female flying connector. **Optional 5m or 10m cable with a connector on one side and open wires on the other.**

HD 52.3D17
HD 52.3D147

HD 52.3DP17
HD 52.3DP147

HD 52.3D
HD 52.3D4

HD 52.3DP
HD 52.3DP4

ACCESSORIES

HD52.3D-S: Further copy of CD-ROM with HD52.3D-S software for PC connection, instrument configuration and monitor. For Windows® operating systems.

RS 52 : Serial connection cable with built-in USB/RS232 converter. USB connector for the PC and screw terminals on the instrument side. The cable is used to configure the instrument before the installation. Length 1.5 m.

CP52.5: Connection cable with M23 19-pin female flying connector on one side, free wires on the other. 5m long.

CP52.10: Connection cable with M23 19-pin female flying connector on one side, free wires on the other. 10m long.

CP52.15: Connection cable with M23 19-pin female flying connector on one side, free wires on the other. 15m long.

CP52.20: Connection cable with M23 19-pin female flying connector on one side, free wires on the other. 20m long.

CP52.C: Further M23 19-pin female flying connector.

HD2004.20: Tripod kit for installing anemometers on a flat base. Height 3m.

HD2004.22: 1200x530x34mm Solar panel mounting kit to a Ø 40÷50mm pole. AISI 304 stainless steel.

HD 2004.20

HD 32MT.1

HD 32.35FP

HD2004.30: 80W monocrystalline solar pannel. Dimensions 1200 x 530 x 34 mm. Model MD5000080 – CS EVOLUTION.

HD32.35: Outdoor-box for complete weather station acquisition system. **Material: AISI 304 stainless steel**. Screen to protect the box from solar radiations. Powder-coated, anodized aluminium white colour. Double lock, one with a key. Dimensions: 450 x 300 x 210 mm. Protection degree: IP66. Equipped with the accessories to mounting on a mast diameter 36 ÷ 52 mm. Provided for 100÷240Vac mains power supply, includes: HD32MT.1 datalogger, power supply unit AC / DC with battery charger, rechargeable 12V battery, surge protection, breakers, power distribution terminals and connectors for connection to external sensors.

HD32.35FP: Outdoor-box for complete weather stations acquisition system. **Material: AISI 304 stainless steel**. Screen to protect the box from solar radiations. Powder-coated, anodized aluminium white colour. Double lock, one with a key. Dimensions: 450 x 300 x 210 mm. Protection degree: IP66. Equipped with the accessories to mounting on a mast diameter 36 ÷ 52 mm. For power supply by solar panel, includes: HD32MT.1 logger, solar panel charge controller, and power distribution terminal block connectors for connection to external sensors.

HD32.36: Outdoor-box for complete weather stations acquisition system. **Material: Polyester reinforced with hot-moulding Fiberglass.** Screen to protect the box from solar radiations. Powder-coated, anodized aluminium. White colour. Key lock. Dimensions: 415 x 310 x 170 mm. Protection degree: IP66. Equipped with the accessories to mounting on a mast diameter 36 ÷ 52 mm. Provided for 100÷240Vac mains power supply, includes: HD32MT.1 datalogger, power supply unit AC / DC with battery charger, rechargeable 12V battery, surge protection, breakers, power distribution terminals and connectors for connection to external sensors.

HD32.36FP: Outdoor-box for complete weather stations acquisition system**. Material: Polyester reinforced with hot-moulding Fiberglass**. Screen to protect the box from solar radiations. Powder-coated, anodized aluminium. White colour. Key lock. Dimensions: 415 x 310 x 170 mm. Protection degree: IP66. Equipped with the accessories to mounting on a mast diameter 36 ÷ 52 mm. For power supply by solar panel, includes: HD32MT.1 logger, solar panel charge controller, and power distribution terminal block connectors for connection to external sensors.

HD 32.35

HD 2013.2
RAIN DETECTOR

The **HD2013.2** is a rain detector based on the capacity principle. The capacity value of the sensitive element, on an alumina rest, changes according to the surface dampened by raindrops. An integrated heater keeps it dry, evaporates water and prevents false signals caused by fog or dew. The heater also activates at low temperatures, melting the snow and allowing to detect snow precipitations. The instrument external circular dome acts as a windshield for the sensor, preventing false indications. The instrument is equipped with three different outputs: a "Rain ON/OFF" output, which detects whether it is raining/snowing (ON) or not (OFF), also used to control a relay coil or similar devices; a 0…1V voltage analogue output (calibrated) and a 1,5…6KHz frequency output (not calibrated), which provide an accurate indication of current precipitation intensity. The ON/OFF output comes with a delay circuit that indicates the "rain over" condition with a 2 minute delay, so that the "rain over" condition is distinguished from the "light rain" one. The heater can be disabled when power consumption is critical. To do it, set the Heater OFF input on 0V.
If requested when ordering, a bird spike, consisting of a 6-spike ring (spike height: 60mm, diameter: 3 mm), can be mounted.

Typical Applications
The rain detector can be used either as a separate device, or connected to a data logger system (for example: in a weather station). In figure 1, the HD2013.2 ON/OFF output is connected to a relay coil that powers an engine: should it rain, the ON/OFF output will energize the relay coil, which will close the normally open contact (in this case the rain detector is employed as part of a control system, such as, for example, for closing windows). Warning: when the HD2013.2 is connected to a relay coil, use always a protection diode, as shown in figure 1.

Installation and Maintenance
Place the detector far from buildings, trees, etc…, taking care that no object is over the detector, as it might prevent rain detection. Use the supplied accessories to mount the instrument; the bracket can be fixed to a pole having a diameter from 30 to 50mm; the pole can be either horizontal or vertical thanks to the bracket double drilling. A standard 5-m cable is supplied for the electrical connection with an IP68 connector to be inserted at the bottom of the instrument: the colours of the leads and the relating functions are to be found in the technical specifications. To ensure good immunity from noises, it is recommended to connect the cable braid to the earth and to keep the heater and the electronics earth leads separate. Keep the sensor clean.

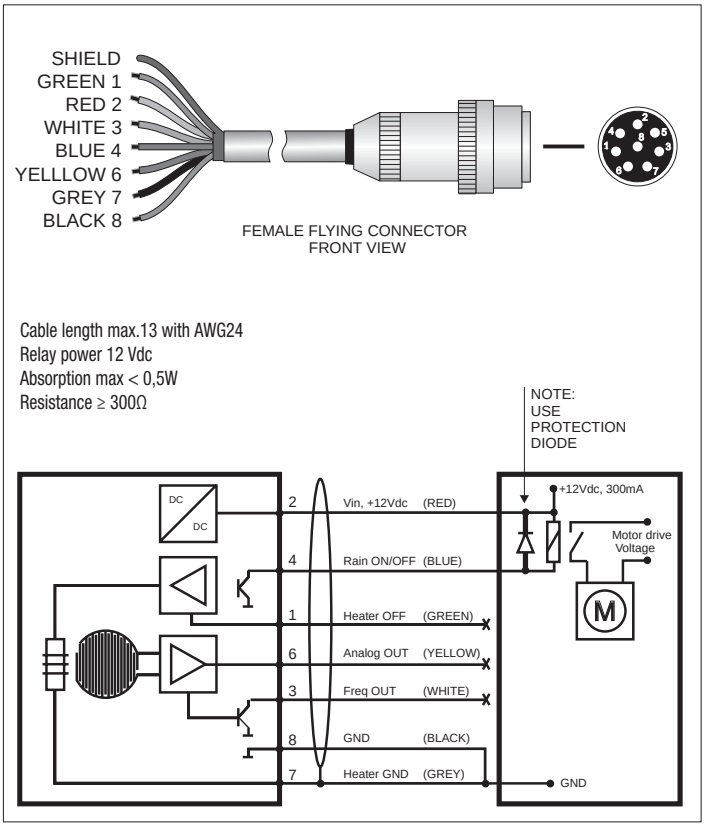


Fig. 1

Technical Data/Specifications

Sensor

Type	Capacitive, with integrated heater
Sensor	6.6cm²
Angle	30°

Sensitivity

Min. sensitive area	0.05cm²
ON delay/Trip delay (OFF>>ON)	< 0.1ms
OFF delay/Shut-off delay (ON>>OFF)	< 5min

Dimensions

Diam. x height	ø107 x 70 mm
Weight	450g
Cable length	5m (other lengths available on request)
Material	BASF LURAN S777K

Electrical Features

Power Supply	
Supply Voltage	12Vdc ± 10%
Current Consumption	130mA (typical) 230mA (max) 10mA (with heater disabled)
Sensor Power Consumption	0.5 … 2.3W
Outputs	
Rain ON/OFF	Open collector, closed in case of rain.
Max. Voltage	15V
Max. Current	50mA
Analogue Output	0…1V (0V = rain, 1V = dry sensor)
Frequency Output	1500 … 6000Hz (rain … dry sensor) Not calibrated
Inputs	
Heater OFF	OFF = connected to GND
Closing Contact Capacity	15Vdc, 2mA

Ambient Conditions

Operating Temperature	-15 … +55°C
Storage Temperature	-40 … +65°C

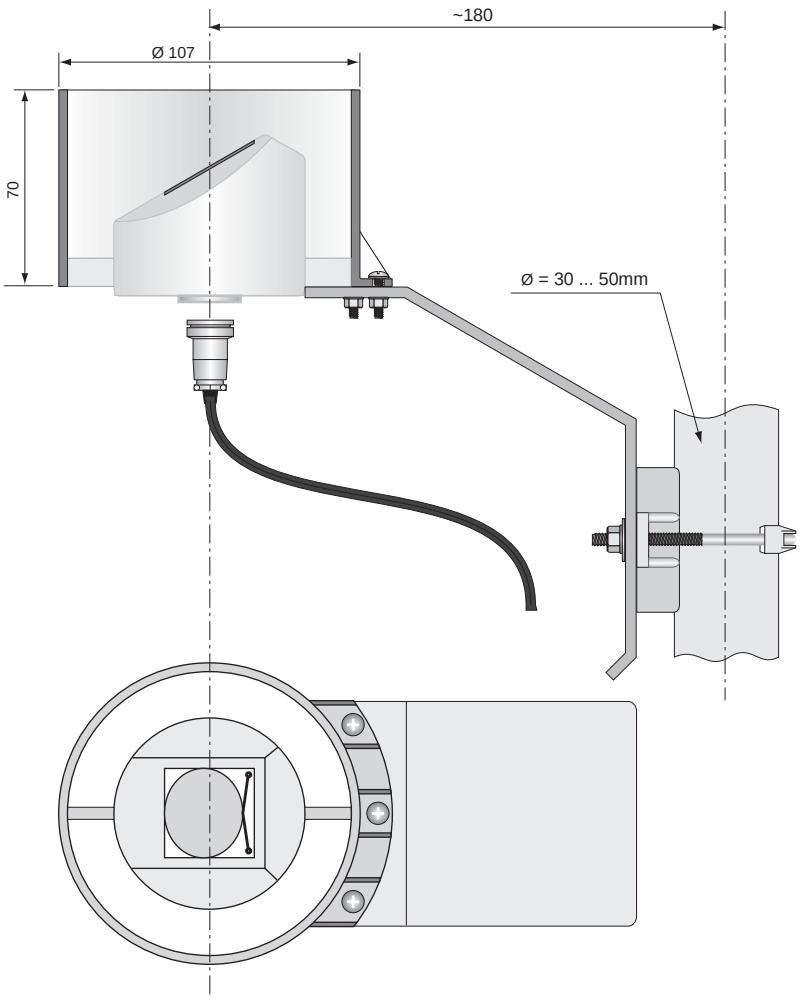
Electrical Connection – Colour Codes		**Pin**	
Power supply (+)	Red	2	+12 Vdc
Rain ON/OFF	Blue	4	Rain ON/OFF
Heater OFF	Green	1	Heather OFF
Analogue Output	Yellow	6	Analogue Output
Frequency Output	White	3	Frequency Output
Electronics ground	Black	8	GND
Heater ground	Grey	7	GND Heather

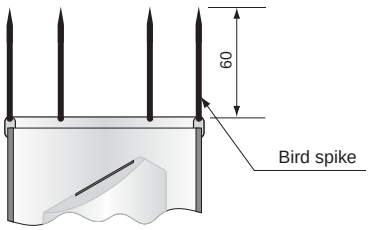
Ordering Codes

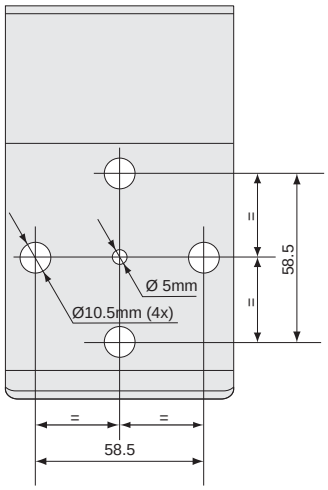
HD2013.2: Rain detector equipped with mounting bracket. 8-pole connector output according to IEC 60130-9 **IP68**. Complete with female flying connector. **Connection cable has to be ordered separately**.

