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.

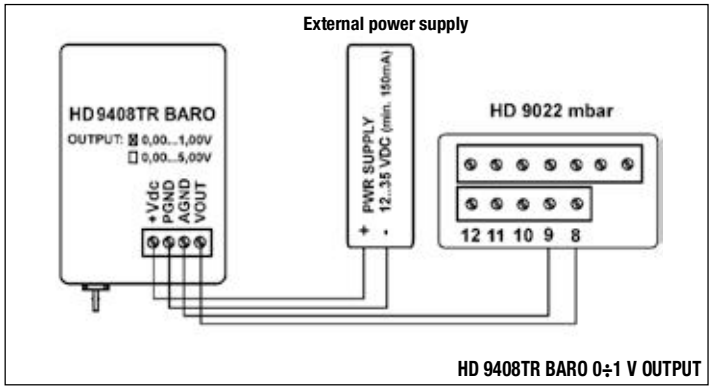
CONNECTION DIAGRAM AND OPERATION

- 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 i ⎍⎍, 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).

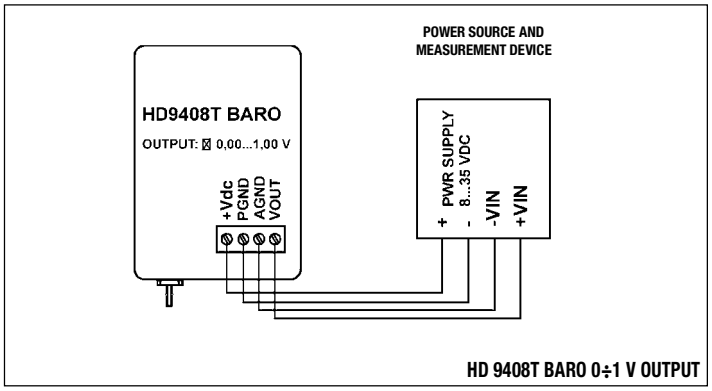
NOTE: the ALARM led comes on to indicate that the relay is energized and the contact is closed.

- **Once installation is completed, check that the cover is tightly closed; the same applies to the grommets.**

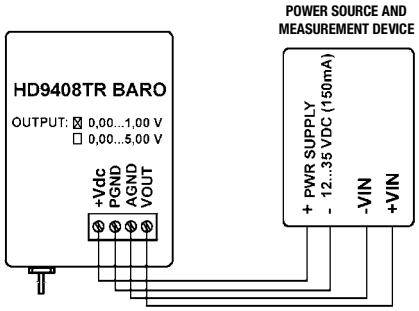
TABLE 1	HI	LO	ALARME LED
MISURA > SET, MISURA < SET + HYS	ON	OFF	OFF
MISURA > SET, MISURA > SET + HYS	ON	OFF	ON
MISURA < SET, MISURA > SET - HYS	OFF	ON	OFF
MISURA < SET, MISURA < SET - HYS	OFF	ON	ON



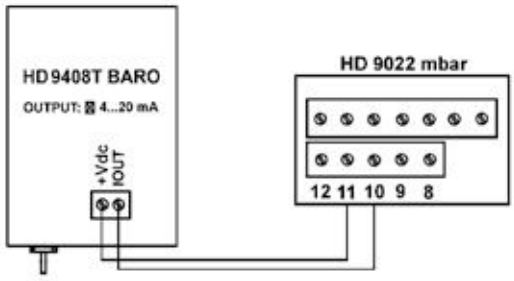
HD 9408TR BARO 0÷1 V OUTPUT



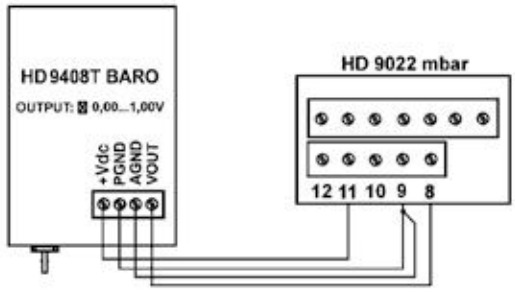
HD 9408T BARO 0÷1 V OUTPUT



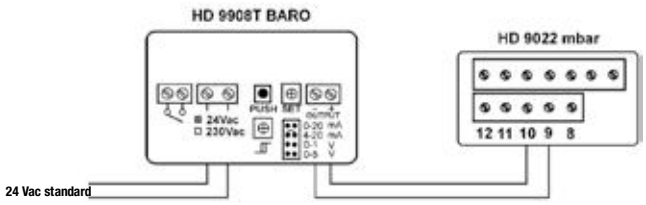
HD 9408T BARO 0÷1 V OUTPUT



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



HD 9408T BARO 0÷1 V OUTPUT



HD 9908T BARO 4÷20 mA OUTPUT

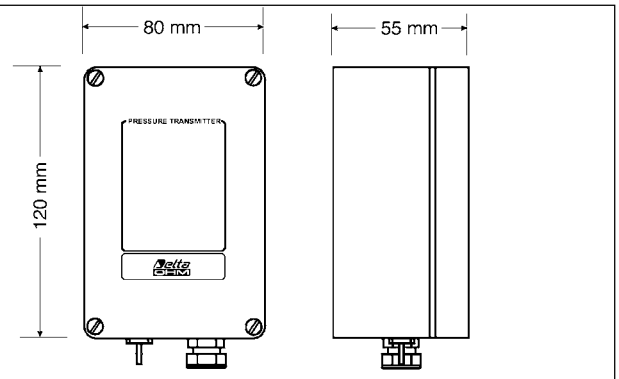
	HD9408T BARO	HD9408TR BARO	HD9908T BARO
Sensor type	Piezoresistive diaphragm		
Measuring range	800 ÷ 1100 mbar / 600 ÷ 1100 mbar on request		
Analog output	0 ÷ 1 Vdc standard; 0 ÷ 5 Vdc, 1 ÷ 5 Vdc, 1 ÷ 6 Vdc and 4 ÷ 20 mA (two wires) on request	0 ÷ 1 Vdc standard; 0 ÷ 5 Vdc, 1 ÷ 5 Vdc and 1 ÷ 6 Vdc on 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: Analog output: 1 mbar 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. to reach full accuracy after a pressure step		
Relay contact output	Absent	Absent	3A/220 Vac resistive load
Set point	Absent	Absent	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	30 psi		

ORDERING CODE

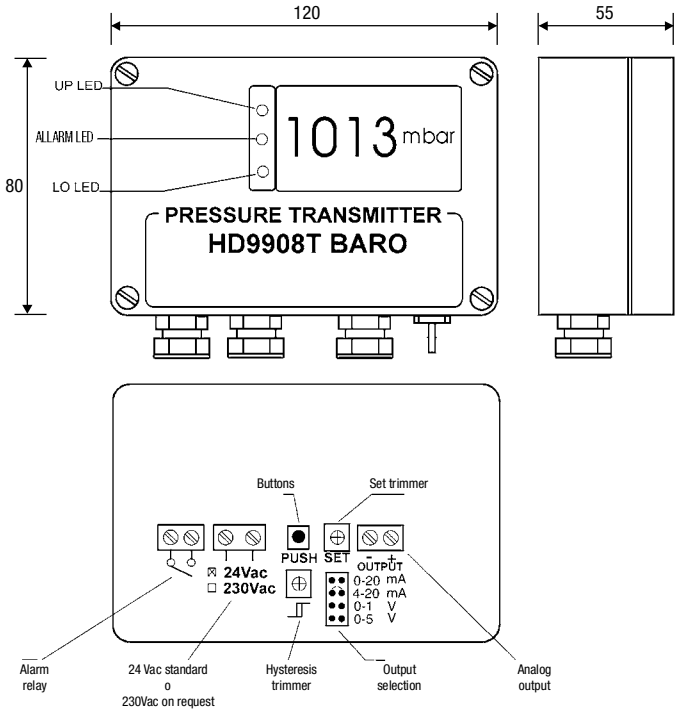
HD9408T BARO 800÷1100mbar barometric transmitter output 0÷1Vdc. Upon request output: 0÷5Vdc, 1÷5Vdc, 1÷6Vdc, 4÷20mA. Working temperature range -30°C ÷ +60°C.

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

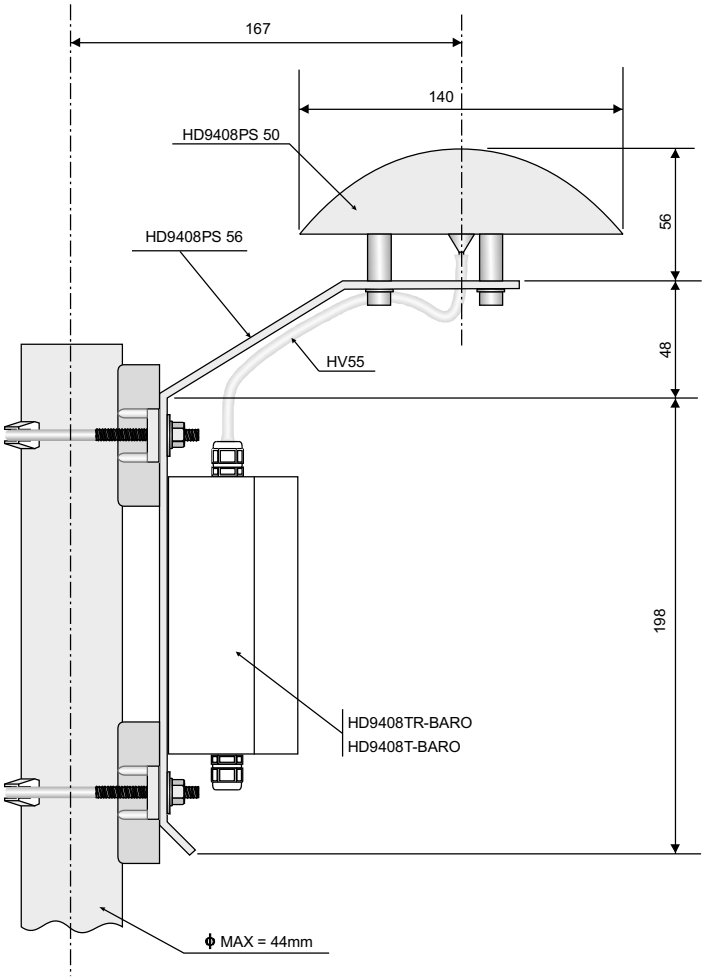


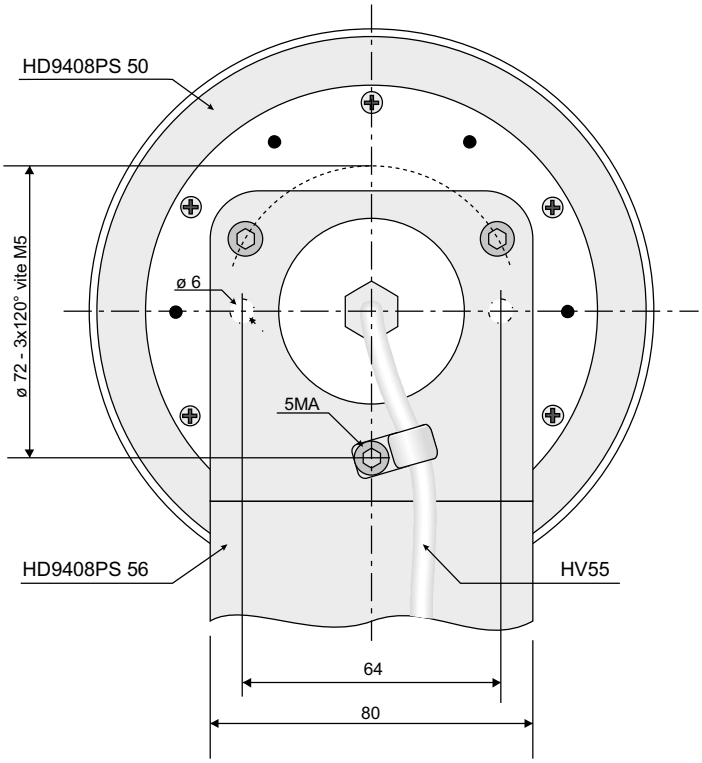
HD 9408T BARO, HD 9408TR BARO



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 the 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 reccomendations the of 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.

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. - Weight of the static port equipped with the bracket	200 gr, 570 gr
Total weight and static port and bracket	570 gr

ORDERING CODE

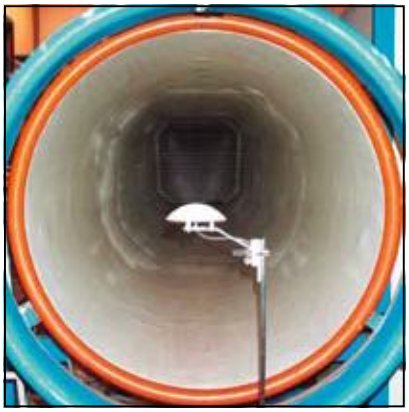
HD9408PS 50K Kit consits of by static port, pole mounting bracket and HV55 tube

HD9408PS 50 Static port for barometric measurements equipped with the HV55 tube

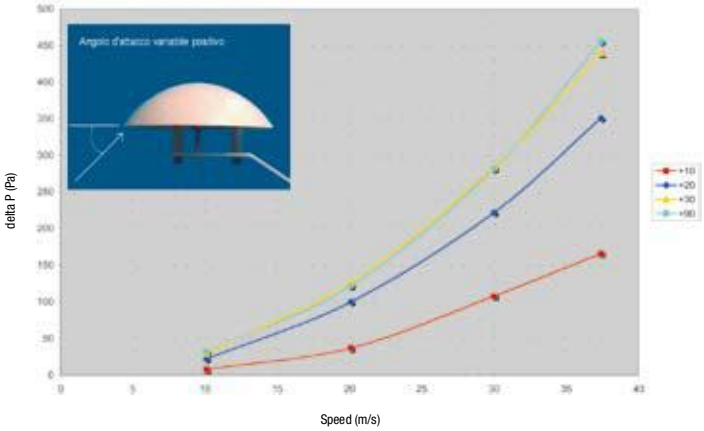
HD9408PS 56 Mounting bracket for static port, barometer fastening, pole anchor

HV55 HV55 UV- and temperature-resistant silicone tube, inside Ø : 3mm, outside Ø : 6mm, L=400mm