CP2013.2.5: 5-m connection cable: 8-pole IEC 60130-9 IP68 female connector on one end. Other lengths available on request.

HD2013.2D: "Bird spike", consisting of a 6-spike ring (spike height: 60mm, diameter: 3 mm), to be expressly requested when ordering.







HD2013
TIPPING BUCKET RAIN GAUGE

The HD2013 is a reliable and sturdy bucket rain gauge, built entirely from corrosion resistant materials in order to guarantee its durability. So as to ensure accurate measurement even with low temperature climatic conditions or during and after precipitations of snow, a version with a heater which is automatically activated around +4°C has been developed so that snow deposits and ice formations are prevented.
The rain gauge is formed by a metal base on which a tipping bucket is set. The rain collector cone, fixed to the aluminium cylinder, channels the water inside the tipping bucket: once the predefined level is reached, the calibrated bucked rotates under the action of its own weight, discharging the water. During the rotation phase, the usually closed reed contact opens for a fraction of a second, sending an impulse to the counter.
The quantity of rainfall measured is based on the count of the number of times the bucket is emptied: the reed contacts, usually closed, open at the moment of the rotation between one bucket's section and the other. The number of impulses can be detected and recorded by **a datalogger such as the** DeltaOhm **HD2013-DB** or by a pulse counter.
A removable filter for periodic cleaning and maintenance is inserted in the water collector cone so as to prevent leaves or other elements blocking the end of the hole. For better water flow, the collector cone is treated with a non-stick paint.
The HD2013R, the version with a heater, operates using either 12Vdc or 24Vdc voltage (to be specified in the order) and uses about 165W. Heating is activated around +4°C.
When submitting your order, upon request a bird dissuader, made of 8 3mm-diameter spikes, 60 mm in height, can be installed on the rain gauge.

Inside view

Electrical connections

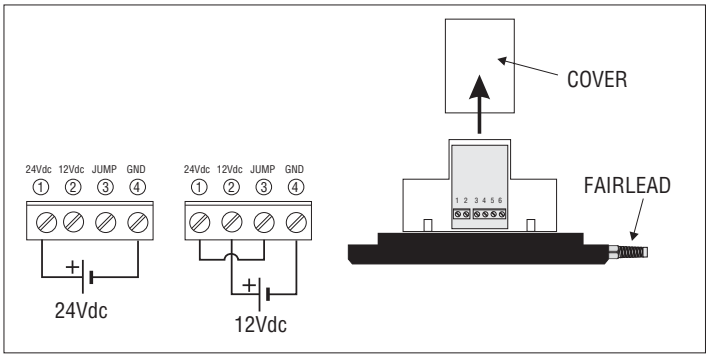


Fig. 1 Electrical connections

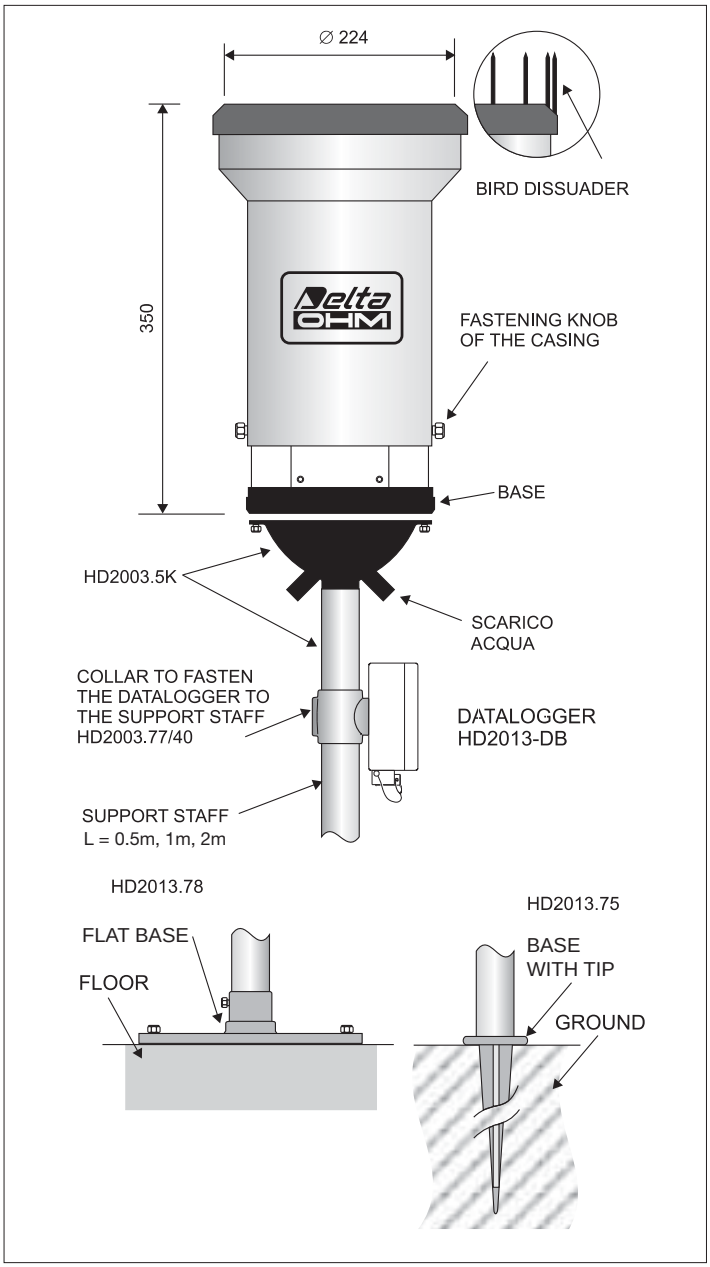


Fig. 2 Mechanical dimensions, installation systems

INSTALLATION AND MAINTENANCE

Upon request the rain gauge can be supplied ready calibrated at 0.2mm of rain per commutation of the bucke (upon request, 0.1 or 0.5 mm calibration can be provided): the calibration value is shown on the instrument's label.
The instrument must be installed in an open area, away from buildings, trees, etc…, ensuring the space over it is free from all objects which could obstruct rain measurements, and in an easily accessible position for the filter to be cleaned periodically.
Avoid installation in areas exposed to gusts of wind, turbulence (for example the top of a hill) as these may distort the measurements.
The rain gauge can be installed on the ground or raised 0.5 m, 1m or 2m above the ground.
Three adjustable support feet have been provided for ground installation so that the instrument can be levelled correctly, and the holes aligned so that it can be fixed to the floor.
For raised installations a collar has been provided which fastens around the base of the instrument on which the support staff must be inserted. The staff may end with either a flange so that it can be fixed to the floor, or a tip to be driven into the ground. The various fastening systems can be seen in fig. 2.
For the tipping device to function correctly and so for the measurement to be correct, it is important that the instrument is placed perfectly level. The base of the rain gauge is fitted with a bubble level.
For installation, unscrew the three screws at the sides of the cylinder that supports the water collector cone.
Note: a heating resistor is fitted around the cone vertex in the **HD2013R** version. To disconnect the power leads, the terminal block's protection cover must be removed and the connector plugged into the heater's leads coming from the cone needs disconnecting (see fig. 3).

Electrical connection

For the version without heating use a 2-wire cable with 0.5 mm^2 minimum wires section, for the version with heating use a 4-wire cable with 2.5 mm^2 minimum wires section. Use a shielded cable over long distances. Slide the cable through the cable gland and fasten it with the cable fastener located near the entry hole at the base of the rain gauge. Unscrew the terminal block protection cover and perform the connections as shown in figure 3. **The rain gauge output, indicated at point 1 in the figure, must be connected to the input of the HD2013-DB rain gauge data logger** (please see the details in the manual of the data logger) **or to a pulse counter or to a data logger**.
The heated version requires power (12 Vdc or 24 Vdc depending on the version supplied) for the resistors: perform the connection as indicated at fig. 1.
If the connections are set correctly, the LED placed near the terminals will be lit up.

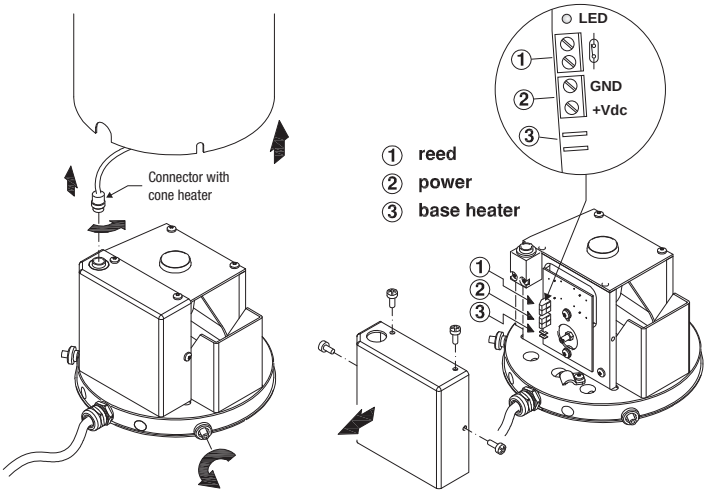


Fig. 3 – Electrical connections (version with heating option)

Maintenance

Verify filter cleanliness periodically; check that there is no debris, leaves or anything else that might obstruct the passage of water.
Check that the tipping bucket contains no dirt, sand, … deposits, or any other obstruction.
If necessary, the surface can be cleaned with mild non aggressive detergent.

Technical characteristics

	HD2013R	HD2013
Power	12Vdc or 24Vdc ±10% / 165W (to be specified in the order)	---
Type of output contact	NC contact (opens during commutation)	
Resolution	0.1 - 0.2 or 0.5 mm/commutation (on request at the time of placing the order)	
Precision	See normalized curve in fig.4. The curve is normalized at 0.2mm /commutation@50mm/h. If HD2013-DB data logger is employed, the measure can be automatically normalized according to this curve.	
Operating temperature range	-20°C ... +60°C	+4°C … +60°C
Heater intervention temperature	+4°C	---
Protection degree	IP64	
Collector area	400 cm^2	
Minimum sections of the wires of the connection cable	0,5mm^2 for the version without heating (HD2013) 2,5mm^2 for the version with heating (HD20123R)	

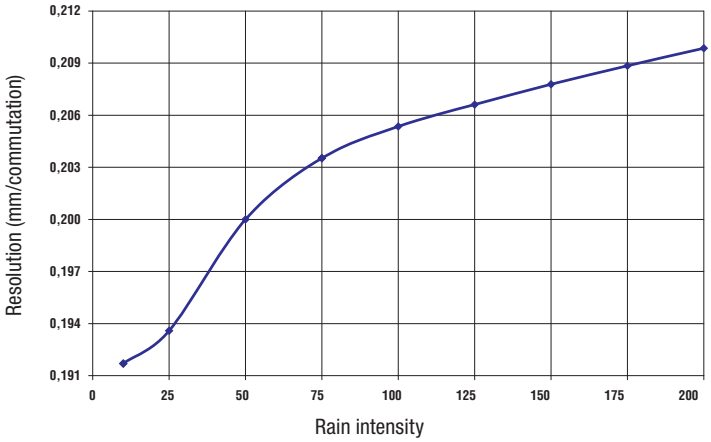


Fig. 4 Resolution according to the rain intensity

Rain gauge installed on the ground.

Rain gauge with bird dissuader.

ORDER CODES

HD 2013: Rain gauge with tipping bucket, area 400cm^2, for temperature range +4°C… +60°C. Resolutions to be specified at order 0.1, 0.2 or 0.5 mm. Output contact normally closed.

HD 2013 R: Rain gauge with tipping bucket, area 400cm^2, equipped with heater for temperature range –20°C…+60°C. Resolutions to be specified at order 0.1, 0.2 or 0.5 mm. Output contact normally closed. Power voltage 12Vdc or 24Vdc ± 10% / power absorption 165W.

HD 2013.18: Bird spike.

HD 2003.5K: Accessory kit for the installation of the rain gauge raised 500 mm from ground, formed by water collection cup with threaded shaft for support bar L = 500 mm.

HD 2003.5K1: Accessory kit for the installation of the rain gauge raised 1 m from ground, formed by water collection cup for the rain gauge, support bar L = 1 m.

HD 2003.5K2: Accessory kit for the installation of the rain gauge raised 2 m from ground, formed by water collection cup for the rain gauge, support bar L = 2 m, accessories HD2003.75K for bracing the mast for installation with pegs on the ground.

HD 2003.5K3: Accessory kit for the installation of the rain gauge raised 2 m from ground, formed by water collection cup for the rain gauge, support bar L = 2 m, accessories HD2003.78K for bracing the mast for installation on the floor.

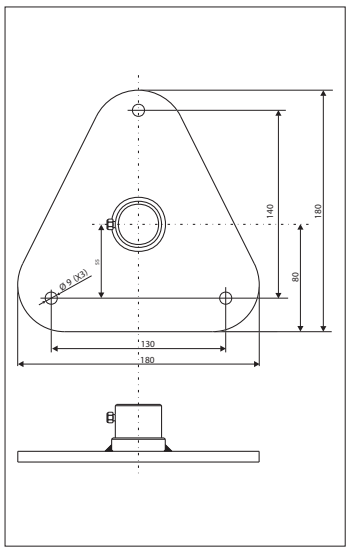
HD 2013L: Device for levelling the rain gauge when it is installed on a support bar. The adjustment is performed by means of fine pitch screws.

HD 2003.75: Flange with tip for the ground to support the raised from the ground rain gauge (to add to the accessory kits HD2003.5K…).

HD 2003.78: Level base for fastening the raised from the ground rain gauge (to add to the accessory kits HD2003.5K…).

HD 2003.77/40: Clamping to fasten the data logger HD2013-DB to the support staff

Bubble level



Base for ground fastening HD2013.78

Tip for ground for rain gauge raised from ground

Support plate for rain gauge raised from ground

HD 2013-DB

HD2013-DB
RAIN GAUGE DATA LOGGER

HD2013-DB is a data logger that has been specifically developed to capture and store rainfall trends. It works with a long life lithium battery that provides, together with the large memory, remarkable recording capacity without user intervention. For user convenience, the supplied lithium battery, when exhausted, can be also replaced by three alkaline batteries (not supplied with instrument).
The backlit display shows in real time the rain quantity during various time intervals.
The instrument is perfectly waterproof thanks to the use of reed relays, instead of the common push-buttons. The reed relays are operated through a magnet, attached to the end of an aluminium handle tied to the case. When not in use, the magnet is placed back into its holder.
The software **HD32MTLogger** supplied with the instrument allows setting of the parameters of the instrument, the real time display of the values captured by the data logger, the download to a PC and the process of the stored data. The connection to the PC is made via the M12 8-pole RS232C serial connector placed at the bottom of the instrument.
HD2013-DB can be connected to the most popular types of rain gauges with normally closed (NC) or normally open (NO) output contact.
The display auto power-off feature allows to prolong the battery life. A front LED lets you check the operating status of the instrument when the display is off. The LED changes color when the rain gauge contact switches, thus allowing to verify that the rain gauge tipping bucket returns correctly in the stable position after emptying.

Technical characteristics

Power supply	Internal 3.6 V lithium-thionyl chloride (Li-$SOCl_2$) **not rechargeable** battery, size C, capacity 8400 mAh, Molex 5264 2-pole connector 3 x 1,5 V alkaline batteries (not supplied with the instrument) can be used to replace the lithium battery when exhausted
Recorded event	NC or NO contact.
Resolution	Configurable from 0.050 to 1.599 mm/sample
Storage capacity	32.255 samples (equal to 6451 mm of rainfall with 0.2 mm/sample resolution) Non-volatile memory and cyclic memory management
PC interface	Isolated RS232C serial port – 115200 baud
Display	2-row backlit LCD
Indications on display	Rain quantity in mm from the counter reset Rain quantity in mm in the last hour and the last 4, 24, 48, 72 and 96 hours
LED indicator	Flashes red if the rain gauge contact is open Flashes green if the rain gauge contact is closed
Battery life	Approx. 5 years of continuous use with the supplied lithium battery and in typical operating mode, in which the backlit display is turned on occasionally (about 10 minutes per day) Approx. 18 months of continuous use with 3 alkaline batteries with 2200 mAh capacity
Operating temperature	-30 °C...+60 °C
Protection degree	IP 67, including connectors

Installation and connections

The housing of the data logger has IP 67 protection degree and can be wall mounted or, in the case of installations with the rain gauge off the ground, fixed to the rain gauge support by means of the HD2003.77/40 clamping. Diameter of the support: 40 mm.

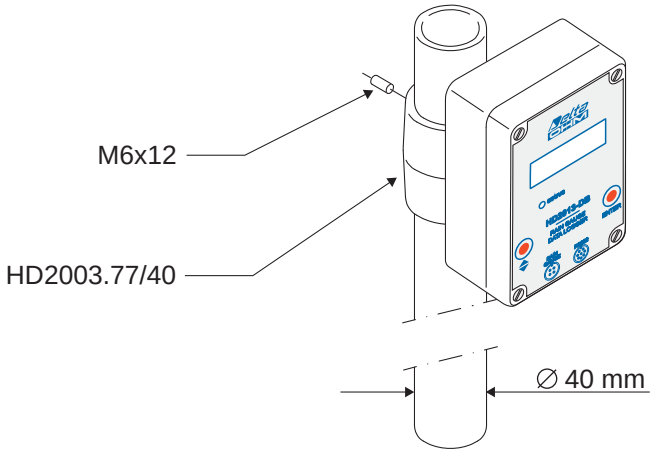
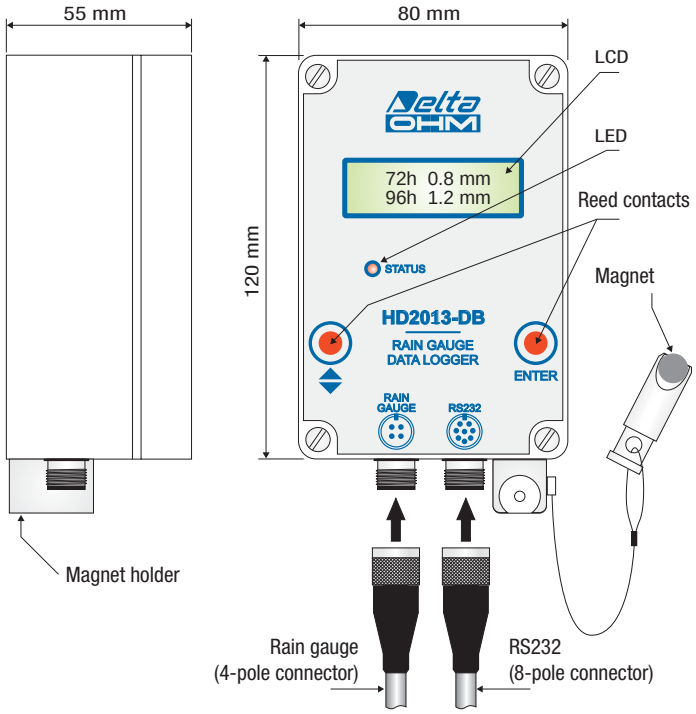


Fig.1: Installation with HD2003.77/40 clamping

HD2003.77/40 Clamping

Two connectors are placed at the bottom of the housing: one 4-pole M12 male connector for the connection to the rain gauge and one 8-pole M12 male connector for the connection to the PC. The arrangement of the two connectors is also clearly indicated on the front mask of the data logger.



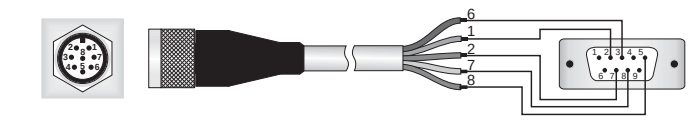
4-pole M12 male connector of the datalogger (visible side)

Cable CP2013-DB

Fig. 2: Description and connections

Connector	Function	Color
1	Rain gauge contact	Brown
2	Rain gauge contact	White
3	Not connected	Blue
4	Not connected	Black

Fig. 3: Connection of the CP2013-DB cable to the rain gauge



M12 8-pole male connector of the data logger (visible side)

DP9 female connector of the cable (soldering side)

M12 connector	Function (PC side)	DB9 connector
1	Rx	2
2	RTS	7
6	Tx	3
7	CTS	8
8	GND	5

Fig. 4: RS232 Serial connection

Over-voltage protection: the data loggers supplied with the mast clamping already mounted on the back of the housing are provided with internal over-voltage protection devices, connected to the clamping. For the correct operation of the protection devices, the mast on which the clamping is fixed, must be connected to ground.

Keyboard

The two function keys that allow to control the instrument are formed by two reed contacts, operable from outside by means of a magnet supplied with the instrument.

Two red areas are indicated on the front of the instrument, corresponding to the word "ENTER" and to the symbols ▲ and ▼: on these areas will be placed the magnet to operate the instrument. Keeping the magnet on the red area for a few instants and then moving it away is equivalent to press a button. For simplicity, in the description of the instrument that follows, this operation will be called: "**press the ENTER button**", "**press the ▲/▼ button**".

After use, the magnet with its support should be placed back into its holder.

Operation

The data logger counts and stores the number of emptying of the rain gauge tipping bucket. Each emptying of the bucket corresponds to a quantity of rain equal to the resolution of the rain gauge. The resolution can be set from 0.050 to 1.599 mm of rain by using the HD32MTLogger software. The rain gauge contact can be both NC and NO type (it is not necessary to set the contact type, the data logger automatically works with both types of contact).

Status indicator: the LED indicator of the data logger indicates the status of the contact of the rain gauge. The LED blinks red if the contact is open, and green if the contact is closed. **Therefore, the LED color allows to highlight the emptying of the bucket and check that the bucket returns in the stable position after emptying**.

Display: the display is backlit; to minimize the battery consumption, the display is switched off if no operation is peformed on the data logger for 2 minutes. However, the data logger is still working even when the display is off, and its activity is signaled by the flashing status indicator LED. In order to turn the display on, press any of the two buttons. When the display is on, the following screens are displayed sequentially:

- quantity of rain in mm in the last hour and the last 4 hours;
- quantity of rain in mm in the last 24 and 48 hours;
- quantity of rain in mm in the last 72 and 96 hours;
- quantity of rain in mm from the last counter reset (partial rainfall); if the correction table is enabled, both the uncompensated and the compensated values are displayed (Note 1);
- date/time and battery voltage;
- user code and serial number of the data logger.

Note 1: if the rain gauge connected to the data logger has a measurement correction table as a function of the rainfall rate, the partial rainfall compensated

View of the magnet

values can also be displayed by storing the correction in the data logger. By default, the correction is disabled. The correction can be enabled by using the HD32MTLogger software. The correction is not applied to the values of quantity of rain in 1h, 4h, 24h, 48h, 72h and 96h.
The values of the quantity of the rain are shown on the display with 0.1 mm resolution. The internal resolution of the data logger is 0.001 mm and the thousandth values are visible by downloading the data to the PC with the HD32MTLogger software.
The data logger indicates "over-range" if the rain quantity in 1h, 4h, 24h, 48h, 72h, 96h exceeds 1000 mm.
The counter of partial rainfall is limited only by the memory capacity (32.255 samples). The memory is managed cyclically: the new sample overwrite the oldest.