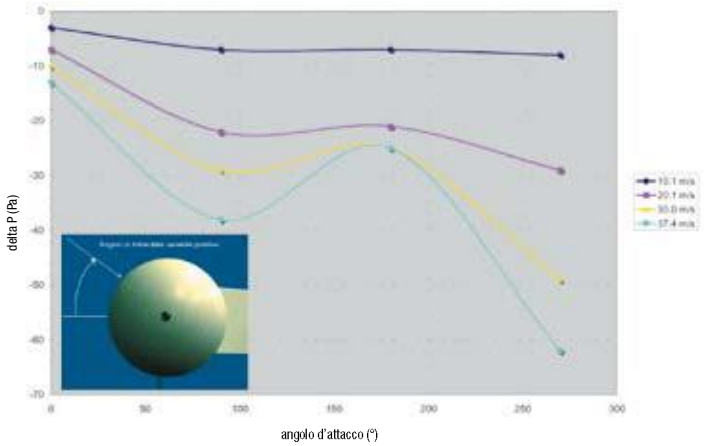
TESTS MADE IN THE WIND TUNNEL



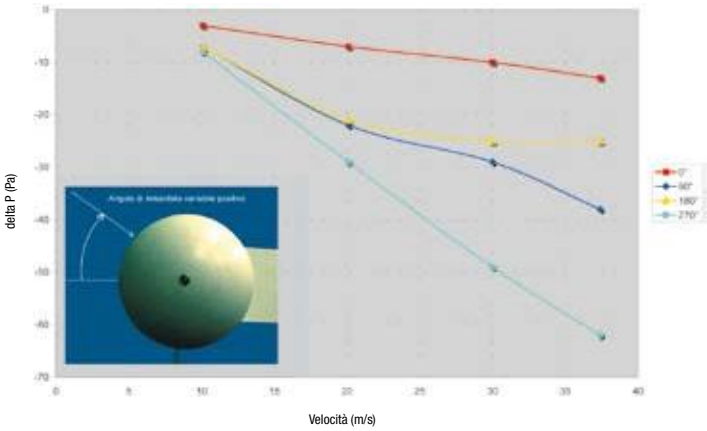
Static port put in front of the wind tunnel



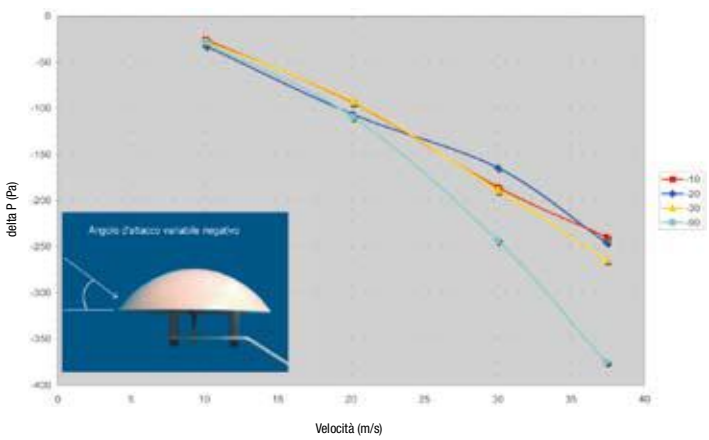
ΔP according to the yaw angle β (join angle α = 0°)



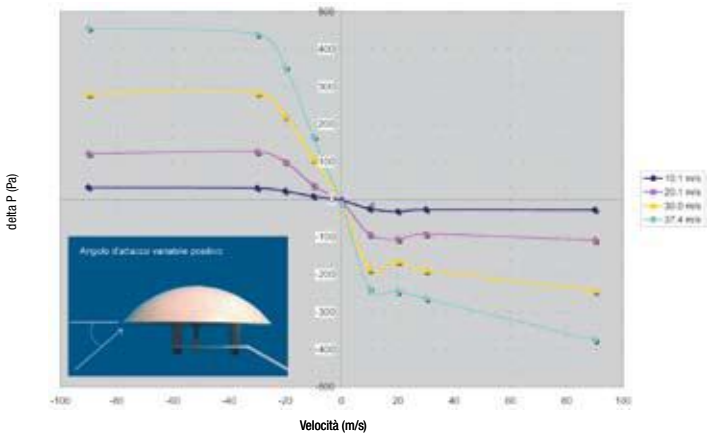
ΔP according to the join angle α (yaw angle β = 0°)



ΔP according to the α join angle (yaw angle β = 0°)



ΔP according to the β yaw angle



ΔP according to the α join angle

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 10…30Vdc 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, 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).

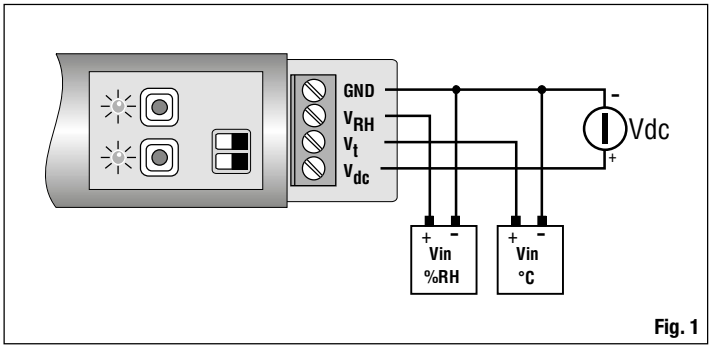


Fig. 1

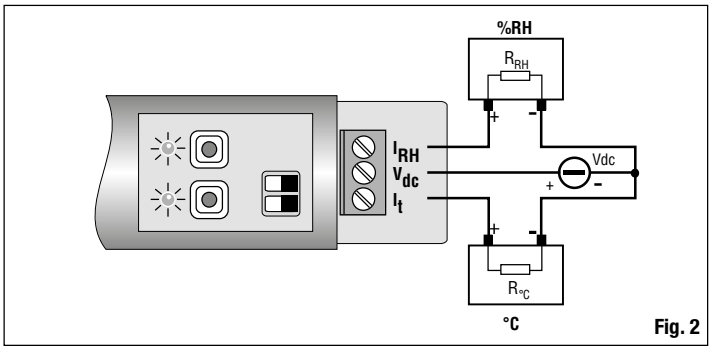


Fig. 2

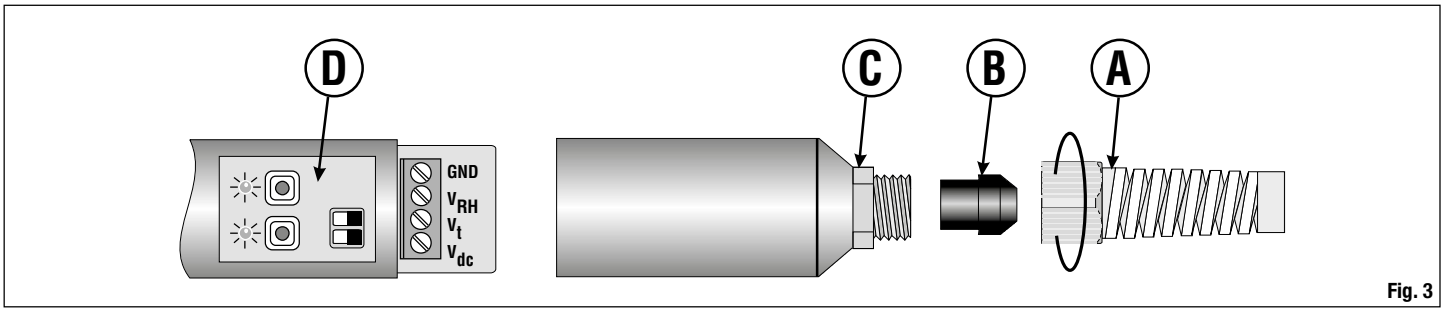


Fig. 3

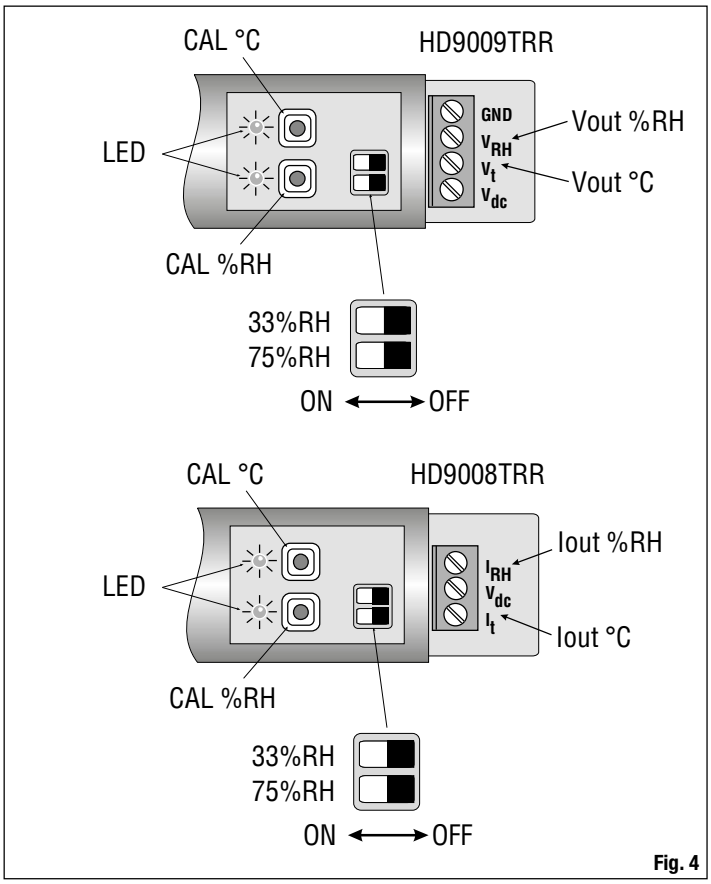


Fig. 4

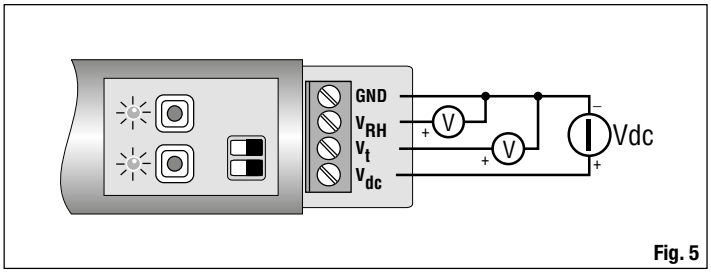


Fig. 5

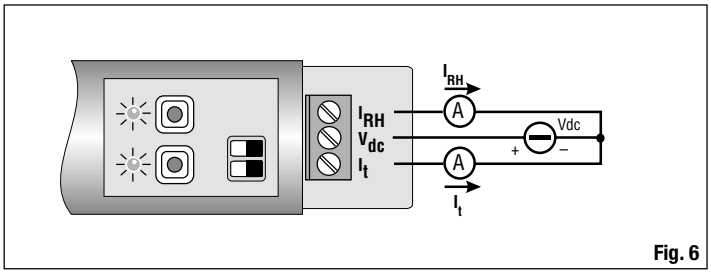


Fig. 6

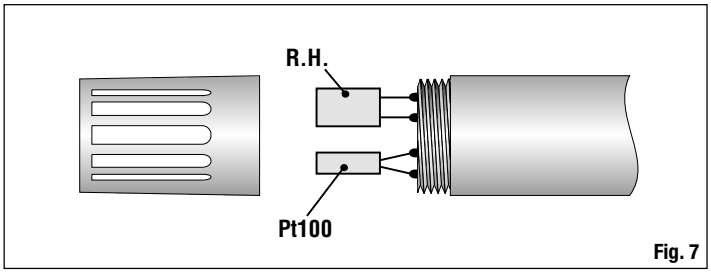


Fig. 7

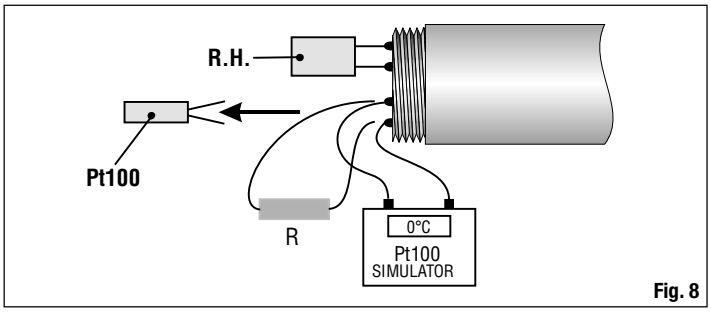


Fig. 8

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 2, "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.

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…Vdc 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 10…30Vdc continuous voltage power supply, a precision ammeter with a 0…25mA min. range.

HD9009TRR: a 10…30Vdc 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: HD9008TR and Fig.6: HD9009TR).
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.

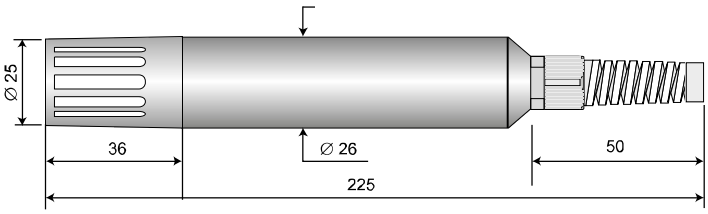
For HD9008TRR: a 7…30Vdc continuous voltage power supply, a precision ammeter with 0…25mA minimum range.

For HD9009TRR: a 7…30Vdc 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		HD9008TRR	HD9009TRR
Electronics Working Temperature		-40…+80°C	
Sensor Working Temperature		-40…+80°C	
Transmitter Power Supply		10...30Vdc (4…20mA)	10…30Vdc (2mA)
Capacity		300 pF typ.	
HUMIDITY	Measuring Range	5…98%RH	
	Accuracy at 20°C	±2%RH (10…90%RH) ±2.5%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	$R_{Lmax} = \frac{(Vdc - 10)}{22mA}$	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 min. with filter; 6 s without filter	
	Output Signal	-40°C = 4.0mA +80°C = 20.0mA	-40°C = 0.00 Vdc +80°C= 1.00 Vdc (*)
	Load Resistance	$R_{Lmax} = \frac{(Vdc - 10)}{22mA}$	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, 1…6Vdc, 0…10Vdc voltage outputs can be provided on ordering.

(**) Out-of-standard measuring ranges have to be requested when ordering or have to be re-programmed with a Pt100 simulator.

(***)Use screened cables.

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.

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.

HD9007
MULTIPLATE RADIATION SHIELD

Characteristics

Luran S777K (BASF) antistatic UV-resistant thermoplastic material with low thermal conductivity and high reflection.

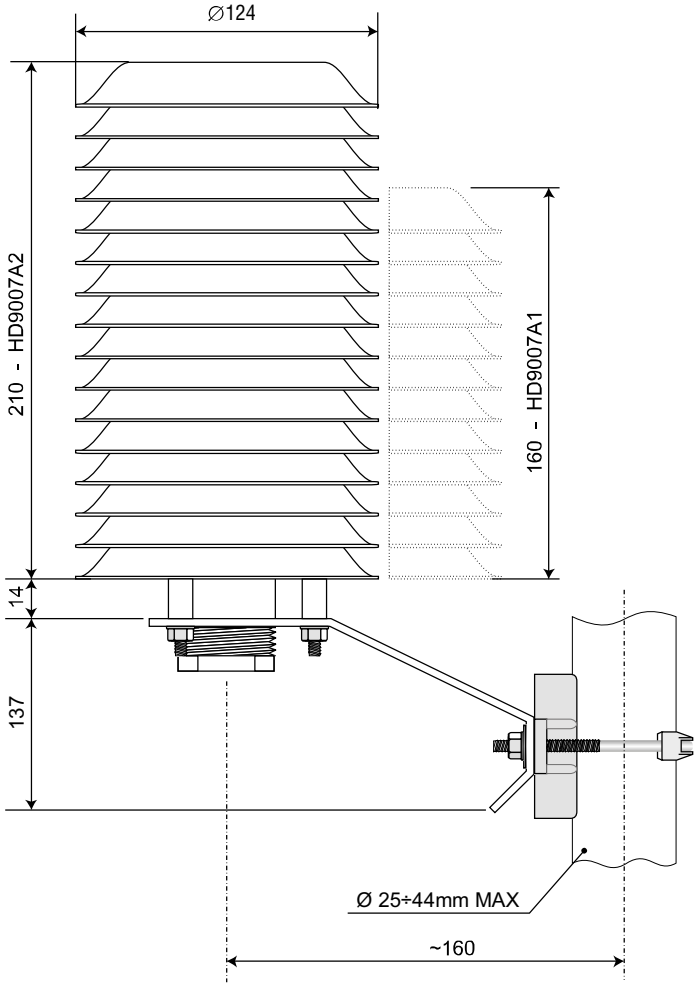
White power-painted, anticorodal aluminium support bracket. Stainless steel U-bar mounting bracket for shafts from 25 to 44mm.