Reset of the partial rainfall counter: the reset of the partial rainfall value can be performed by using the HD32MTLogger software or directly by using the data logger keyboard according to the following procedure:
1. turn the display on, if turned off, by pressing any of the two buttons on the data logger;
2. wait until the display shows the message "Use magnet to enter MENU";
3. press the ▲/▼ button by using the magnet; "RESET INCR. COUNT" indication appears;
4. select "YES" by pressing ENTER button; the data logger automatically exits MENU.

To exit MENU without resetting the counter, when "RESET INCR. COUNT" indication appears select "NO" by pressing the ▲/▼ button, then select ENTER button to exit.
Date/time, user code, resolution, correction table and language of the data logger can be set by using the HD32MTLogger software (see the instructions of the software).

Connection to PC
The data logger is provided with an RS232 serial port with 8-pole M12 connector located at the bottom of the instrument. For the connection to the PC use:
- the **HD2110RS** cable for the connection to a RS232 port of the PC;
- the **CP25** cable for the connection to a USB port of the PC; to use the **CP25** cable, the related USB drivers must be installed in the PC.

With the **HD32MTLogger software**, for Windows® operating systems, it is possible to set the parameters and the language of the instrument, view in real time the values captured by the data logger, download to the PC and process the stored data.
When the data logger is connected with the HD32MTLogger software, the backlit display is always on. To prolong the battery life, it is recommended to maintain the connection only for the time necessary.

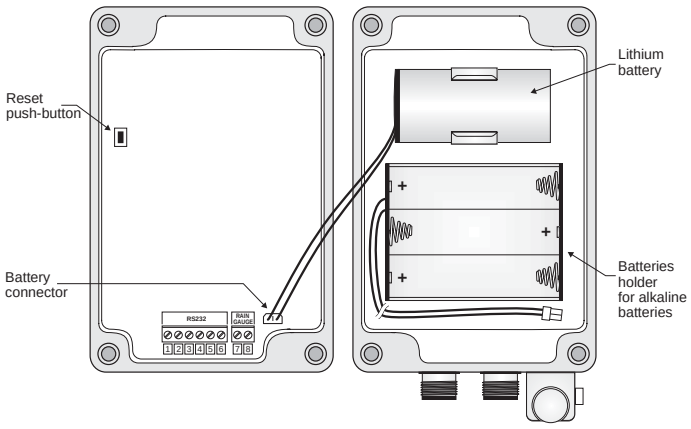


Fig. 5: Inside view of the data logger

Battery replacement
HD2013-DB uses an internal 3.6 V lithium-thionyl chloride (Li-$SOCl_2$) **not rechargeable** battery, size C, with Molex 5264 2-pole connector. The charge status of the battery is constantly monitored and displayed.
When the battery voltage drops below a certain value, the instrument automatically turns off the backlit of the display, so as to minimize the battery consumption and allow the instrument to continue to perform the measurement functions. When the backlit is turned off, it is recommended to replace the battery soon.
If the battery voltage drops further to a level that does not allow the correct operation of the instrument, the message "CHANGE BATTERY NOW!" is displayed; in such a case, the battery replacement is necessary.
The instrument is equipped with non-volatile memory: the data remain stored even if the battery is discharged and disconnected.

1. To replace the battery, proceed as follows:
2. disconnect the instrument from the PC, if connected;
3. unscrew the four screws fixing the front cover;
4. remove the battery connector and take the battery out of its holder;
5. insert the new battery paying attention to the correct polarity (the connector is provided with a protection device that prevents the reversal of polarity);
6. as an alternative to the lithium battery, if not available, three 1.5 V alkaline batteries can be used, to be inserted in the batteries holder shown in figure 5. In such a case, connect the batteries holder connector to the battery connector on the board of the instrument;
7. close the cover with the fixing screws; when closing, verify that the sealing gasket is properly positioned; the screws must be securely fastened.

Ordering codes
HD2013-DB: Rain gauge data logger. With backlit LCD. Detects and stores up to 32.255 pulses caused by the bucket emptying. Resolution configurable from 0.050 to 1.599 mm/pulse. Isolated RS232 serial output. IP 67 protection degree. Powered by a 3.6 V lithium battery. Supplied with: internal not rechargeable lithium-thionyl chloride (Li-$SOCl_2$) battery (**BAT-2013DB**), **HD32MTLogger** software, 4-pole female connector (**FCM12.4**). The **HD2003.77/40** clamping for the fixing the data logger to the Ø 40 mm support mast of the rain gauge, the **CP2013-DB** cable for the connection to the rain gauge and the **HD2110RS** (RS232) or **CP25** (USB) cable for the connection to the PC have to be ordered separately.
CP2013-DB: 4-pole cable. Length 1 m. 4-pole M12 connector on one side, open wires on the other side.
HD2110RS: Serial connection cable with M12 connector on the instrument side and 9-pole SubD female connector for RS232C on the PC side.
CP25: Serial connection cable with USB connector on the PC side and 8-pole M12 female connector on the instrument side. The cable has a built-in USB/RS232 converter and connects the instrument directly to the PC USB port.
HD2003.77/40: Clamping for fixing the data logger to the Ø 40 mm support mast of the rain gauge.
BAT-2013DB: 3.6 V lithium-thionyl chloride (Li-$SOCl_2$) **not rechargeable** battery, capacity 8400 mAh, size C, Molex 5264 2-pole connector.
FCM12.4: 4-pole M12 female spare connector, for connecting the data logger at distances greater than 1 m from the rain gauge.
FCM12.8: 8-pole M12 female spare connector, for connecting the data logger to the PC.

HD 32MT.1
METEO DATA LOGGER

The **HD32MT.1** is a data logger capable of capturing and logging the values measured by a series of sensors connected to its inputs.
The data logger is completely programmable by the user and is therefore very versatile. The supplied **HD32MTLogger** application software, supplied with the instrument, allows simple and intuitive programming by using graphic interfaces, without the need of learning any programming language, thus minimizing the time needed to make the system operational.
The values recorded by the instrument can be transferred to a PC by using the **HD32MTLogger** software. The data logger can be configured to memorize the instant value, the minimum value, the maximum value, the average value and the standard deviation of the measurements. For measurements that require the counting of pulses, the total counted pulses can be stored.
Different acquisition/recording intervals can be programmed per each input. Each recording includes acquisition date and time
The data logger has a "flash" internal memory arranged in circular mode: when the memory is full the new data overwrite the older ones. The number of storable measurements depends on the number of sensors employed, on the type of measurement to be stored and on the fact that the sensors are acquired all at the same time or at different instants. For example, with 8 sensors captured at the same time, 100,000 records can be stored, each one composed of 8 instantaneous measurements.
Data can also be directly recorded to a removable **SD**-type memory card with a capacity of **4 GB**. The use of a memory card allows extending the memory capacity of the instrument, allowing not to loose the data when the memory is full.
Three data logger versions are available, according to the possibility of communication with the PC:

- **Basic version**: the communication with the PC for data transfer or programming is done via cable connection.
- **Version with Radio Modem option**: in addition to the direct cable connection to your PC, you can transfer the data and program by **VHF** radio using optional external radio modems.
- **Version with TCP/IP option:** data transfer and programming can be done via TCP/IP via optional external **Ethernet** Serial Server.

All versions can be equipped with an optional **GSM** module to be connected externally to the instrument, through which you can send alarm **SMS** to mobile phones and send the recorded data by **e-mail** or to an **FTP** address.
The instrument can be connected to the most common sensors used in industrial and environmental fields, with both analog and digital output.
The typical sensors that can be connected to the instrument are:

- sensors with analog voltage output, both unipolar and bipolar;
- sensors with analog current output (0…20mA, 4…20mA);
- type K, J, T, N, R, S, B, E thermocouple temperature sensors; with automatic cold junction compensation by using a temperature sensor internal to the data logger;
- Pt100/Pt1000 and NTC temperature sensors;
- Sensors with digital output (TTL levels), or analog (periodical), for counting measures, frequency and period (e.g. sensors for soil water content)
- Resistors and potentiometers to measure resistance and voltage relationship (e.g. vane anemometer)
- magnetic sensors with reed contact (e.g. open door)
- solar radiation sensors (pyranometers, albedometers, net-radiometers, luxmeters, pyrgeometers, duration of irradiation)
- sensors with open/close contact output (e.g. rain gauges, cup anemometers);
- sensors with RS485 output and MODBUS-RTU protocol;
- HD2003 and HD52.3D series Delta Ohm anemometers.

Calculated quantities:

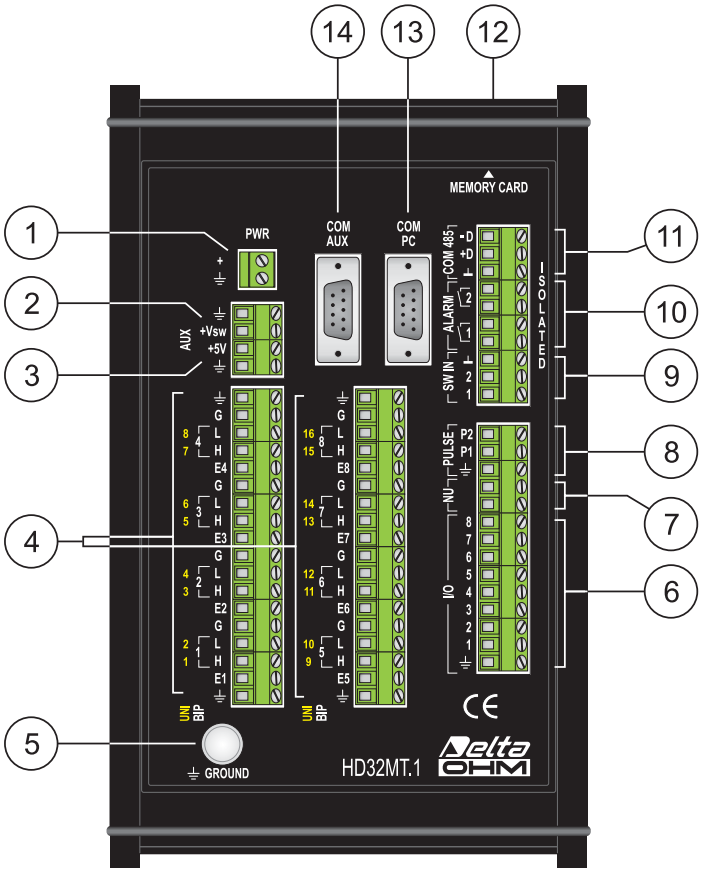
- Dew Point, Heat Index, Wind Chill, Saturation Vapour Pressure
- Custom mathematical formulas applied to the measured quantities, with arithmetic operators, logical, mathematical and trigonometric functions, control functions (IF…THEN)
- Reference Evapotranspiration **ETo** with FAO Penman-Monteith method.

There are potential-free contact alarm outputs and digital alarm outputs. The outputs are activated if the values measured by sensors connected to data loggers exceed the programmed thresholds. The data logger is able to store and report error conditions caused by malfunction of the connected sensors, hardware or data logger during acquisition and storage. The alarm outputs can also be programmed to detect such errors.
The instrument is particularly suitable for use in weather stations, for the detection and remote transmission of climatic variables. Delta Ohm manufactures a wide range of sensors for measuring environmental variables that can be connected to the data logger, including sensors for measuring temperature, humidity, barometric pressure, wind speed, solar radiation, amount of rainfall, etc.
The data logger can be supplied with a program of measures and stores pre-installed according to specifications of the customer, in order to be operational immediately after installation of the system. The program is installed directly from Delta Ohm to meet the required specifications when ordering. Some features of the data logger are **password** protected (Clock Setup, User Code Setup, Send Program, GSM Setup). If needed the password is entered by the user at the time of connection.
Power supply from 12 to 30 Vdc. The system can also be powered by a solar panel and backup battery of adequate capacity, allowing for installation in remote sites without electrical power. An internal lithium battery keeps the date and time of the instrument in the absence of external power. The data logger can provide power to all sensors connected at its terminals. It can signal and store when the supply voltage is below a programmable threshold and go into wait (standby) mode to low power consumption. In this mode, the datalogger interrupts the power supply to all sensors and suspends acquisitions/loggings, until the supply voltage returns at least to the minimum threshold.

Technical characteristics

Sizes / Weight	222x140x63 mm / About 1 kg
Case material	Coated aluminium
Operating conditions	-20 … 50 °C, 0 … 85% RH no condensation
Storage temperature / Power Supply	-25 … 65 °C / 12 … 30 Vdc
Absorption	40 mA @ 12 Vdc
Data acquisition interval / Data logging interval	Programmable from 1 to 60 seconds / Programmable from 2 seconds to 24 hours
Storage capacity	4 MB internal memory SD memory card reader up to 4 GB
Number of samples that can be stored	The storage of a record consisting of N values requires (4 x N) bytes of memory plus 8 bytes for the date and time.
Analog inputs	16 channels, each channel used as an single-wire (single-ended) input or alternatively two adjacent channels used as a differential input.Measurement ranges: ±25 mV, ±100 mV, ±1000 mV, ±2500 mV Resolution: 16 bit, Accuracy: 0.01% f.s. Input impedance: 100 Mohm
Digital input/output ports (I/O)	8 ports, each configurable as an input for connecting a sensor or alarm output or sensor enabling. TTL logic levels (0⇒Vin<0.8 V, 1⇒Vin>3 V) Max. input voltage: 5.5 V
Inputs for high frequency pulse counting	2 inputs Frequency of pulses 100 kHz max. TTL logic levels (0⇒Vin<0.8 V, 1⇒Vin>3 V) Minimum pulse duration 10 µs
Inputs for number of potential-free contact opening/closing counting	2 insulated inputs Switch frequency 50 Hz max. Minimum opening or closing time 10 ms
RS485 connection	RS485 port (up to 8 sensors can be connected) for Anemometers series HD2003 and HD52.3D and sensors with MODBUS-RTU protocol.
RS232 connection	2 RS232 ports, one for connection to PC or to **optional** Radio Modem or to optional Ethernet module and one for connection to **optional** GSM module. Sub-D 9-pole male connectors
Alarm outputs	2 insulated voltage-free contact outputs Contact: max. 1 A @ 30 Vdc resistive load You can configure the single digital I/O ports as alarm outputs
Auxiliary supply outputs	+5V regulated, max. 500 mA +Vsw (switched): with same value of the power input, **it is active only during acquisition of measurements**

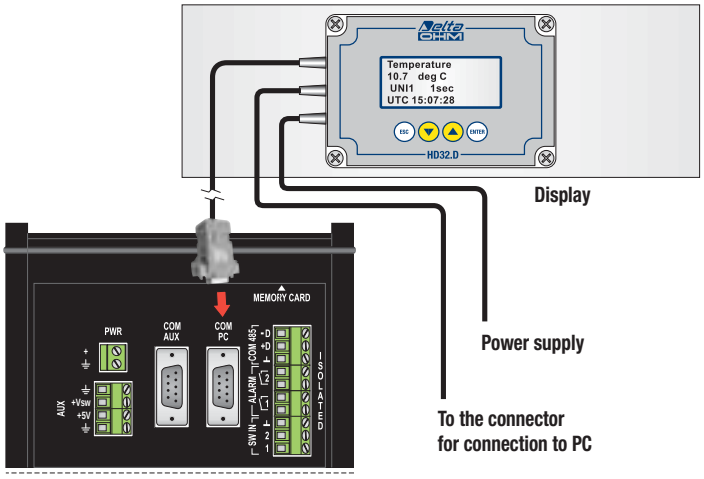
Description of terminals



1. Power input **PWR** 12…30 Vdc.
2. Switched power supply output **+Vsw**. With the same value of the power input, but **active only during acquisition of measurements**.
3. Regulated power supply output **+5V**.
4. Inputs for analogue signals. Divided into 8 channels corresponding to 8 differential inputs (**BIP** channels) or 16 single-ended inputs (**UNI** channels). The differential input number is shown in white to the left of the terminals.
   Each channel is composed of four terminals:
   Terminal **E**: Excitation voltage. Used only in certain measurement configurations.
   Terminal **H**: If the channel is used as a differential input, it corresponds to the "**+**" connection of the input signal. If the channel is used for single-ended inputs, it corresponds to the "**+**" connection of the input signal of the single-ended channel with the number indicated in yellow to the left of the terminal.
   Terminal **L**: If the channel is used as a differential input, it corresponds to the "**—**" connection of the input signal. If the channel is used for single-ended inputs, it corresponds to the "**+**" connection of the input signal of the single-ended channel with the number indicated in yellow to the left of the terminal.
   Terminal **G**: Analog ground. It has the same potential of the power supply ground. If the channel is used for single-ended inputs, it corresponds to the "**—**" connection of the input signal.
5. Terminal for ground protection.
6. Digital input/output channels. 8 channels are available, each one usable as input for connection of sensors with ON/OFF digital output, or as alarm outputs.
7. Not used.
8. **PULSE** inputs for high frequency pulse counting Two inputs are available, marked with P1 and P2.
9. Insulated inputs **SW IN** for number of voltage-free contacts opening/closing count. Two inputs are available, marked with 1 and 2.
10. Voltage-free contact alarm outputs. Two outputs are available, marked with 1 and 2.
11. RS485 serial port for the connection of anemometers series HD2003 and HD52.3D…, and sensors with MODBUS-RTU protocol.
    The connection to the RS485 port of sensors other than those indicated may not work properly due to a different communication protocol.
12. Memory card reader.
13. RS232 serial port **COM PC**, for direct connection to the PC or for connection of the **optional** Radio Modem (Radio Modem version) or of the optional Ethernet module.
14. RS232 serial port **COM AUX** for connection of the **optional** GSM module.

Display

It is possible to connect an **optional** LCD display to the data logger, to check the values acquired by the data logger without having to connect your PC.
The display is available in the basic version (**HD32.D**), or with the GPS option (**HD32.D.GPS**) to automatically update the clock of the data logger. The displays are designed for being fixed to the outdoor housings HD32.35, HD32.35FP, HD32.36 and HD32.36FP.
The display is backlit and connects to the data logger **COM PC** RS232 serial port. The supply voltage required by the display is 8...30 Vdc.



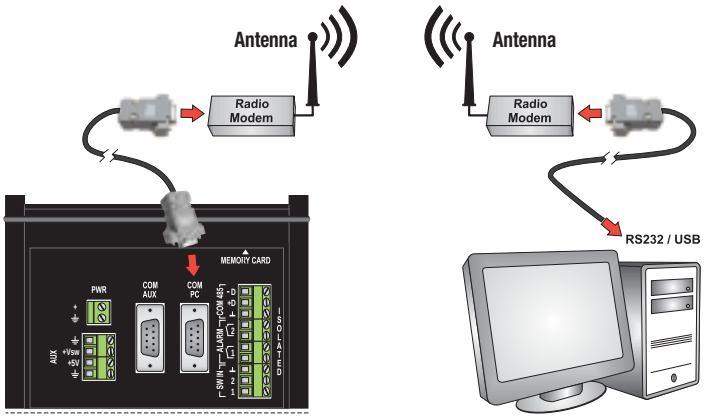
Connection of the display

For each measurement is displayed: the name of the parameter measured, the value of the measure, the unit of measurement, the data logger input the sensor is connected to, the acquisition interval and the current UTC time in the data logger.
The various measures are automatically scrolled on the display, or alternatively can be scrolled manually.

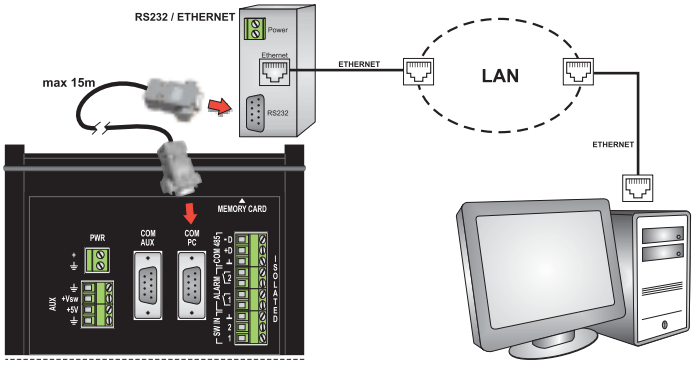
Data communication

There are different ways to communicate the stored data to the PC:
direct cable communication;
- communication via VHF radio modem (radio modem version only);
- communication via a Local Area Network (LAN) with TCP/IP protocol (an optional RS232/ Ethernet module is required);
- communication via the GSM network (only if the optional GSM module is present).

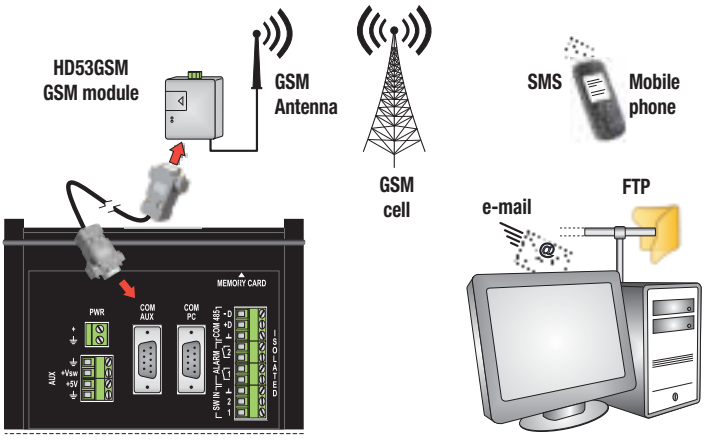
The communications via VHF Radio Modem and GSM module are especially useful for installations in remote unattended areas
Via the GSM connection, the data logger is capable of sending alarm messages via **SMS** to mobile phones, and stored data via Internet to **e-mail** and **FTP** addresses. In the GSM module must be inserted a **SIM** card enabled for data transmission, to be obtained from a telephone operator that has a suitable GSM network coverage in the place where the system will be installed.



Communication via VHF Radio Modem



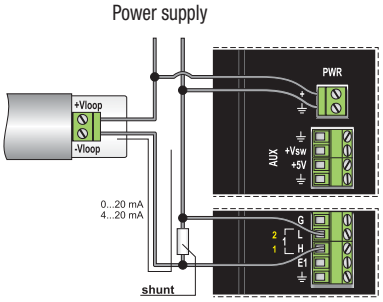
Communication via local area network with TCP/IP protocol



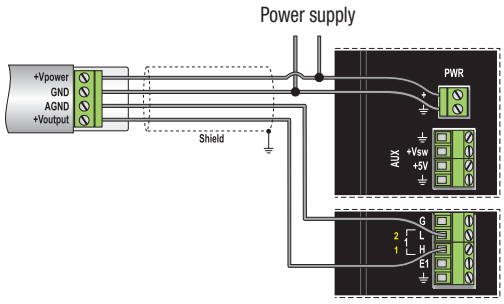
Communication via GSM network

Connection of sensors

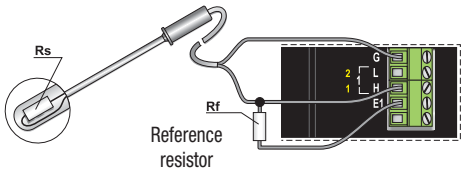
The data logger is designed for the connection of a wide variety of sensors, with both analog and digital output, used in many application fields. Only to show a few examples, the connections of some devices of widespread use are illustrated.