Dimensions: external Ø : 130 mm.

Height, excluding bracket: HD9007 A1: 190 mm, weight: 640 gr.
HD9007 A2: 240 mm, weight: 760 gr.

Sensor fixing ring nuts: Ø 27 mm, Ø 25 mm on demand when ordering.

HD9007 ring-shield is suitable to protect temperature and RH/temperature sensors used in weather stations from solar radiations, rain and wind.



- the sensor Pt100 (100Ω at 0 ° C) 1/3DIN wire used is accurate and stable over time, it is possible to extract for periodic calibration
- the support structure of the sensor has low thermal conductivity
- power the electric motor is 12Vdc, 35mA maximum current
- the construction of the screen is plastic Luran S777K UV resistant
- support of the probe is expected to be installed on poles for weather stations

Features

- intake by electric motor
- suction flow: 422 l / min, 35Pa
- Power: 12Vdc - 25mA nominal
- Expected life: 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, lungh.580mm, complete with bracket on pole diameter 25 ÷ 44mm maximum
- cable: 8-wire Pt100 sensor for feeding the engine. Cable CPM12AA8 ... to 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. On the one hand to 8 pin female connector on the other thread open. Length 2 meters.

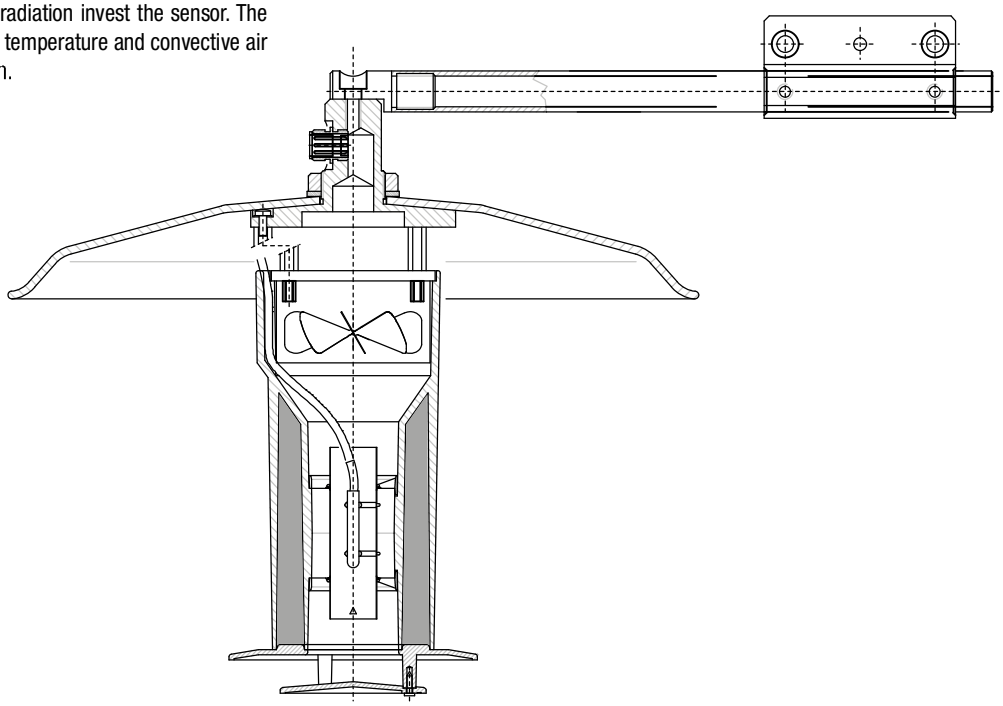
CPM12.AA8.5: 8-pin cable for Pt100 sensor and motor. On the one hand to 8 pin female connector on the other thread open. Length 5 meters.

CPM12.AA8.10: 8-pin cable for Pt100 sensor and motor. On the one hand to 8 pin female connector on the other thread open. 10 m.

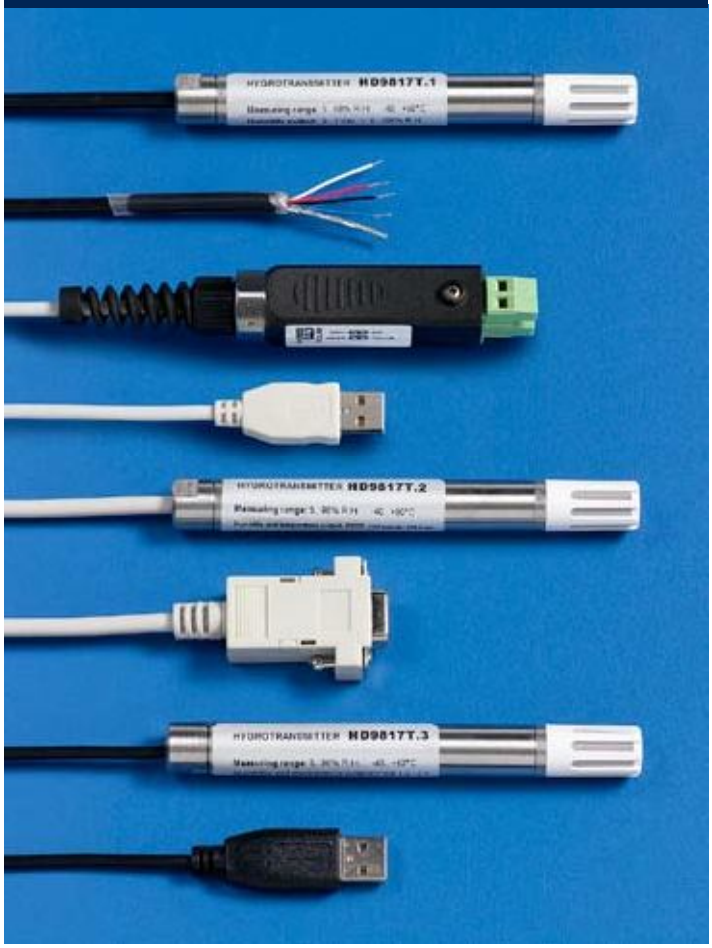
HD 9006.13: Flange for mounting to poles with diameters from 25 to 44mm.

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 Convention of the screen.
The position sensor inside the screen is such that radiation 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 radiation shield:
- reduces the measurement error



HD 9817T1R
HD 9817T2R
HD 9817T3R



HD 9817T1R, HD 9817T2R, HD 9817T3R TEMPERATURE AND HUMIDITY TRANSMITTERS WITH ANALOGUE OR DIGITAL OUTPUT

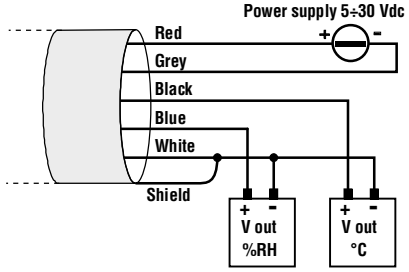
Dual relative humidity and temperature transmitter for HVAC applications, environmental monitoring, pharmaceutical storage, food transport, greenhouse automation, etc. Equipped with an IP65 stainless steel AISI 304 housing, it is suitable even for severe environments; besides, its ultra-compact dimensions (∅ 14 x 133 mm) and wide range of outputs (analogue 0...1V or digital RS232C, 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

	HD9817T1	HD9817T1.1	HD9817T2	HD9817T3
Output	0...1V = 0…100%RH 0...1V = –40…+60°C (-20…+80°C on request)		RS232C non insulated, 2400 baud rate	USB 1.1-2.0 non insulated
Temperature sensor	Pt100	NTC 10kΩ	Pt100	Pt100
Load resistance	R_L > 10kΩ			
Cable Connection	L=1,5m (7 wires + shield)		L= 2m DB9 female connector	L= 2m USB connector type A

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 I 063.9	It sends the current measurement (tttt.t I hhh.h) t = temperature h = RH
U0	&	International System of units
U1	&	Imperial units

Note for HD9817T3 model with USB ouput

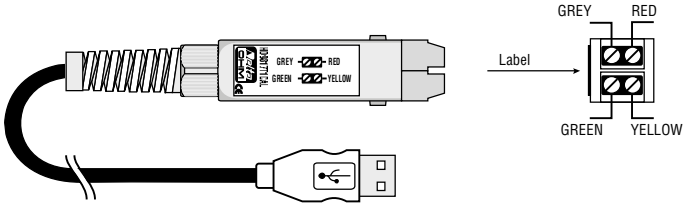
This model requires that you install USB drivers first in order to ensure a correct PC connection: **don't connect the instrument to your PC before installing the drivers**. For further details, see the guide in the CDRom which is supplied with the instrument.

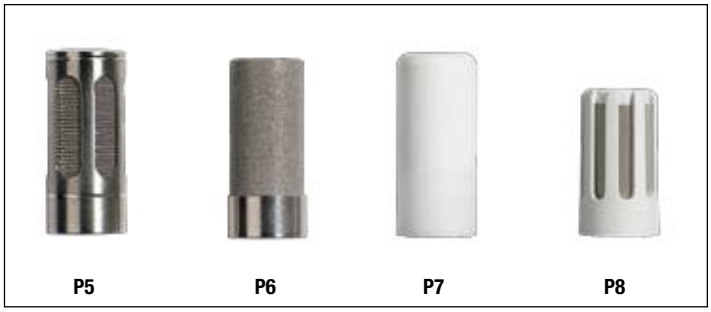
Relative humidity calibration

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.

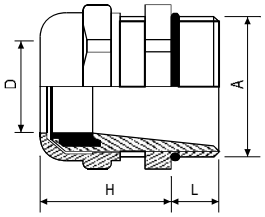




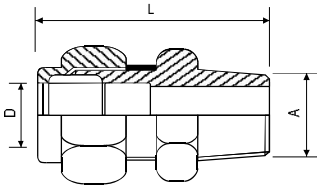
Installation notes

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



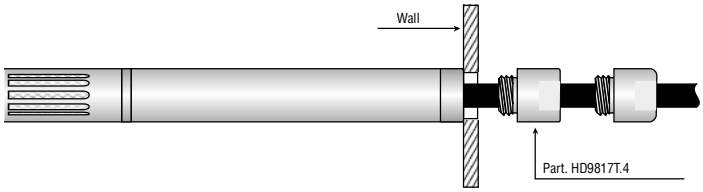
PG16.12 Metal cable gland
D = 10…14mm
L = 6.5mm
H = 23mm
A = PG16



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...30Vdc) between the wires:
Red = (+) power supply positive
Grey = (-) power supply negative.

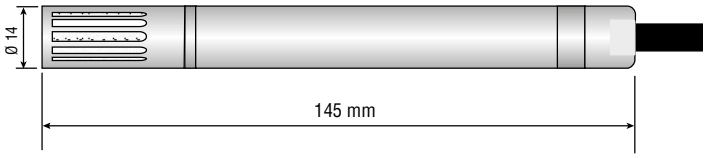
Analogue output

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.

HD9817T… Dimensions



Technical data		
HD9817T1R - HD9817T1.1- HD9817T2 - HD9817T3		
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	±2% (10…90%RH), ±2,5% in the remaining range
	Temperature dependence	2% on the whole temperature range
	Hysteresis and repeatability	1%RH
	Long term stability	1%/year
Temperature	Sensor type	Pt100 1/3 DIN (on request, NTC 10kΩ: code HD9817T1.1
	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…30Vdc
	Consumption	Typically 2mA
	Max. operating temperature	-40…+80°C (for short periods)
	Operating humidity	0…100%RH
Housing	Dimensions	Ø14x138mm
	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...30Vdc. AISI 304 housing. Probe protection class IP65. Dimensions ∅14x133mm. Output with cable L=1,5m (7 wires + shield). Max. working temperature -40°+80°C. **Supplied with HD9817TC software.**

HD9817T1.1R: 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...30Vdc. AISI 304 housing. Probe protection class IP65. Dimensions ∅14x133mm. 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 ∅14x133mm. 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 ∅14x133mm. Output with cable L= 2m with USB type A connector. Max. working temperature -40°+80°C. **Supplied with HD9817TC software.**

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. Adapter is required HD9008.26.14

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

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.

P5: 20µ stainless steel grid protection for probes Ø 14mm, thread M 12x1.

P6: 20µ sintered stainless steel protection for probes Ø 14mm, thread M 12x1.

P7: 10µ PTFE protection for probes Ø 14mm, thread M 12x1.

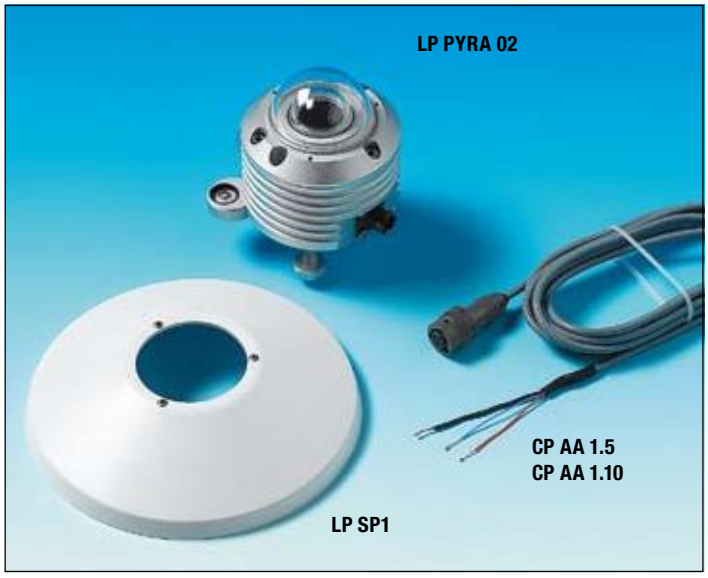
P8: 20µ stainless steel and Pocan grid protection, thread M 12x1.