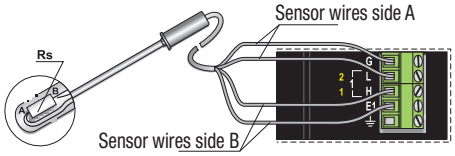
2-wire current output transmitters



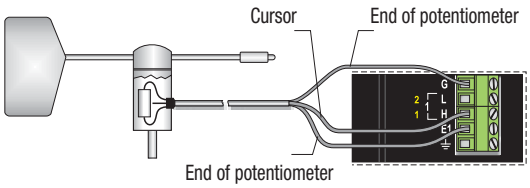
Voltage output transmitters



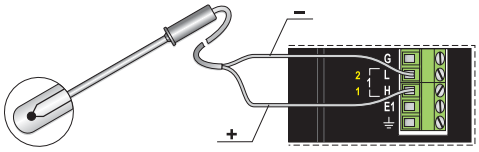
2-WIRE RESISTIVE SENSORS



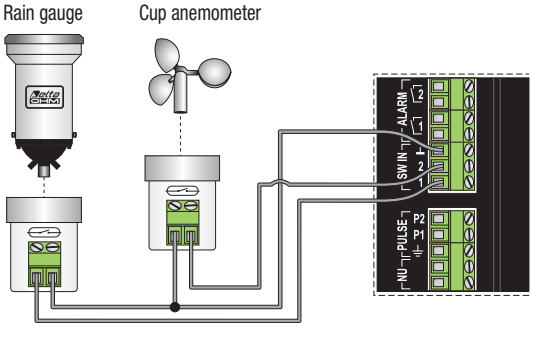
4-wire resistive sensors (Pt100/Pt1000)



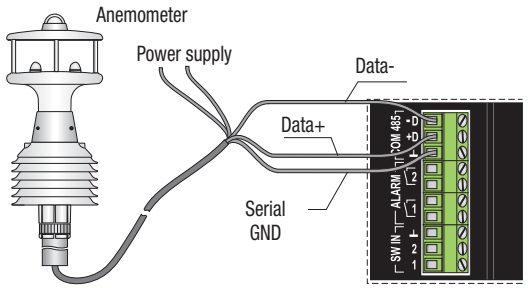
3-wire potentiometric sensors



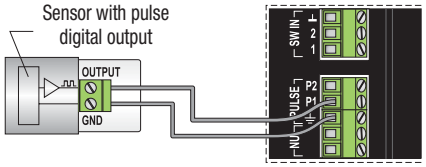
Thermocouples / sensors with mV output



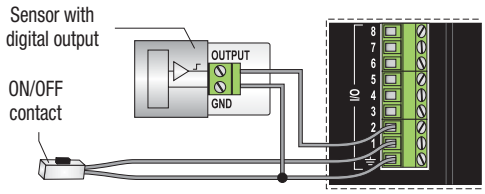
Sensors with contact frequency output



Delta OHM anemometers
Sensors with RS485 Modbus-RTU output

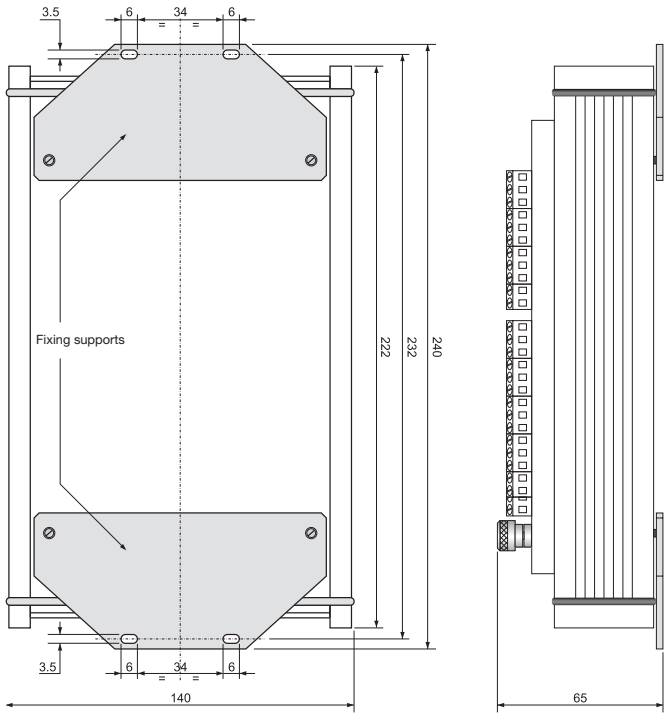


Sensors with digital frequency output



Acquisition of logic states

Dimensions



Order codes

HD32MT.1: Data logger supplied with: **HD32MTLogger** software for programming, data downloading, monitoring and data processing on a PC, operating manual.

The probes, the cables, the GSM module and the display must be ordered separately.

The radio modem option should be requested at time of ordering, the radio modem modules with the antennas must be ordered separately.

Accessories

HD32MTLogger: Further copy of CD-ROM with software HD32MTLogger for programming, data download, monitor and PC data management. For Windows® operating systems.

9CPRS232: Null modem cable with 9-pin Sub-D female connector on both sides for connection to the PC RS232C. Cable length 2 m.

C.205: Connection cable with USB connector on PC side and sub-D 9-pole female connector on instrument side. The cable has a built-in RS232/USB converter and connects the data logger directly to the USB port of the PC.

C.205M: Connection cable with USB connector on PC side and sub-D 9-pole male connector on Radio Modem side. The cable has a built-in RS232/USB converter and connects the Radio Modem directly to the USB port of the PC.

HD32.35: Outdoor housing complete with acquisition system for weather stations. **Material: AISI 304 stainless steel**. Screen to protect the housing from solar radiation, powder-coated anodized aluminum. White. Double locking one of which is a key. Dimensions 450 x 300 x 210 mm. Degree of protection IP66. Supplied with accessories for attachment to the pole diameter 36 ÷ 52 mm. **Provided for 100 ÷ 240Vac mains power supply**, includes: HD32MT.1 data logger, AC/DC power supply unit with integrated battery charger, 12V rechargeable backup battery, surge protectors, disconnectors, terminal block for power supply distribution and connectors for connecting the external sensors. **Wired and tested.** Available with optional alarm sensor to signal the opening of the housing door.

HD32.35FP: Outdoor housing complete with acquisition system for weather stations. **Material: AISI 304 stainless steel**. Screen to protect the housing from solar radiation. Powder-coated anodized aluminium white. Double locking one of which is a key. Dimensions 450 x 300 x 210 mm. Degree of protection IP66. Supplied with accessories for attachment to the pole diameter 36 ÷ 52 mm. **Provided for power supply from solar panel**, includes: HD32MT.1 data logger, solar charge controller, terminal block for power supply distribution and connectors for connecting the external sensors. **Wired and tested.** Available with optional alarm sensor to signal the opening of the housing door.

HD32.36: Outdoor housing complete with acquisition system for weather stations. **Material: Polyester with fiberglass-reinforced hot-moulding**. Screen to protect the housing from solar radiation, powder-coated anodized aluminum. White. Key lock. Dimensions 415 x 310 x 170 mm. Degree of protection IP66. Supplied with accessories for attachment to the stainless steel pole diameter 36 ÷ 52 mm. **Provided for 100 ÷ 240Vac mains power supply**, includes: HD32MT.1 data logger, AC/DC power supply unit with integrated battery charger, 12V rechargeable backup battery, surge protectors, disconnectors, terminal block for power supply distribution and connectors for connecting the external sensors. **Wired and tested.** Available with optional alarm sensor to signal the opening of the housing door.

HD32.36FP: Outdoor housing complete with acquisition system for weather stations. **Material: Polyester with fiberglass-reinforced hot-moulding**. Screen to protect the housing from solar radiation, powder-coated anodized aluminum. White. Key lock. Dimensions 415 x 310 x 170 mm. Degree of protection IP66. Supplied with accessories for attachment to the stainless steel pole diameter 36 ÷ 52 mm. **Provided for power supply from solar panel**, includes: HD32MT.1 data logger, solar charge controller, terminal block for power supply distribution and connectors for connecting the external sensors. **Wired and tested.** Available with optional alarm sensor to signal the opening of the housing door.

HD32.D: LCD viewer designed for being fixed on outdoor housings HD32.35, HD32.35FP, HD32.36 and HD32.36FP.

HD32.D.GPS: LCD viewer designed for being fixed on outdoor housings HD32.35, HD32.35FP, HD32.36 and HD32.36FP. With GPS module for automatical time synchronization of the data logger.

HD32MT.ALM: Sensor that signals the opening of the housing door.

TP32MT.1P.I: 4-wire 1/3 DIN Pt100 temperature probe, Ø 4 mm, L=150 mm, pointed, 5 m cable, isolated sensor. Temperature range -40…+100 °C.

TP32MT.2.I: 4-wire 1/3 DIN Pt100 temperature probe, Ø 6 mm, L=150 mm, 5 m cable, isolated sensor. Temperature range -40…+100 °C.

TP32MT.11P: T type thermocouple temperature probe, Ø 4 mm, L=150 mm, pointed, 5 m cable, isolated. Temperature range -40…+100 °C.

TP32MT.12: T type thermocouple temperature probe, Ø 4 mm, L=300 mm, 5 m cable, isolated. Temperature range -40…+100 °C.

TP878.1SS.0: Temperature contact probe for solar panels, 4-wire Pt100. Cable 5 m. Temperature range +4…+85 °C.

HD4V8T Baro: Barometric transmitter with 0…1 Vdc output. Working range 600…1100 mbar. Power supply 10…40 Vdc. Temperature working range -30…+60 °C. Installation inside the outdoor housing HD32.35, HD32.35FP, HD32.36 and HD32.36FP.

HD53GSM: Quad-band wireless GSM/GPRS module, including whip antenna and RS232 serial port.

HDRM0169; VHF radio modem module pair, frequency 169 MHz, including whip antenna and RS232 serial port. Already configured for connection to the logger and the PC (the two modules are not interchangeable). The modules only work with the version of the data logger with radio modem option.

HD2004.20: Tripod kit for installing anemometers on a flat base. Material: anodized aluminum. Height 3 m.

HD2004.22: 1200 x 530 x 34 mm solar panel mounting kit to a Ø 40÷50 mm mast. AISI 304 stainless steel.

HD2004.30: 80W monocrystalline solar panel. Dimensions 1200 x 530 x 34 mm.

HD 32.35
HD 32.35FP
HD 32.36
HD 32.36FP

HD 52.35 - HD 52.35FP - HD 52.36 - HD 52.36FP
DATA ACQUISITION SYSTEM FOR METEO STATIONS

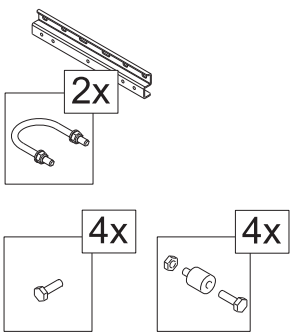
HD32.35: Outdoor-box for complete weather station acquisition system. **Material: AISI 304 stainless steel**. Screen to protect the box from solar radiations. Powder-coated anodized aluminium, white colour. Double lock, one with a key. Dimensions: 450 x 300 x 210 mm. Protection degree: IP66. Equipped with the accessories to mounting on a mast diameter 36 ÷ 52 mm.
Provided for 100 ÷ 240Vdc mains power supply, includes: HD32MT.1 datalogger, power supply unit AC / DC with battery charger, rechargeable 12V battery, surge protection, breakers, power distribution terminals and connectors for connection to external sensors.

HD32.35FP: Outdoor-box for complete weather stations acquisition system. **Material: AISI 304 stainless steel**. Screen to protect the box from solar radiations. Powder-coated anodized aluminium, white colour. Double lock, one with a key. Dimensions: 450 x 300 x 210 mm. Protection degree: IP66. Equipped with the accessories to mounting on a mast diameter 36 ÷ 52 mm. **For power supply by solar panel,** includes: HD32MT.1 logger, solar panel charge controller, and power distribution terminal block connectors for connection to external sensors.

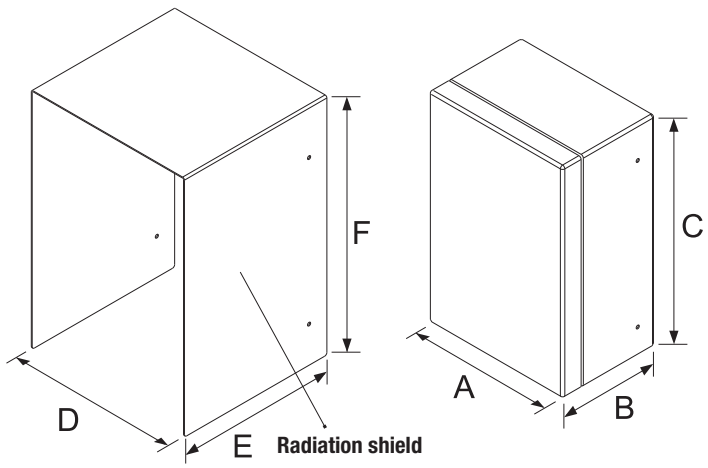
HD32.36: Outdoor-box for complete weather stations acquisition system. **Material: Polyester reinforced with hot-moulding Fiberglass.** Screen to protect the box from solar radiations. Powder-coated, anodized aluminium. White colour. Key lock. Dimensions: 415 x 310 x 170 mm. Protection degree: IP66. Equipped with the accessories to mounting on a mast diameter 36 ÷ 52 mm.
Provided for 100 ÷ 240Vdc mains power supply, includes: HD32MT.1 datalogger, power supply unit AC / DC with battery charger, rechargeable 12V battery, surge protection, breakers, power distribution terminals and connectors for connection to external sensors.

HD32.36FP: Outdoor-box for complete weather stations acquisition system. **Material: Polyester reinforced with hot-moulding Fiberglass.** Screen to protect the box from solar radiations. Powder-coated, anodized aluminium. White colour. Key lock. Dimensions: 415 x 310 x 170 mm. Protection degree: IP66. Equipped with the accessories to mounting on a mast diameter 36 ÷ 52 mm. **For power supply by solar panel**, includes: HD32MT.1 logger, solar panel charge controller, and power distribution terminal block connectors for connection to external sensors.

HD 32.35FP



	mm					
	A	B	C	D	E	F
HD32.35 HD32.35FP	300	210	450	340	235	502
HD32.36 HD32.36FP	310	170	415	350	195	470



HD 53GSM

HD53GSM
QUAD-BAND GSM/GPRS MODULE

HD53GSM is a wireless quad-band GSM/GPRS modem. The module is controlled via standard RS232 serial interface and AT commands. It features:

- SIM card slot,
- SMA antenna connector,
- power line connector with remote on/off line,
- two status LED: the POWER LED is switched on when the GSM is powered, the NET LED indicates the connection status to the GSM net,
- RS232 Sub-D 9-pin connector.

Specifications:

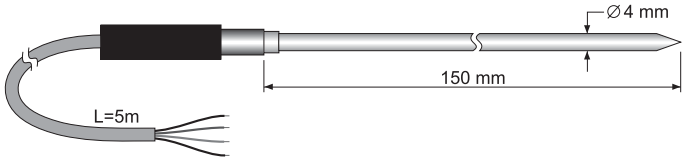
Frequency band (MHz)	GSM850, GSM900, DCS1800, PCS1900
Output power	Class 4 (2W) @ GSM850 and GSM900 Class 1 (1W) @ DCS1800 and PCS1900
Antenna connector	Female SMA, 50 ohm
Interface	RS232, Sub-D 9-pin connector
SIM	1.8V and 3V SIM card slot
Power supply	8…28Vdc, with removable terminal block and ON/OFF pin
Operating temperature	-35…+80°C

Other features:

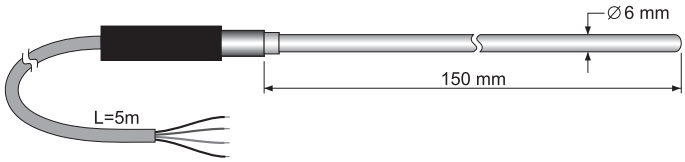
- Controllable via AT commands
- TCP/IP stack integrated
- Power Saving Mode

TEMPERATURE PROBES

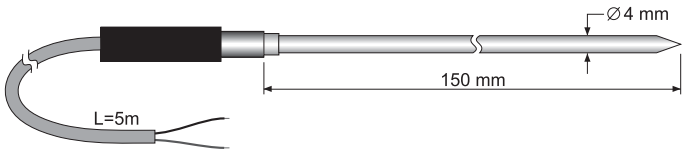
TP 32MT.1P.I: 4-wire 1/3 DIN Pt100 temperature probe, Ø 4mm,L=150mm, pointed, 5m cable, isolated sensor. Temperature range -40…+100°C.



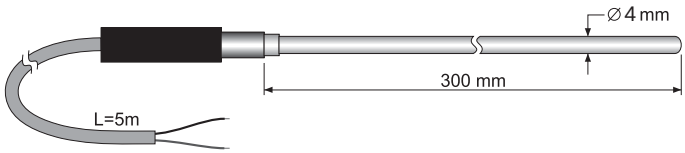
TP 32MT.2.I: 4-wire 1/3 DIN Pt100 temperature probe, Ø 6mm,L=150mm, 5m cable, isolated sensor. Temperature range -40…+100°C.



TP 32MT.11P: T type thermocouple temperature probe, Ø 4mm,L=150mm, pointed, 5m cable, isolated. Temperature range -40…+100°C.

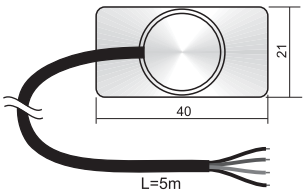


TP 32MT.12: T type thermocouple temperature probe, Ø 4mm,L=300mm, 5m cable, isolated. Temperature range -40…+100°C.



TEMPERATURE PROBE FOR SOLAR PANEL
TP878.1SS

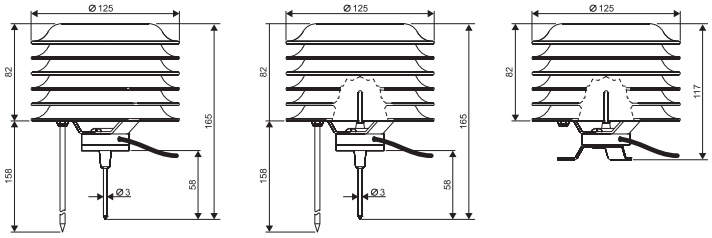
TP 878.1SS.0: Contact probe for solar panels. Pt100 4-wire. Cable 5 m. Temperature working range 0…+85 °C.



TP 32MTT.03.A: 4-wire Pt100 1/3 DIN temperature probe for measuring the soil temperature at a depth of 50 mm. With protective shield form solar radiations. Temperature range -40…+85°C. 4-pole cable ended with open wires. Cable length L = 2, 5 or 10 m.

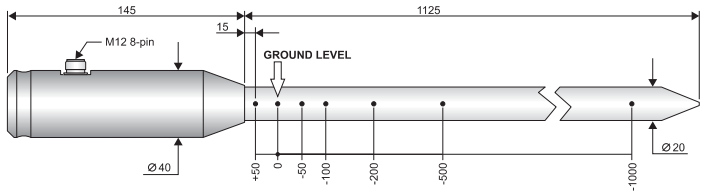
TP 32MTT.03.B: Temperature probe with two 4-wire Pt100 1/3 DIN sensors for measuring the soil and air temperature (± 50 mm). With protective shield form solar radiations. Temperature range -40…+85°C. 8-pole cable ended with open wires. Cable length L = 2, 5 or 10 m.

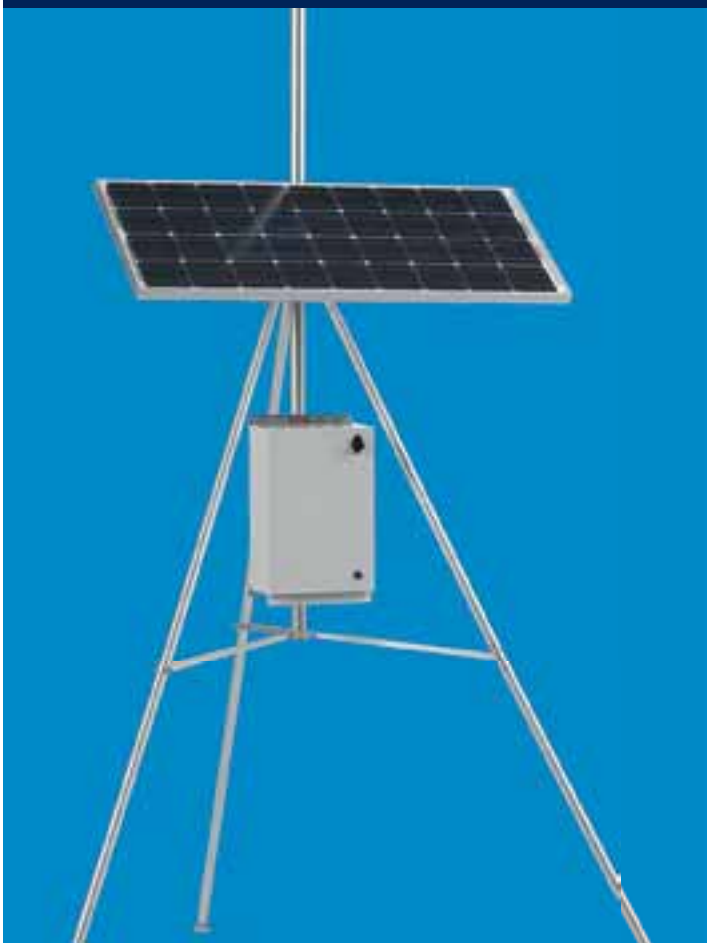
TP 32MTT.03.C: 4-wire Pt100 1/3 DIN temperature probe for measuring the air temperature. With protective shield form solar radiations. Temperature range -40…+85°C. 4-pole cable ended with open wires. Cable length L = 2, 5 or 10 m.



TP32MTT.03.A TP32MTT.03.B TP32MTT.03.C

TP 32MTT.03: Temperature probe with seven Pt100 1/3 DIN sensors for measuring the temperature at the depth of: +5 cm, 0, -5 cm, -10 cm, -20 cm, -50 cm, -1m with respect to the ground level, according to the WMO indications. Digital RS485 output with MODBUS-RTU protocol. 8-pole M12 male connector. 5…30 Vdc power supply. It can be connected to the RS485 port of the HD32MT.1 datalogger. The CPM12 AA8… must be ordered separately.