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 ground-based 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.
No power supply is needed; pyranometers generate a voltage which is usually equal to:

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

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/m²)	
Impedance	33 Ω ÷ 45 Ω	
Measuring range	0 ÷ 2000 W/m²	
Viewing field	2π sr	
Spectral field	305 nm ÷ 2800 nm W/m² (50%)	
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/m²	25 W/m²
b) Response to temperature change 5K/h	<|± 4|W/m²	<|± 6|W/m²
3a) Non stability over 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) 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

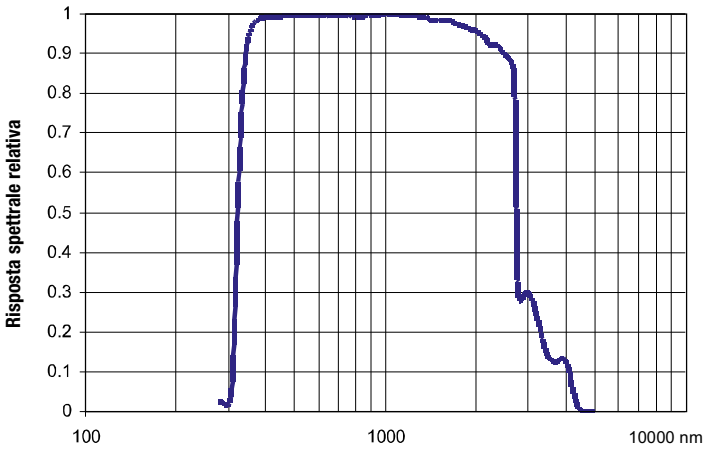
LP PYRA 02: First class pyranometer according to ISO 9060. Complete with: shade disk LP SP1, desiccant sachet with silica-gel crystals, 2 cartridges, spirit level, 4-pole flying connector and Report of Calibration. Typical sensitivity 10µV/(W/m$_2$).**Connection cable has to be ordered separately**.

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, 4-pole flying 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, 4-pole flying connector and Report of Calibration .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 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



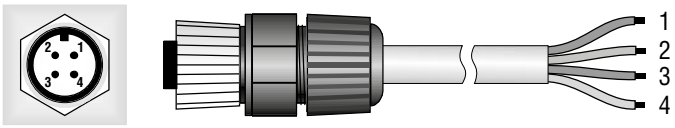
Risposta spettrale tipica dei Piranometri

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, 4-pole flying connector and Report of Calibration. Typical sensitivity 10µV/(W/m_2). **Connection cable has to be ordered separately.**
LP PYRA 03AC: Second class pyranometer according to ISO 9060. Complete with spirit level, 4-pole flying connector and Report of Calibration. Typical sensitivity 10µV/(W/m_2). **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 flying connector and Report of Calibration. Typical sensitivity 10µV/(W/m_2). **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 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 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. Typical sensitivity 10µV/(W/m_2). **Connecting cable has to be ordered separately**.
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. Typical sensitivity 10µV/(W/m_2). **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. Typical sensitivity 10µV/(W/m_2). **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).
CP AA 2.5: Flying 7-pole connector, complete with UV-resistant cable L=5m. For the instruments LP PYRA 05- LP PYRA 06 - LP UVB 02.
CP AA 2.10: Flying 7-pole connector, complete with UV-resistant cable L=10m. For the instruments LP PYRA 05- LP PYRA 06 - LP UVB 02.

ORDER CODE:
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.

HD978TR3, HD978TR4, HD978TR5, HD978TR6

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



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

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

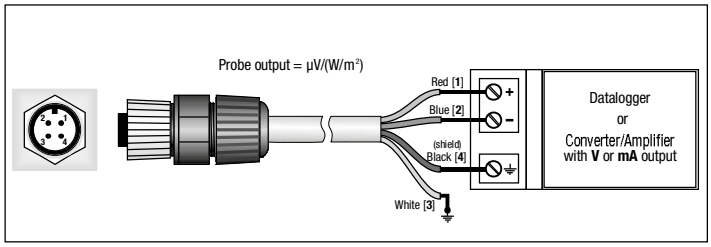
LP PYRA 02AC - LP PYRA 03AC - LP PYRA 12AC

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

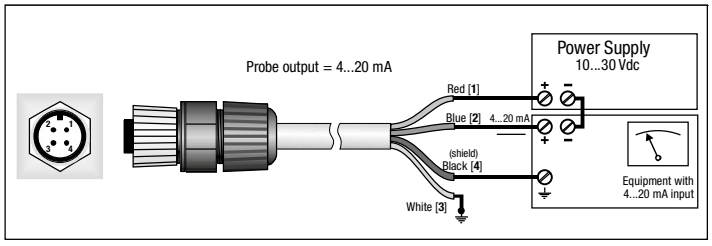
LP PYRA 02AV - LP PYRA 03AV - LP PYRA 12AV

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

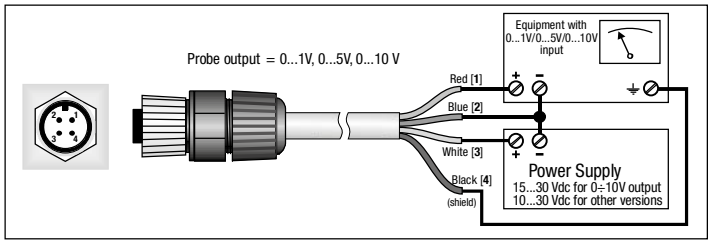
LP PYRA 02 - LP PYRA 03 - LP PYRA 12 CONNECTION DIAGRAMMS



LP PYRA 02 AC



LP PYRA 02 AV



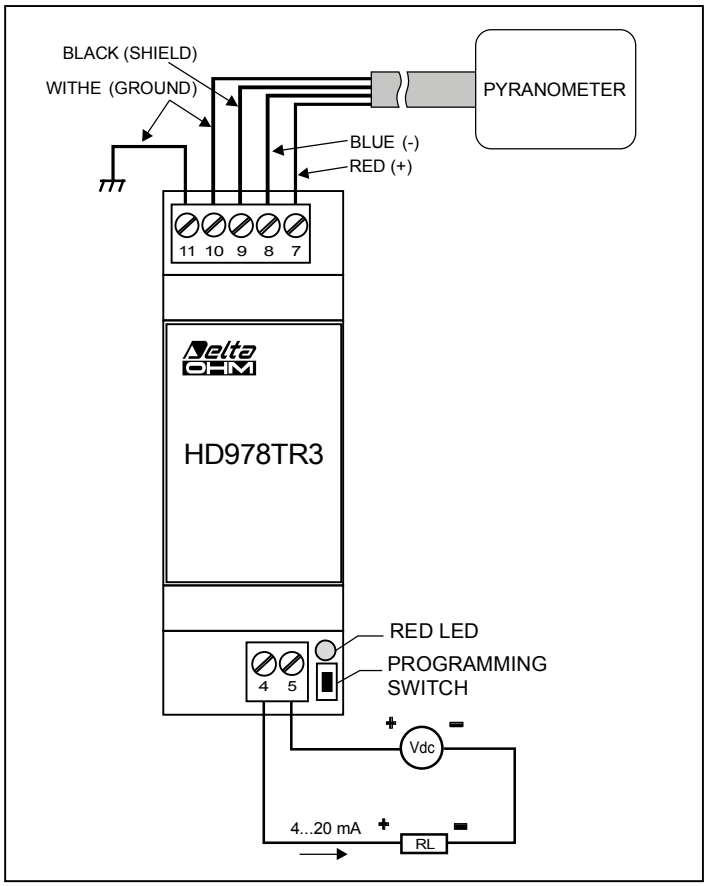


Fig.5 Connection diagram of the HD978TR3 to a pyranometer.

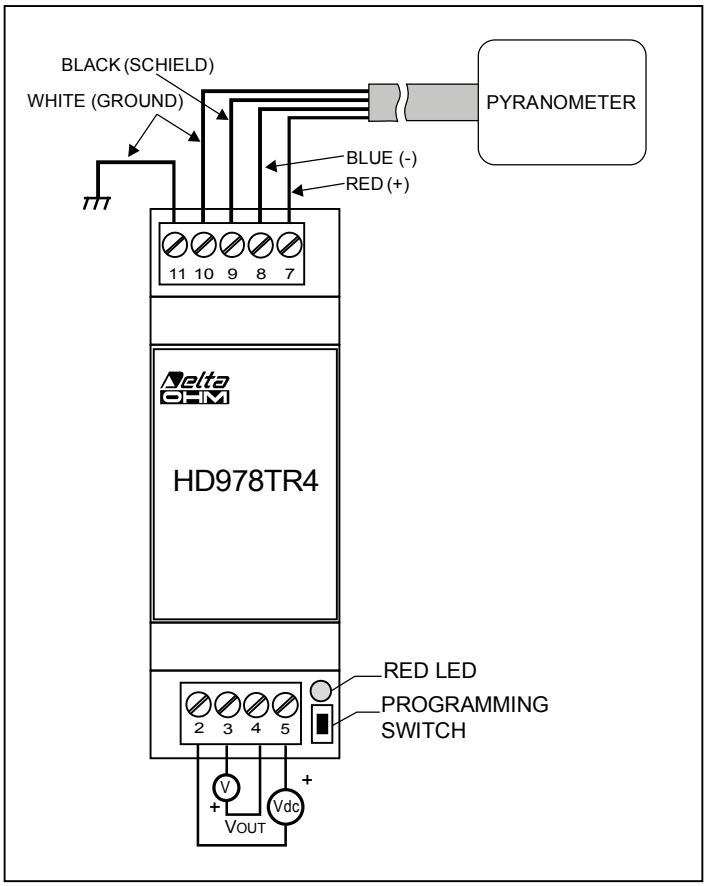
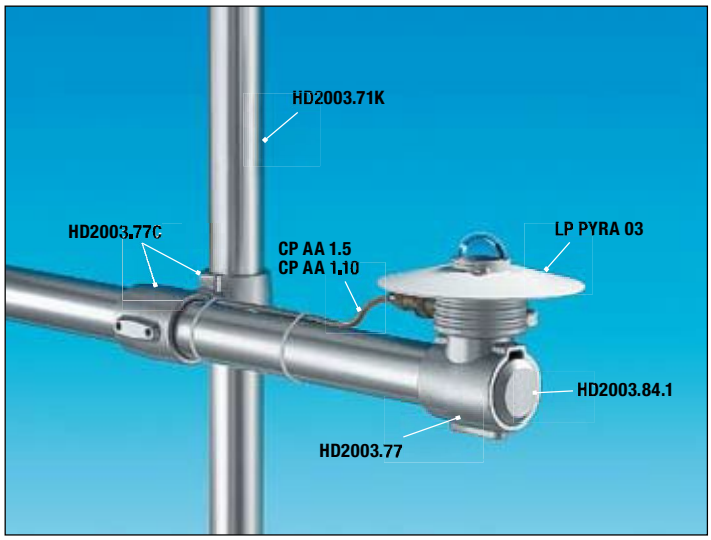
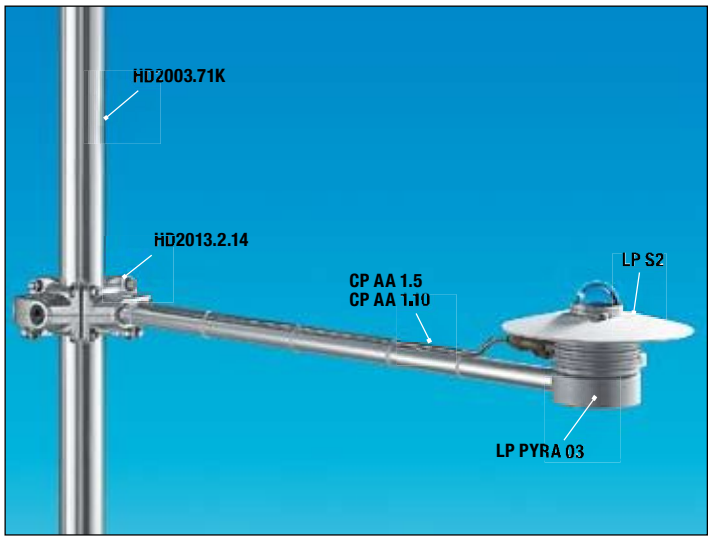


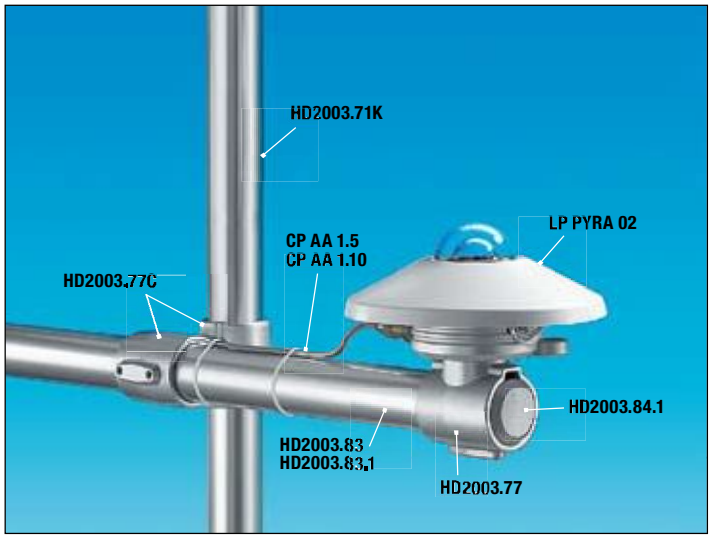
Fig.6 Connection diagram of the HD978TR4 to pyranometer.



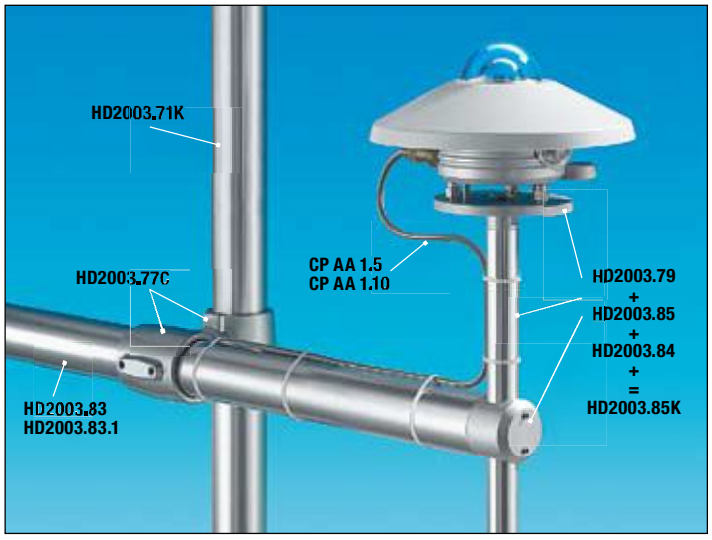
LP PYRA 03 + HD2003.77 + HD2003.77C



HD2013.2.14 + LP PYRA 03 + LP SP2 + LP S2



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



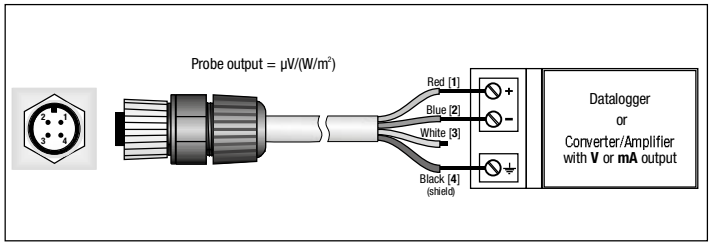
LP PYRA 02 + HD2003.85K + HD2003.77C

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 tools are robust, reliable, provided to withstand the adverse climatic conditions are suitable for installation in the field.
The pyranometer **LP PYRA 08**, measure 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 with mV output does not need power and have a typical sensitivity of 15 mV / (kW m^{-2}). The pyranometer are also available with the output signal amplified and converted into a current signal 4 ... 20mA or voltage 0 ... 1 Vdc, 0 ... 5 V or 0 ... 10Vdc. The heating option allows you to operate at low temperatures with good results in those places where frequent snowfall would cover the glass dome for long periods.
Each pyranometer is calibrated individually with reference to the WWR (World Radiometric Reference in Davos CH) and accompanied by calibration report.