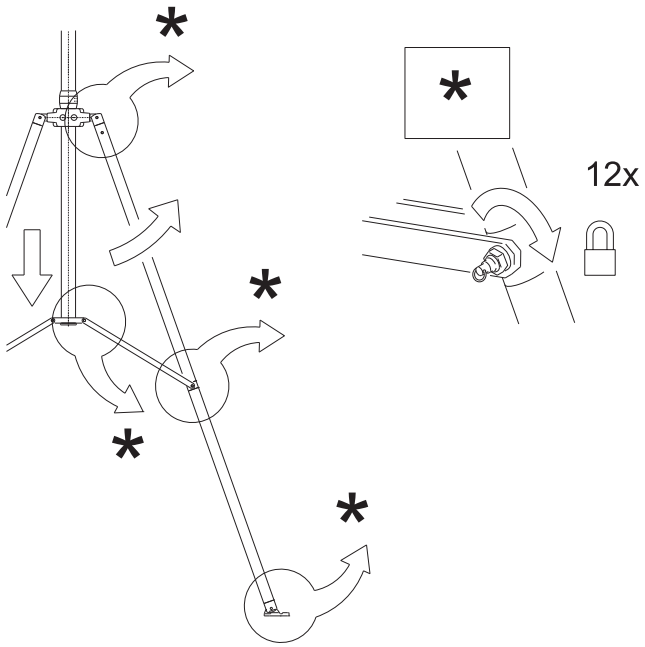


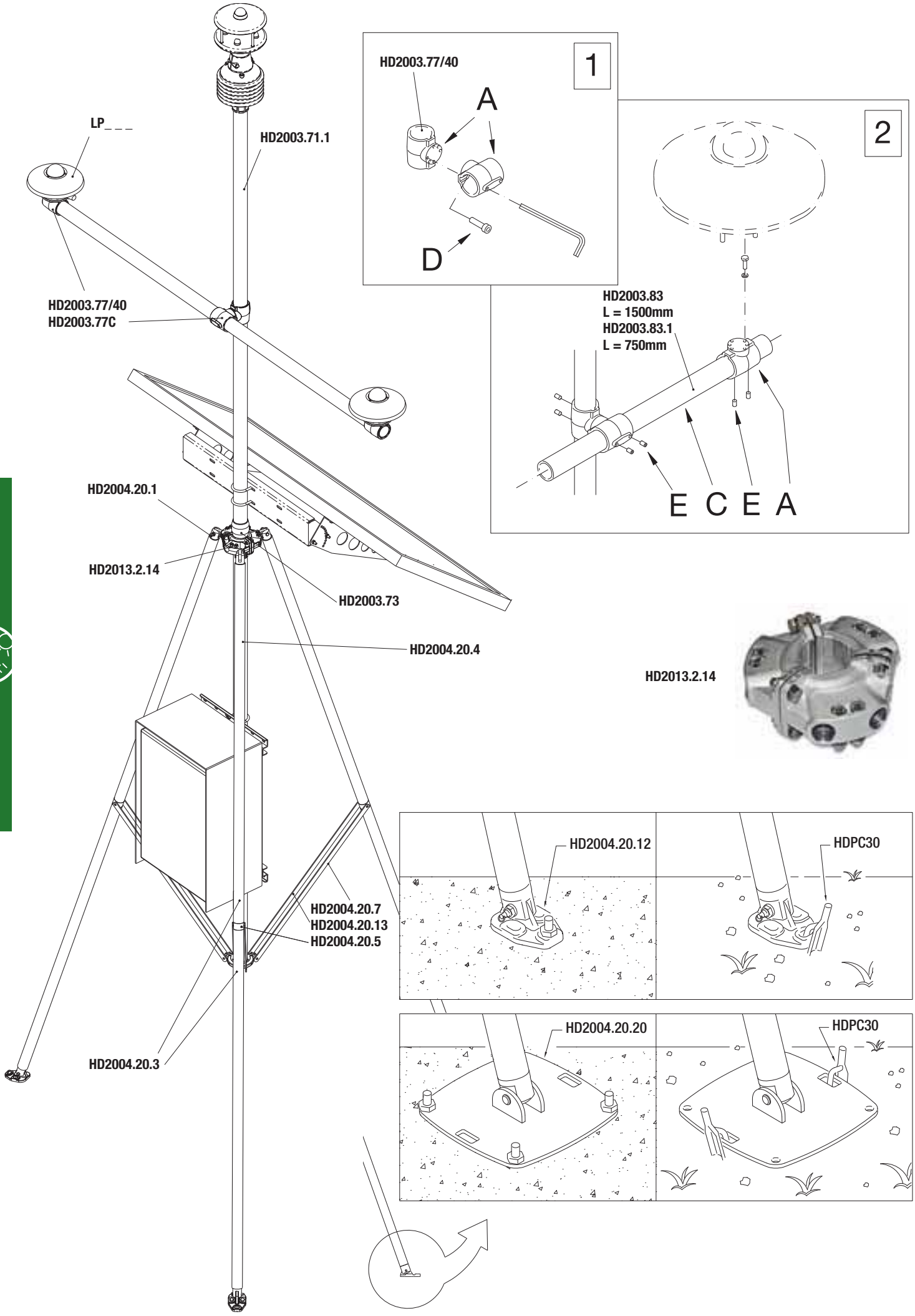


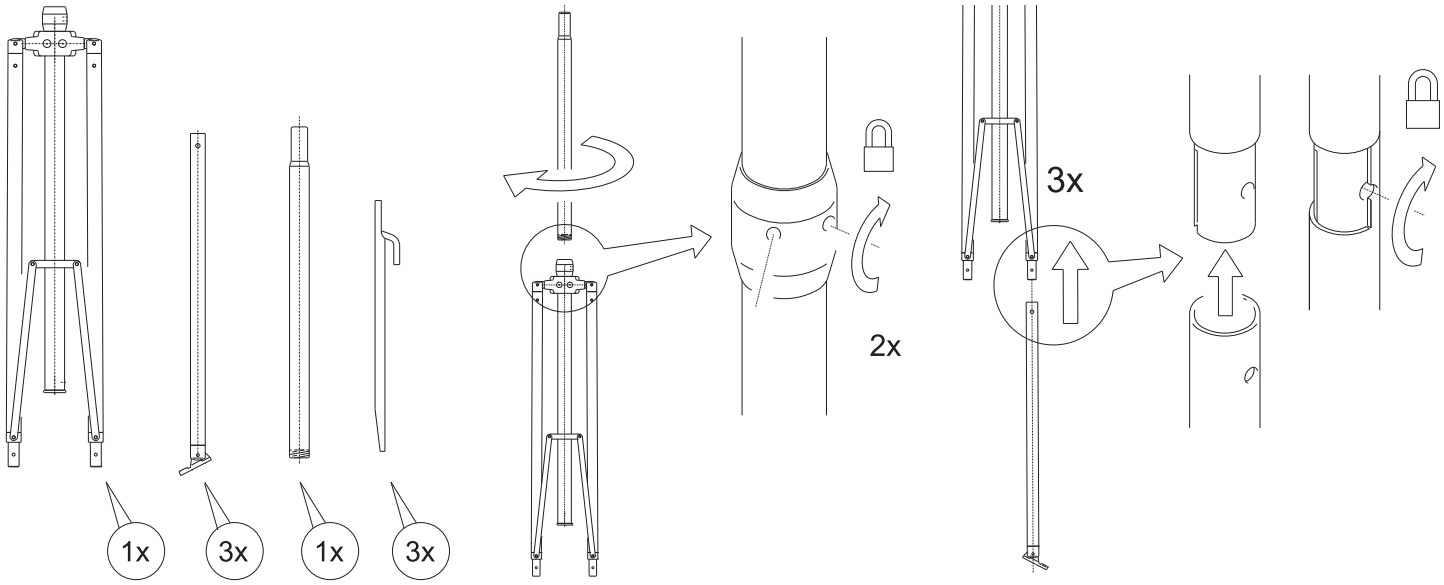
HD2004.20 TRIPOD
HD2004.22 HOLDER FOR SOLAR PANEL

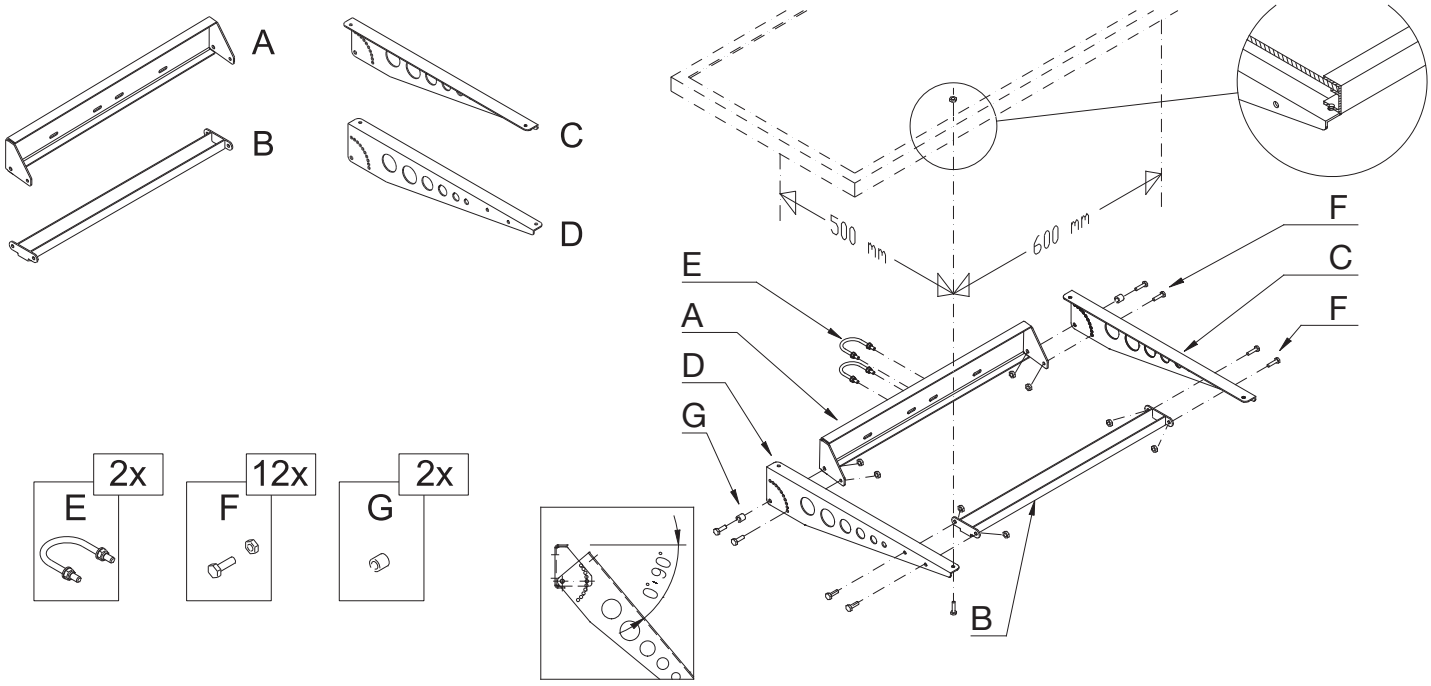
HD 2004.20: Tripod kit with adjustable legs for installing environmental sensors (anemometers, pyranometers, temperature and humidity, etc.). Material: anodized aluminum. Height 3m. It can be fixed on a flat base with screws or to the ground with pegs.

HD 2004.22: Adjustable holder to be fixed to the mast. Material: AISI 304. For installing the solar panel. Dimensions: height 530 mm, width 620 mm.

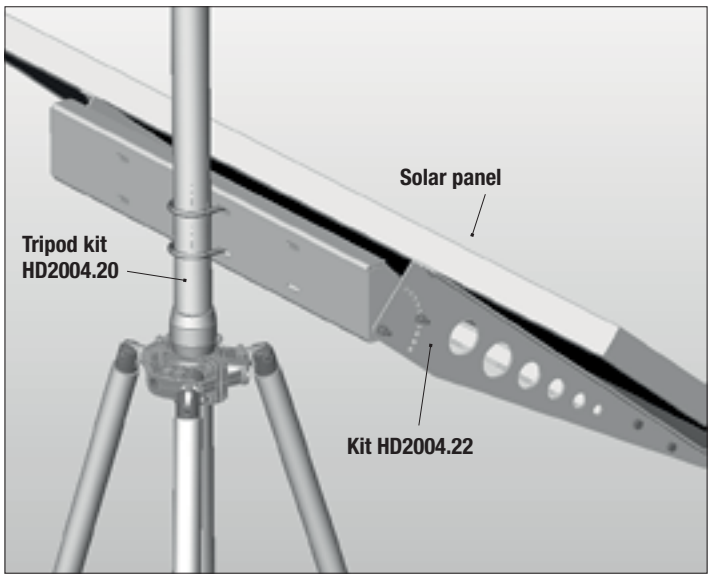



LP_ _ _
HD2003.71.1
HD2003.77/40
HD2003.77C
HD2004.20.1
HD2013.2.14
HD2003.73
HD2004.20.4
HD2004.20.7
HD2004.20.13
HD2004.20.5
HD2004.20.3
HD2003.77/40
1
A
D
2
HD2003.83
L = 1500mm
HD2003.83.1
L = 750mm
E C E A
HD2013.2.14
HD2004.20.12
HDPC30
HD2004.20.20
HDPC30


1x
3x
1x
3x
2x
3x


A
B
C
D
500 mm
600 mm
E
A
D
G
F
C
F
B
2x
E
12x
F
2x
G
0°-90°

HD2004.22


Solar panel
Tripod kit
HD2004.20
Kit HD2004.22