LP PYRA 08 thanks to a new sensor used 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.

LP PYRA 08 - LP PYRA 08BL CONNECTION DIAGRAMMS



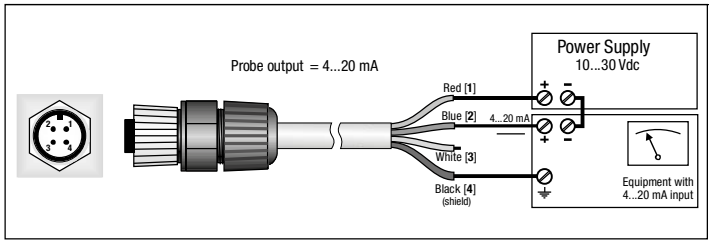
Technical specifications	LP PYRA 08
Typical sensitivity	15 mV (kW/m^2)
Impedance	5Ω
Measuring range	2000 W/m^2
Viewing field	2πsr
Spectral field	305 nm – 2800 nm (50%) (Figure 1)
Working temperature	-40 °C – 80 °C
Specifications according to ISO 9060	
Response time (95%)	**<8 sec**
Zero Off-set	25 W/m^2
a) Response to a thermal radiation (200 W m^{-2})	<|±6| W/m^2
b) Response to a change of temperature 5K/h	<|±2.5| %
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.

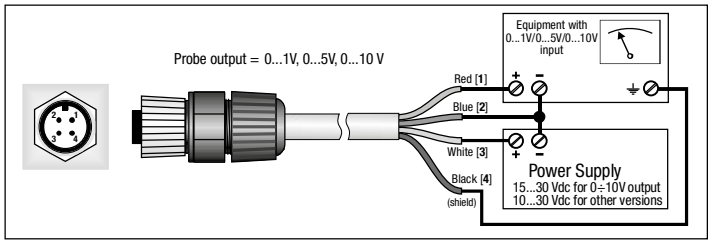
PURCHASING CODES

LP PYRA 08: Second Class pyranometer according to ISO 9060, complete with fast response sensor, calibration report, Silica gel can be replaced when exhausted. Different configurations available. M12 male connector. The cable with the female connectormust be ordered separately. Use the cables CPM12 AA ... 2, 5 or 10 meters.

LP PYRA 08BLAC



LP PYRA 08BLAV



LP PYRA ☐ ☐

- **R** = heating option
- **No letter** = not heated

- **08** = output in mV per kW / m²
- **08BL** = output mV per 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:

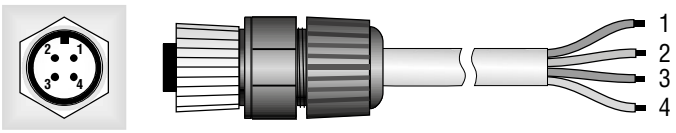
CPM12 AA ☐.☐

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

- **4** = 4-poles cable for not heated versions
- **8** = 8-poles cable with heating, **option R**

WIRING DIAGRAMS:

4-poles cable CPM12 AA4…



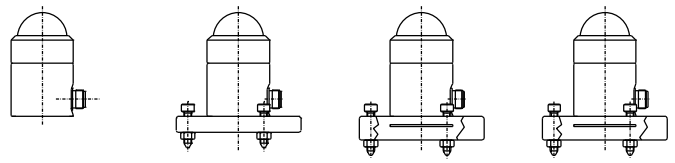
Spina M12 fissa 4 poli **Presa M12 volante 4 poli**

LP PYRA 08, LP PYRA 08BL, LP PYRA 08BLAC

Connector	Function	Colour
1	Negative (-)	Blue
2	Positive (-)	Red
3	Display	Black
4	Not connected	White

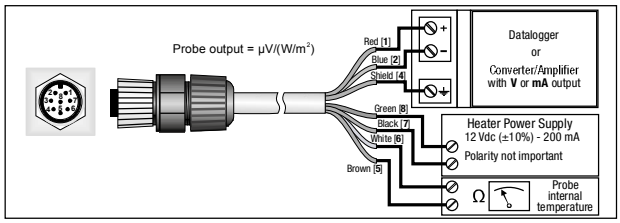
LP PYRA 08BLAV

Connector	Function	Colour
1	(+) Vout and (-) Vcc	Blue
2	(+) Vout	Red
3	Display	Black
4	(+) Vcc	White

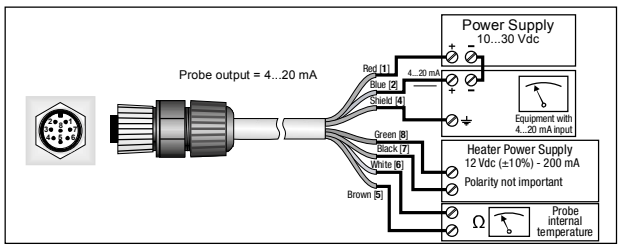


LP PYRA 08 **LP PYRA 08BL** **LP PYRA 08BLAC** **LP PYRA 08BLAV**

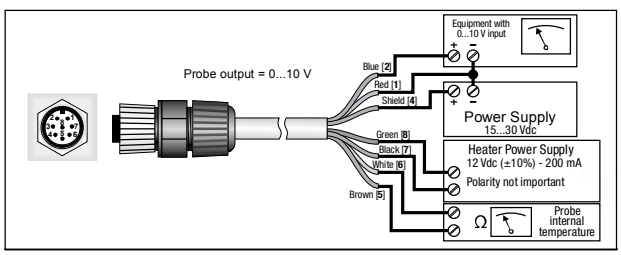
LP PYRA 08R - LP PYRA 08BLR CONNECTION DIAGRAMS



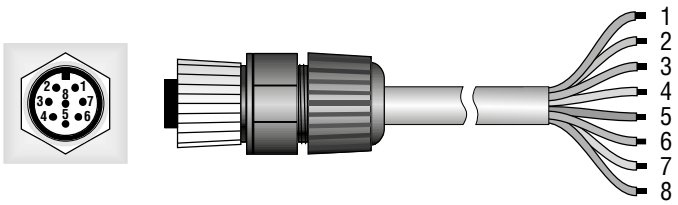
LP PYRA 08 - LP PYRA 08BLACR CONNECTION DIAGRAMS



LP PYRA 08 - LP PYRA 08BLAVR CONNECTION DIAGRAMS



8-poles cable CPM12 AA8…



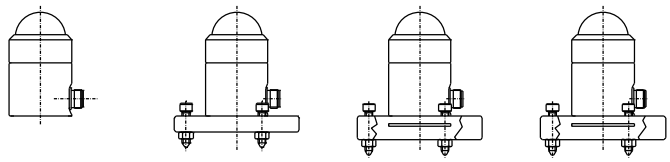
Spina M12 fissa 8 poli **Presa M12 volante 8 poli**

LP PYRA 08R, LP PYRA 08BLR, LP PYRA 08BLACR

Connector	Function	Colour
1	Positive (+)	Red
2	Negative (-)	Blue
3		
4	Display	Sock
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green

LP PYRA 08BLAVR

Connector	Function	Colour
1	(-) Vout and (-) Vcc	Red
2	(+) Vout	Blue
3		
4	(+) Vcc	Sock
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green



LP PYRA 08R **LP PYRA 08BLR** **LP PYRA 08BLACR** **LP PYRA 08BLAVR**

LP PYRA 08BLAC

LP PYRA 08 BL

LP PYRA 08

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 pyrameter 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 (the two pyranometers which made up of the LP PYRA 05 are coupled in order to have the same sensitivity) can be directly sent to a data logger or to an automatic data processor. 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:

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

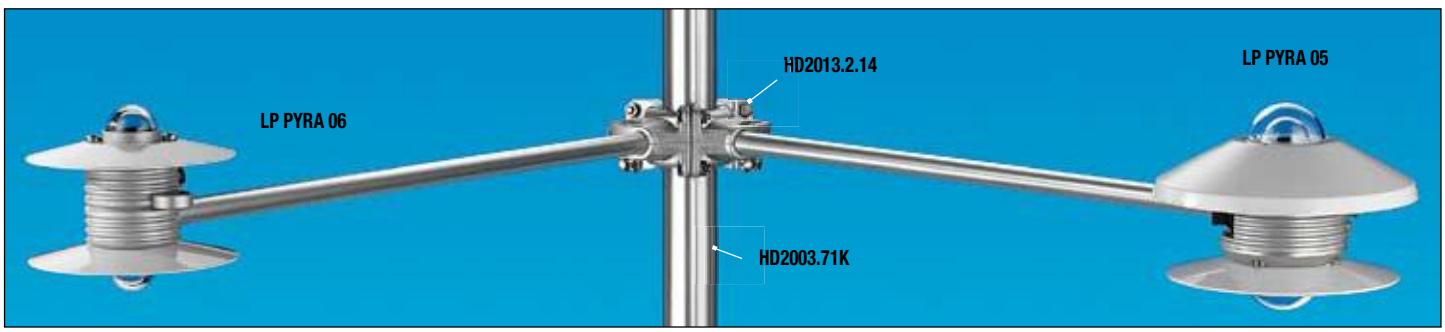
Every pyranometer composing the albedometer is calibrated separately as per the WRR (World Radiometric Reference) standard and is supplied with the relevant Report of Calibration.
These are strong and reliable ground-based instruments, especially designed to be used under all weather conditions. They 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) themperature 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

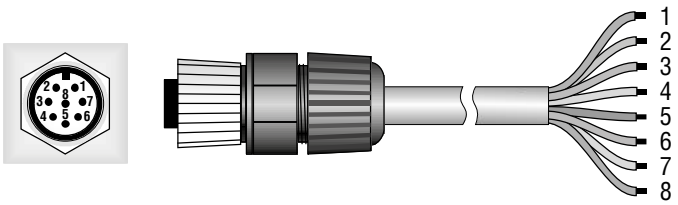
LP PYRA 05: Albedometer made up of two 1st Class pyranometers, according to ISO 9060. Complete with: top shade disk and bottom shade disc, drying cartridge with silicagel crystals, 2 silica gel cartridges, spirit level, rod for attachment to a mast, and Report of Calibration. Typical sensitivity 10µV/(W/m²). **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).



HD 2013.2.14 + LP PYRA 05 + LP PYRA 06

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, rod for attachment to a mast, connecting cable 5m and Report of Calibration. Typical sensitivity 10µW/(W/m²). **The connection cable has to be ordered separately.**
CP AA 2.5: Flying 7-pole connector, complete with UV-resistant cable L=5m. For the instruments LP PYRA 05- LP PYRA 06 - LP UVB 02.
CP AA 2.10: Flying 7-pole connector, complete with UV-resistant cable L=10m. For the instruments LP PYRA 05- LP PYRA 06 - LP UVB 02.
HD978TR3 Configurable signal converter amplifier with 4÷20mA (20÷4mA) 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.
HD978TR4 Configurable signal converter amplifier with 0÷10 (10÷0Vdc) output.
Input measuring range -10..+60mV. Default setting 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.

WIRING DIAGRAM LP PYRA 05 - LP PYRA 06

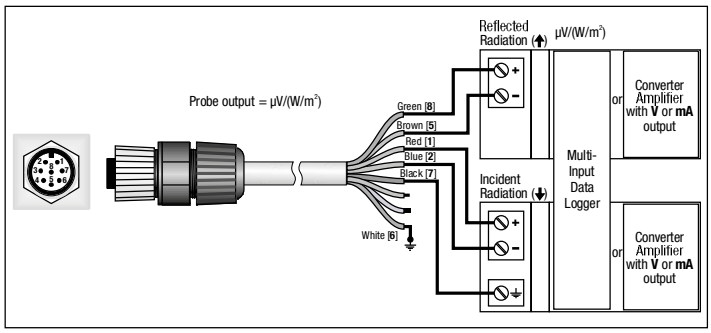


Fixed 8-pole plug M12 **Flying 8-pole M12 socket**

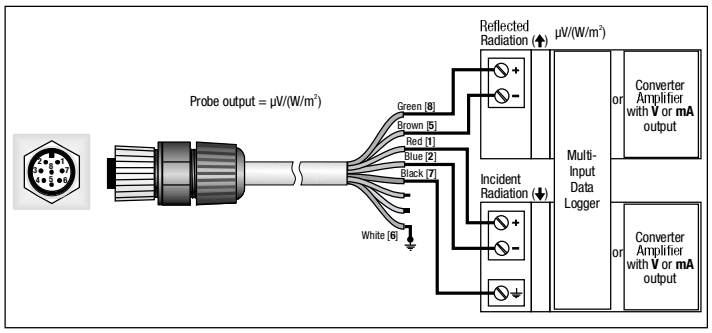
Connector	Function	Colour
8	V out (+) of the signal generated by the lower detector (↑)	Green
6	Housing (⏚) (LP PYRA 05) Not connected (LP PYRA 06)	White
2	V out (-) of the signal generated by the upper detector (↓)	Blue
1	V out (+) of the signal generated by the upper detector (↓)	Red
7	Display (⏚)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

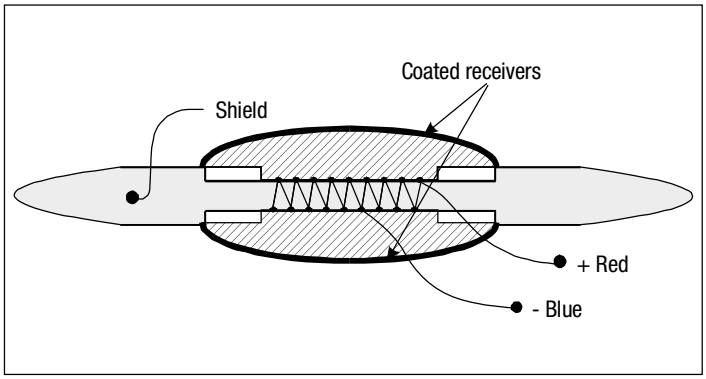


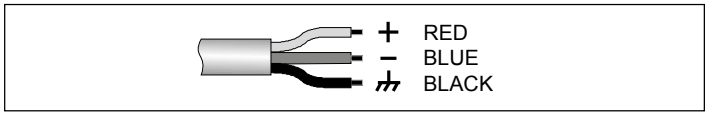
FIG. 1

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.

CONNECTION DIAGRAM LP NET 07



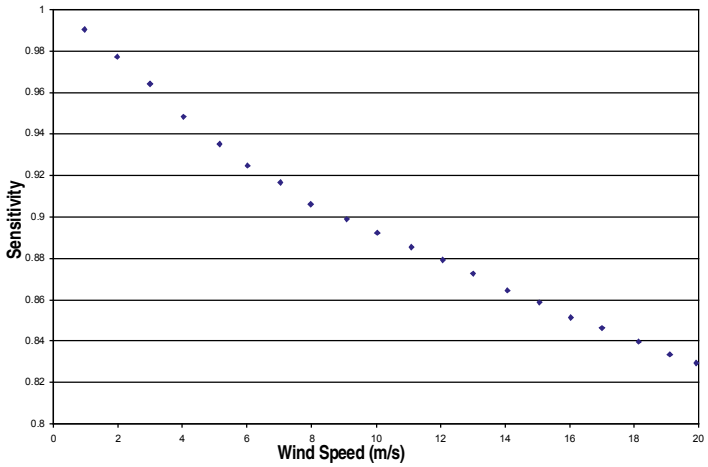


FIG. 2

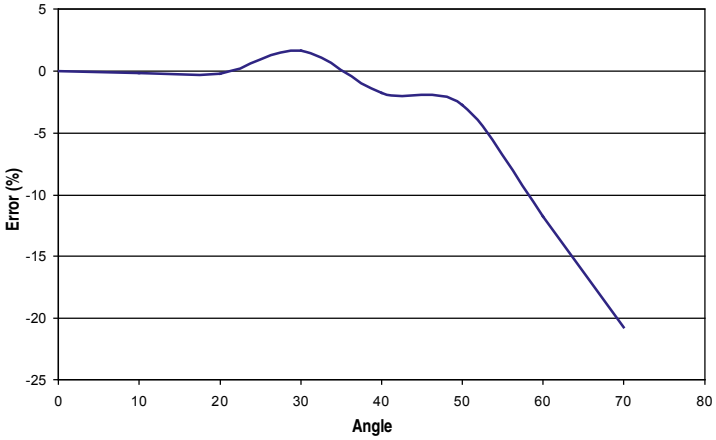


FIG. 3

- 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.

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 color 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 4000kΩ. 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:
Cleaning can be done with normal maps for the cleaning of lens paper 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:

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

$F_{net} = F_{net\_0}/(1-0.011 \times V)$ $\quad V \leq 10$m/s
$F_{net} = F_{net\_0}/(0.95-0.006 \times V)$ $\quad 10$m/s$< V <20$m/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 behavior of the error related to the angle of incidence.

Technical specifications:

Typical sensitivity:	10 μV/(W/m^2)
Impedance:	2Ω ÷ 4 Ω
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. 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. 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.
HD978TR4 Configurable signal converter amplifier with 0÷10 (10÷0Vdc) output.
Input measuring range -10..+60mV. Default setting 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.

LP PHOT 02 – LP PHOT 02AC – LP PHOT 02AV PHOTOMETRIC PROBES

The LP PHOT 02, LP PHOT 02AC, and LP PHOT 03AV 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.

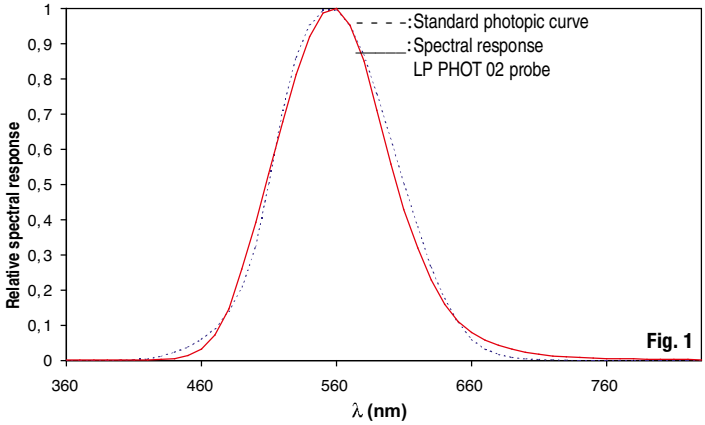


Fig. 1

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

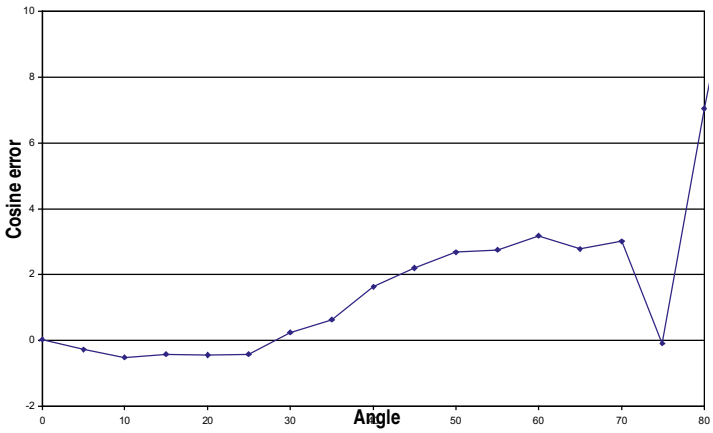


Fig. 2

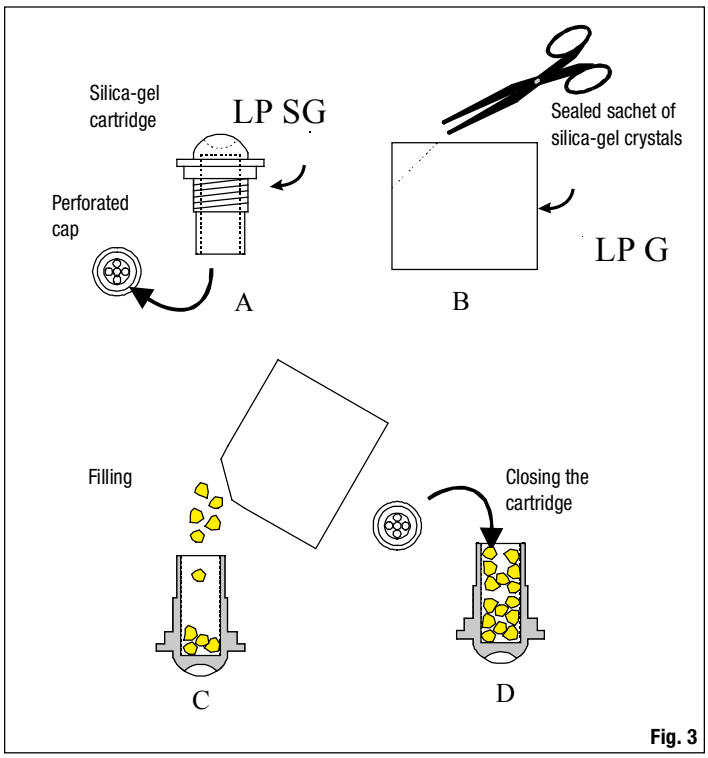


Fig. 3

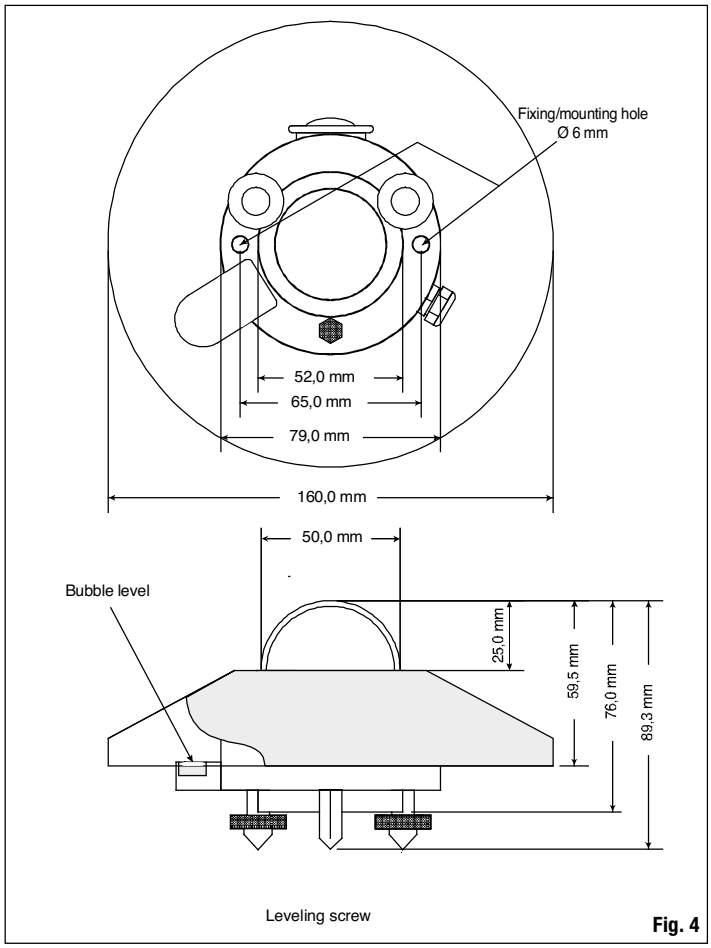
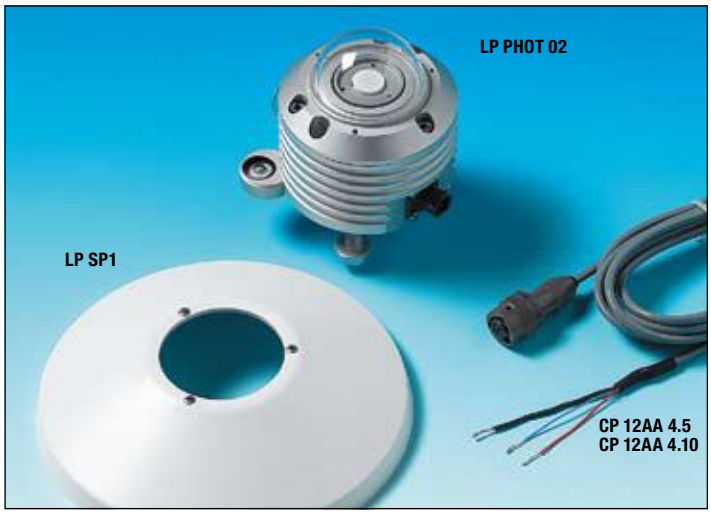


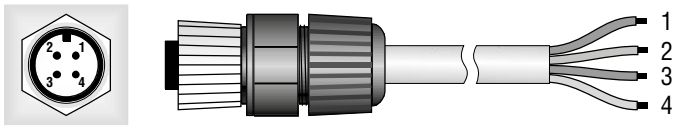
Fig. 4



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 socket**

P 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	Positivo (+), +Vdc	Red
2	Negativo (-), -Vdc	Blue
3	Not connected	White
4	Shield (⏚)	Black

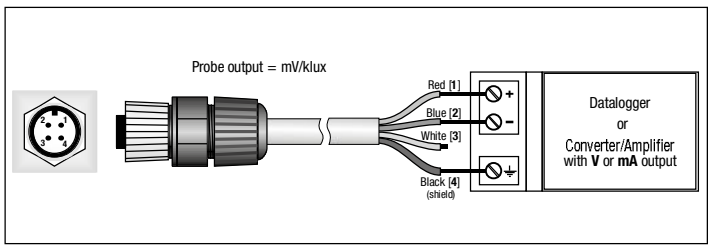
LP PHOT 02 AV

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

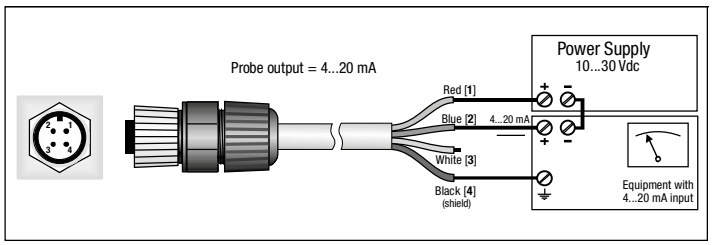
- To allow cleaning the outer dome regularly and carrying out the instrument maintenance, LP PHOT 02 should be mounted in easily reachable places. At the same time, you should check that no building, tree, or any other obstacle exceeds the horizontal plane where the luxmeter is mounted. In case this 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.
- For a correct horizontal placing, LP PHOT 02 is provided with a bubble level; inclination

CONNECTION DIAGRAMS

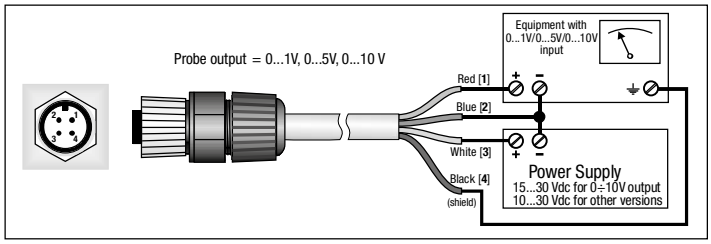
LP PHOT 02



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 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 n. **3**. 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, we strongly recommend 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, flying 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, flying 4-pole M12 plug and Calibration Report. **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, flying 4-pole M12 plug and Calibration Report. **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.

CPM12 AA4.5: 4-pole UV resistant cable L=5 m. For the instruments LP PHOT 02, LP PHOT 02AC, LP PHOT 02AV.

CPM12 AA4.10: 4-pole UV resistant cable L=10 m. For the instruments LP PHOT 02, LP PHOT 02AC, LP PHOT 02AV.

Configurable amplifiers and converters

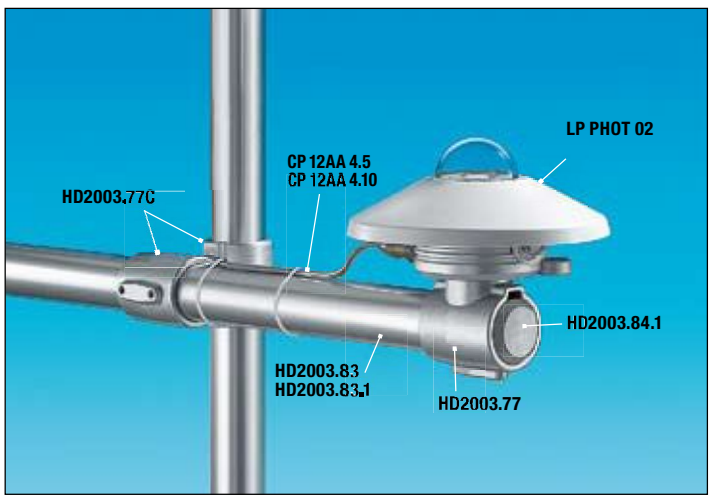
HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Two DIN module (35mm) for rail attachment. Minimum measuring range 2mV. **Configurable with HD 778 TCAL.**

HD978TR4: Configurable signal converter amplifier with 0÷10 (10÷0Vdc) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Two DIN module (35mm) for rail attachment. Minimum measuring range 2mV. **Configurable with HD 778 TCAL.**

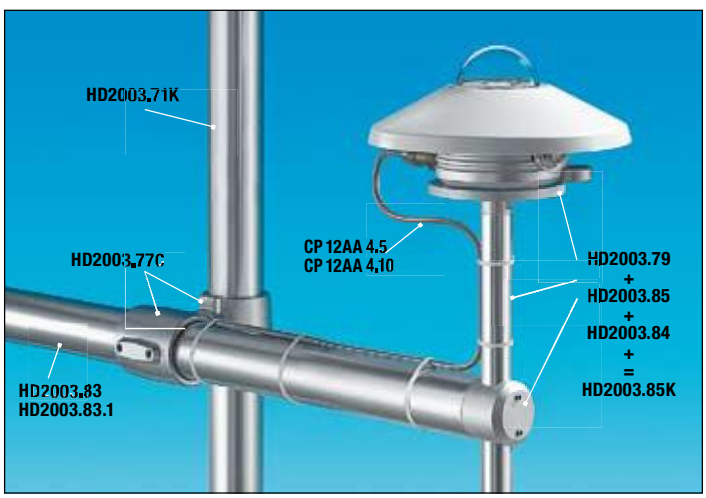
HD978TR5: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Minimum measuring range 2mV. **Configurable with HD 778 TCAL. For wall mounting.**

HD978TR6: Configurable signal converter amplifier with 0÷10 (10÷0Vdc) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Minimum measuring range 2mV. **Configurable with HD 778 TCAL. For wall mounting.**

HD 778 TCAL: Power generator in the range –60mv…+60mV, **regulated by PC through RS232C serial port. DeltaLog-7** software to configure type K, J, T and N thermocouple transmitters and HD978TR3, HD978TR4, HD978TR5 and HD974TR6 converters.



LP PHOT 02



LP PHOT 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 4.
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:

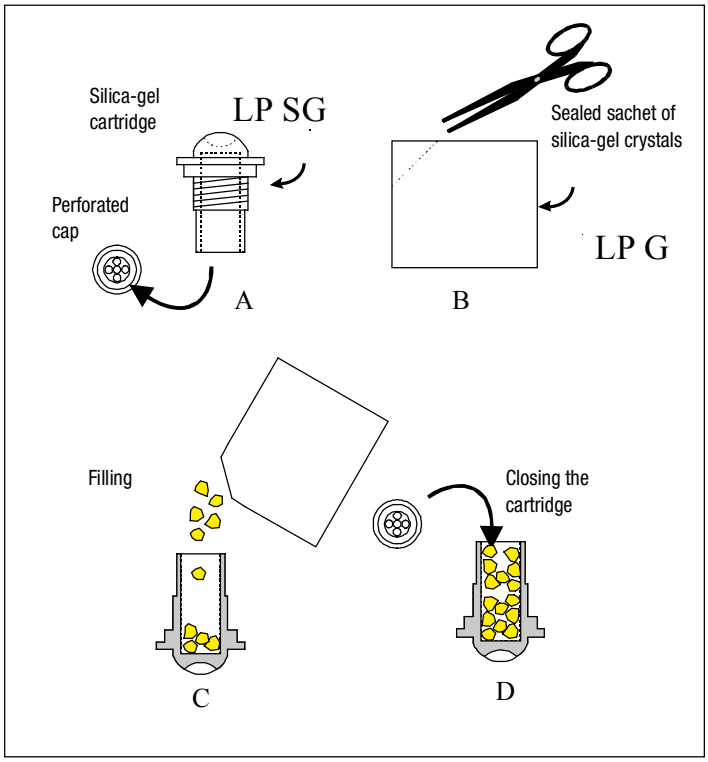
1- Loosen the three screws that fix the white shade disk
2- Unscrew the silica gel cartridge using a coin
3- Remove the cartridge perforated cap
4- Open the sachet containing silica gel (supplied with the radiometer)
5- Replace the silica gel crystals
6- Close the cartridge with its own cap, paying attention 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 flying 4-pole M12 connector
- UV-proof PTFE cables are **available on request**, cable colors and connector poles of the screened 2-wire cable are matched as follows:
  Black → shield braid
  Red → (+) signal generated by the detector
  Blue → (-) negative signal generated by the detector (connected to the housing)
- 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 20mV. In order to better exploit the radiometer features, the readout instrument should have a 1µV resolution.



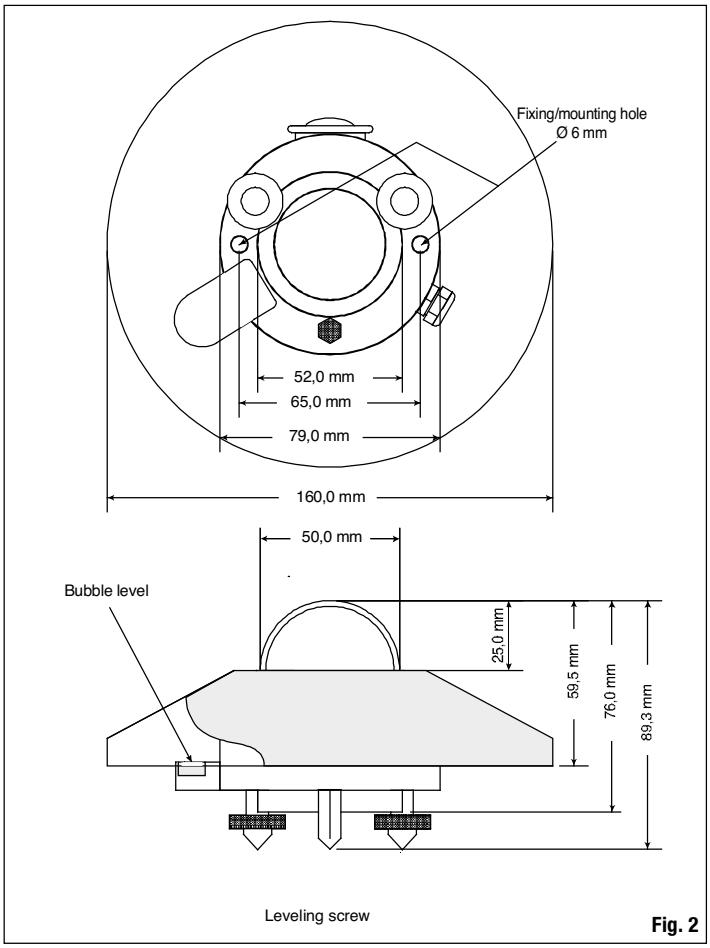
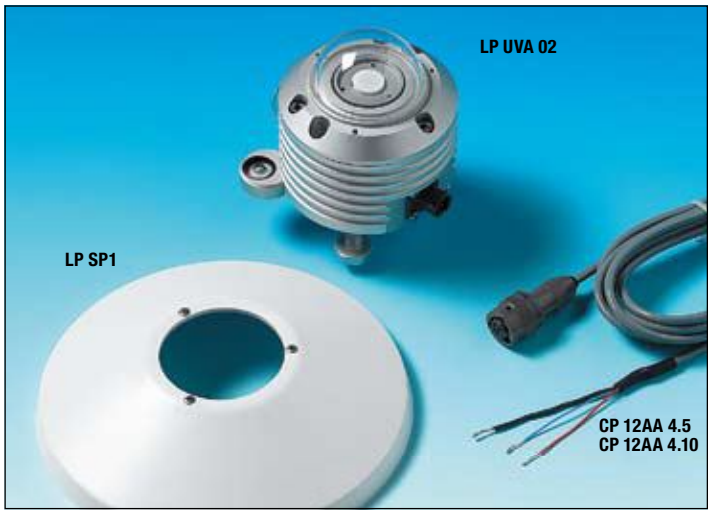


Fig. 2



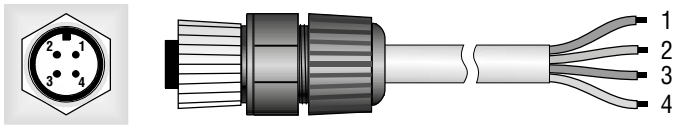
active when their color is **yellow**, while they turn **white** as soon as they loose their power. Read instructions on how to replace them. Silica gel typical lifetime goes from 2 to 6 months depending on the environment where the radiometer works.

Calibration and Measurements:
The radiometer **S** sensitivity (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:

$$E_e = DDP/S$$

WIRING DIAGRAM LP PHOT 02



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

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	Positivo (+), +Vdc	Red
2	Negativo (-), -Vdc	Blue
3	Not connected	White
4	Shield (⏚)	Black

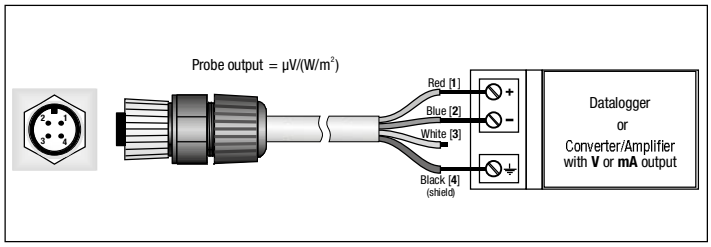
LP UVA 02 AV

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

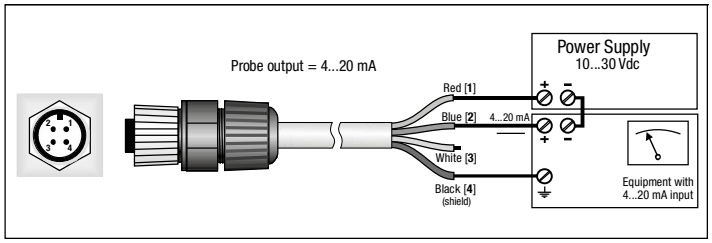
Maintenance:
It is important to keep the outer glass dome clean to grant measurement best accuracy. Consequently, the more the dome will be kept clean, the more measurements will be accurate. Washing can be made using water and standard papers for lens, or, in some cases, using pure ethyl alcohol. After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

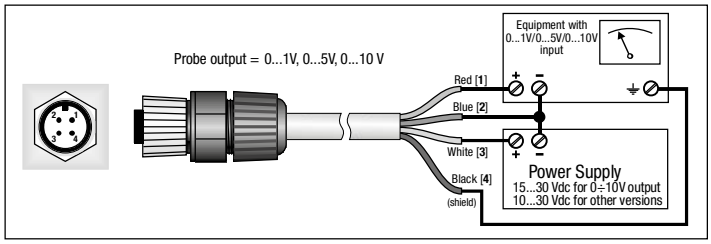
LP UVA 02



LP UVA 02 AC



LP UVA 02 AV



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) .

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 SIT calibration center N° 124 for the calibration of UVA radiometer.
The calibration was performed by reference to Delta Ohm srl primary standard with monochromatic light at 365 nm obtained separating the emission line of a Xe-Hg lamp with an inferential filter. To get best performances from your LP UVA 02 it is strongly recommended that the calibration be checked annually.
N.B. At the moment no international agreement exist for the calibration of this kind of radiometer, so the calibration coefficient is dependent from the calibration procedure like reported in the following article:
"*Source of Error in UV Radiation Measurements*", T. C. Larason, C. L. Cromer on "*Journal of Research of the National Institute of Standards and Technology*" Vol. 106, Num. 4, 2001. (The article is free on the NIST's WEB site at the following address : http://www.nist.gov/jers)

Technical Specifications:

Typical sensitivity:	150 ÷ 350µV/(W/m^2)
Response time:	<0.5 sec (95%)
Impedance:	5 ÷ 7.5 KΩ
Measuring range:	0-200 W/m^2
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

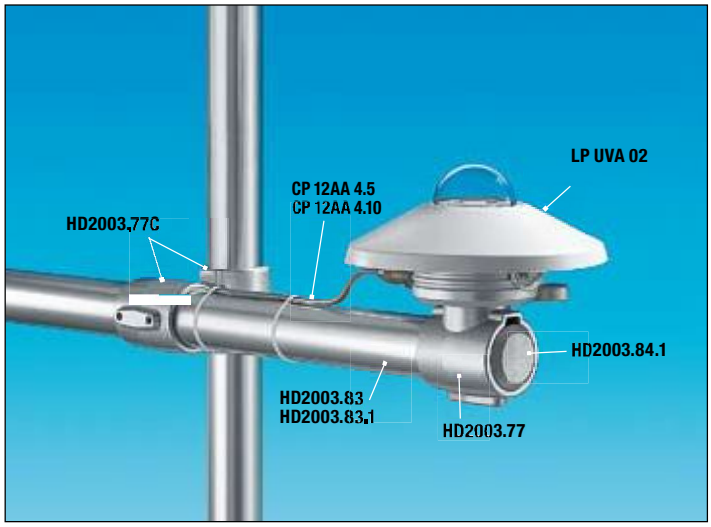
ORDERING CODES

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, flying 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…150W/m²)**, integrated transmitter amplifier, **power supply 10…30Vdc**. Complete with flying 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…150W/m²)**, integrated transmitter amplifier, **power supply 10…30Vdc. (15..30Vdc for 0…10Vdc output).** Complete with flying 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 UVA 02

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 AA4.5: 4-pole UV resistant cable L=5 m. For the instruments LP UVA 02, LP UVA 02AC, LP UVA 02AV.

CPM12 AA4.10: 4-pole UV resistant cable L=10 m. For the instruments LP UVA 02, LP UVA 02AC, LP UVA 02AV.

Configurable amplifiers and converters

HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Two DIN module (35mm) for rail attachment. Minimum measuring range 2mV. **Configurable with HD 778 TCAL.**

HD978TR4: Configurable signal converter amplifier with 0÷10 (10÷0Vdc) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Two DIN module (35mm) for rail attachment. Minimum measuring range 2mV. **Configurable with HD 778 TCAL.**

HD978TR5: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Minimum measuring range 2mV. **Configurable with HD 778 TCAL. For wall mounting.**

HD978TR6: Configurable signal converter amplifier with 0÷10 (10÷0Vdc) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Minimum measuring range 2mV. **Configurable with HD 778 TCAL. For wall mounting.**

HD 778 TCAL: Power generator in the range –60mv…+60mV, **regulated by PC through RS232C serial port. DeltaLog-7** software to configure type K, J, T and N thermocouple transmitters and HD978TR3, HD978TR4, HD978TR5 and HD974TR6 converters.

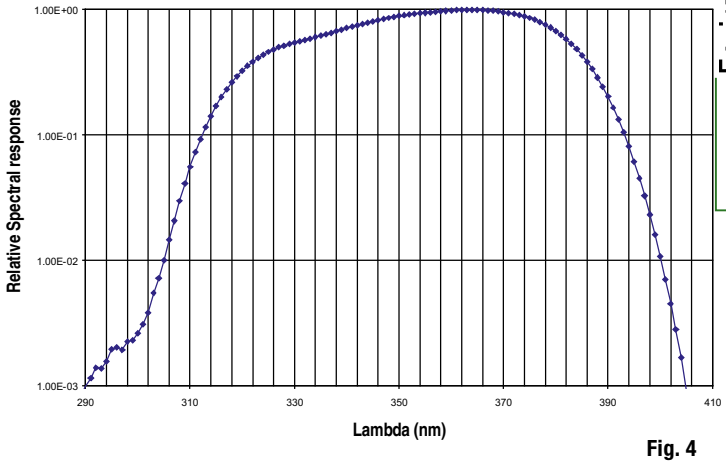


Fig. 4

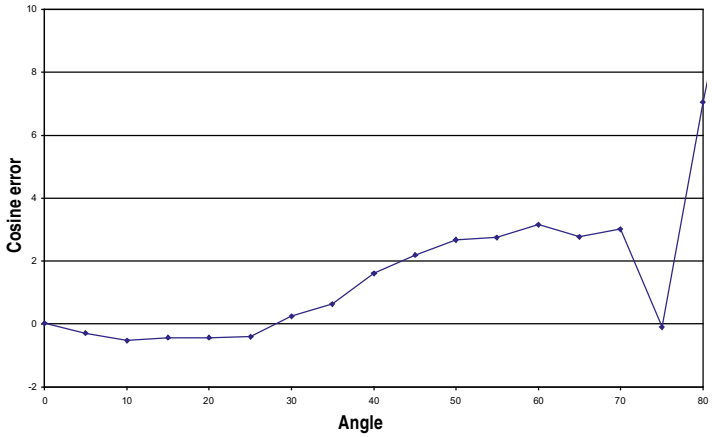


Fig. 5

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.

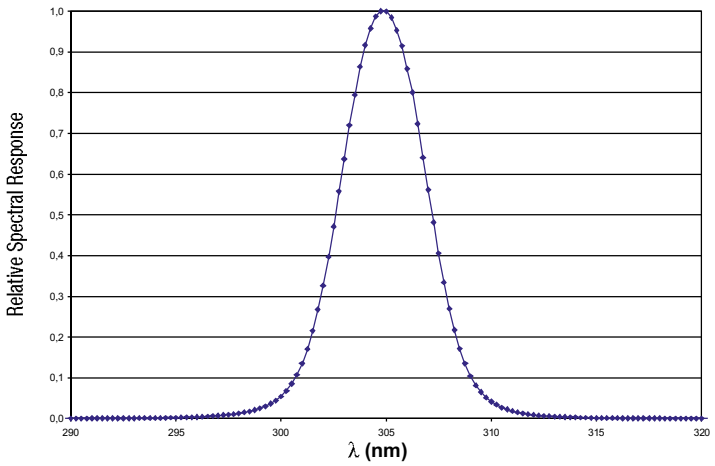


Fig. 1A

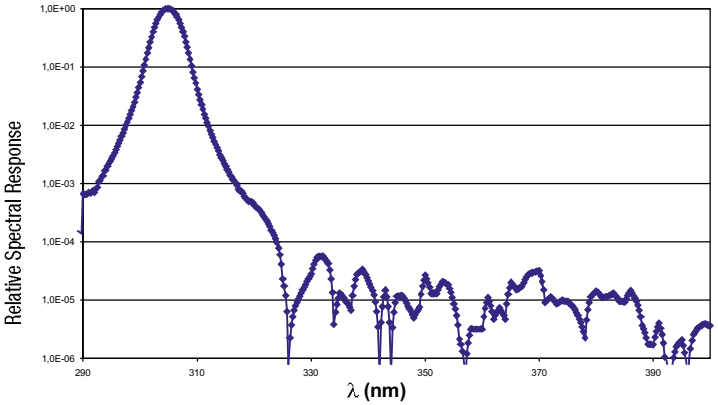


Fig. 1B

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).

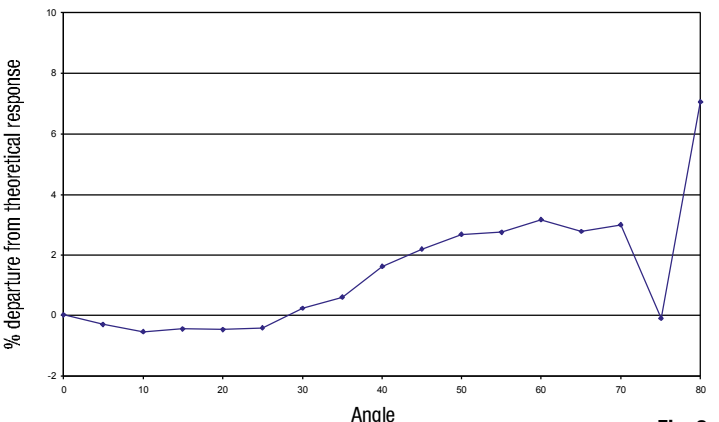


Fig. 2

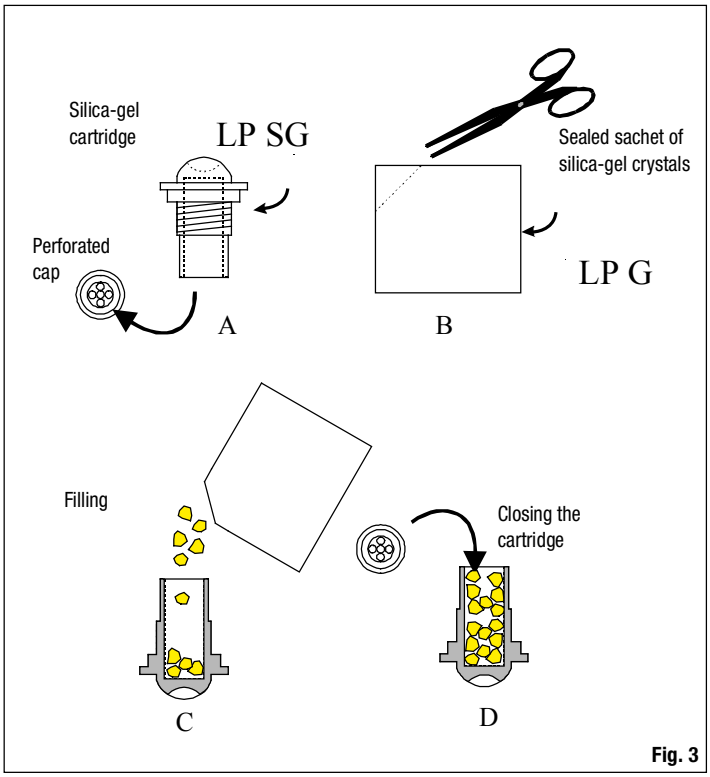


Fig. 3

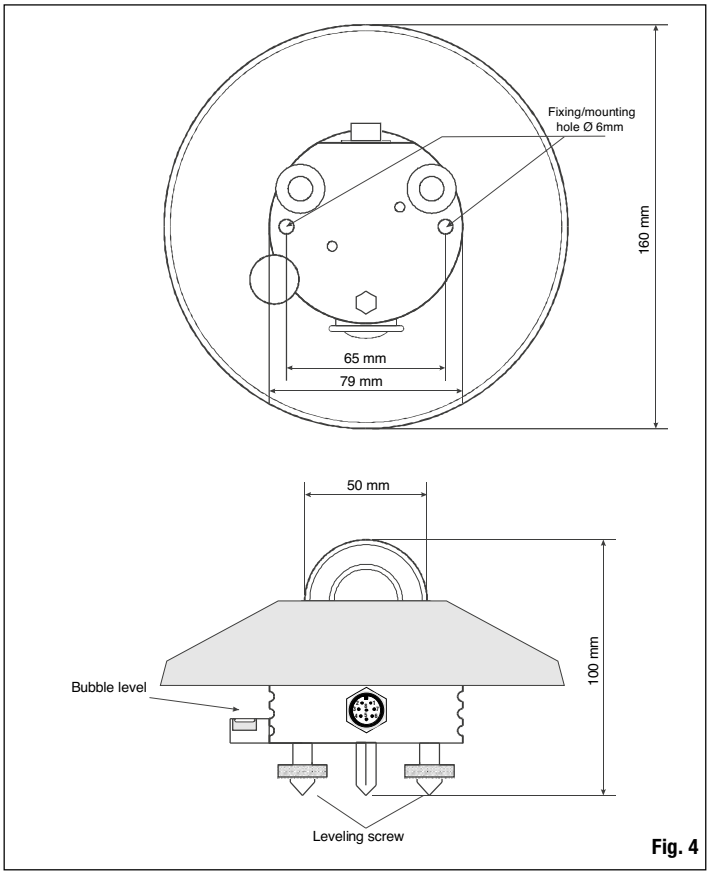


Fig. 4

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.

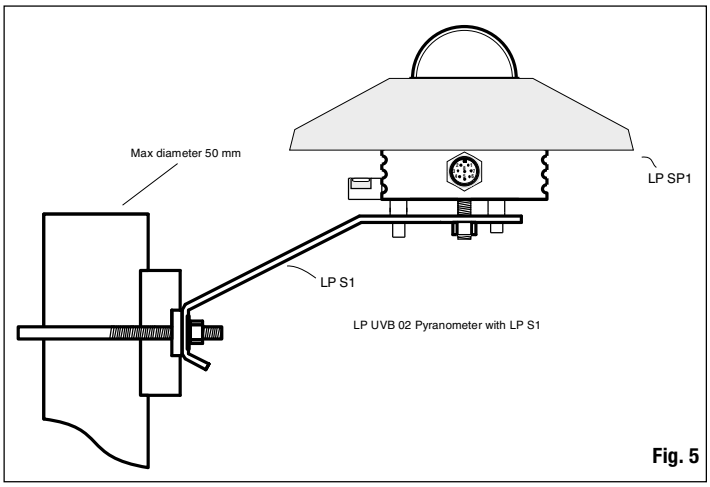


Fig. 5

Electrical Connections and Requirements for Electronic Readout Devices

The connections on the output connector are indicated below:

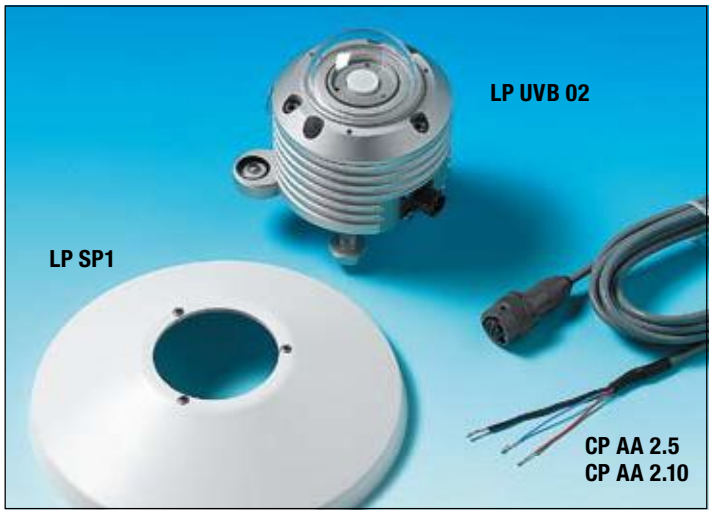
Pin8: V+, positive supply voltage for LP UVB 02 internal electronics. 7Vdc < V+ <30Vdc
Pin6: VoutTemp+, output signal for temperature measurement. 0V (-40°C) < Vout Temp+ < 1V (+60°C)
Pin2: Vout+, output signal for irradiance measurement in the UVB band. 0V < VoutUV+ < 4V.
Pin1: Ground of the two output 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.

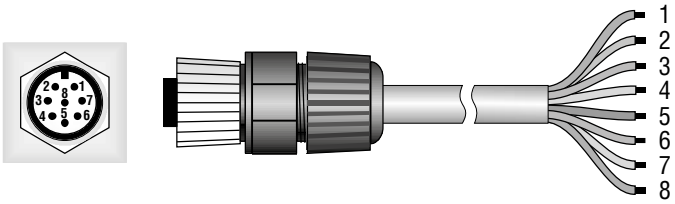
N.B. The input load resistance of the data acquisition system must be greater than 10KΩ. The connection scheme is shown in figure 6.

The cable supplied with the UV-resistant output connector 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 radiometer dome.



WIRING DIAGRAM LP UVB 02

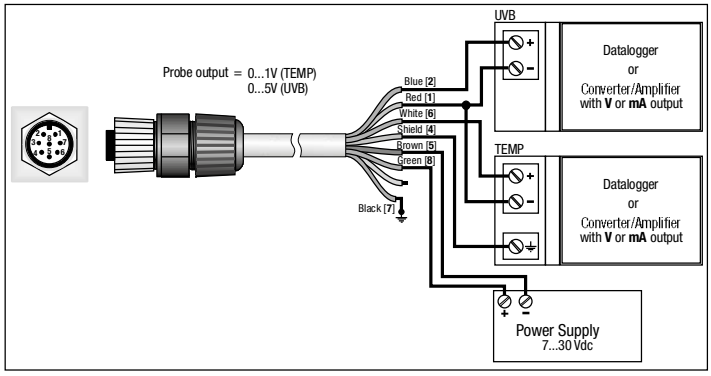


Fixed 8-pole plug M12 **Flying 8-pole M12 socket**

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



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/m²)
Response time:	<0.5 sec (95%)
Min. load impedance:	10 KΩ
Measurement range:	0-8 W/m²
Viewing range:	2π sr
Spectral range:	305nm Peak 302.5nm ÷ 307.5 nm (1/2) 304nm ÷ 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, flying M12 8-pole 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 AA2.5: 8-pole UV resistant cable L=5 m.
CPM12 AA2.10: 8-pole UV resistant cable L=10 m.

HD 2003
HD 2003.1

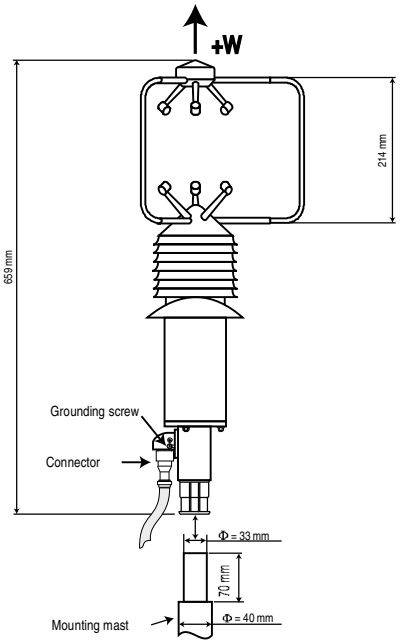
HD 2003, HD 2003.1
THREE AXIS ULTRASONIC ANEMOMETER

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.

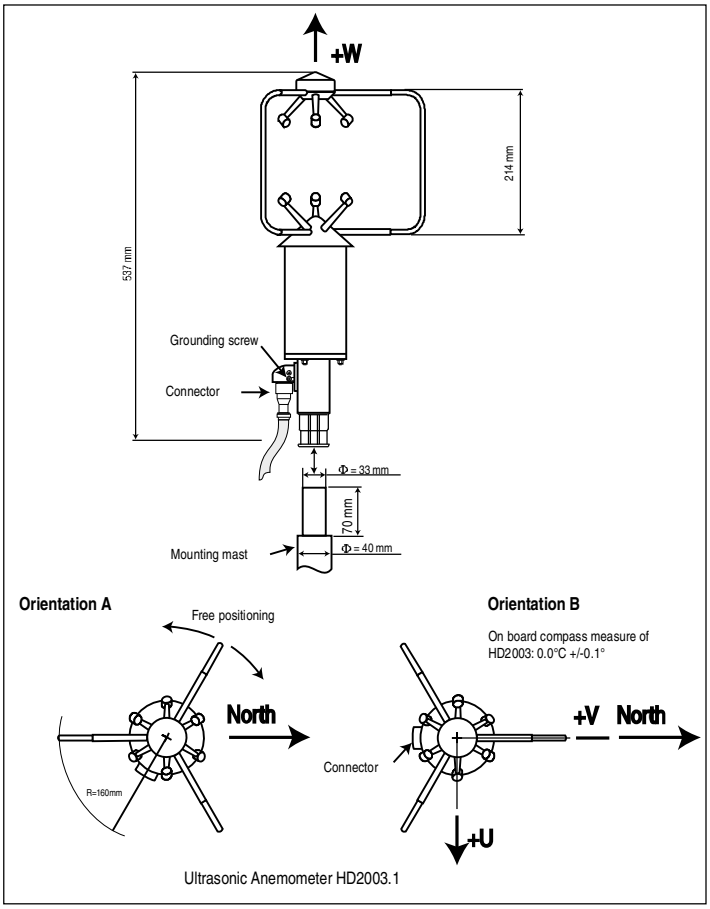
The HD2003 main features are:
- Determination of the anemometric quantities represented in diverse measurement units: wind speed and direction, U-V-W Cartesian components of speed, sound speed, sonic temperature.
- **(HD2003 Model)** additional output quantities: Temperature, Relative Humidity and Pressure.
- 5 analogue voltage or current outputs, with different measuring ranges.
- RS232 and Multidrop RS485 Serial Communication interfaces.
- 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.
- 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.

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

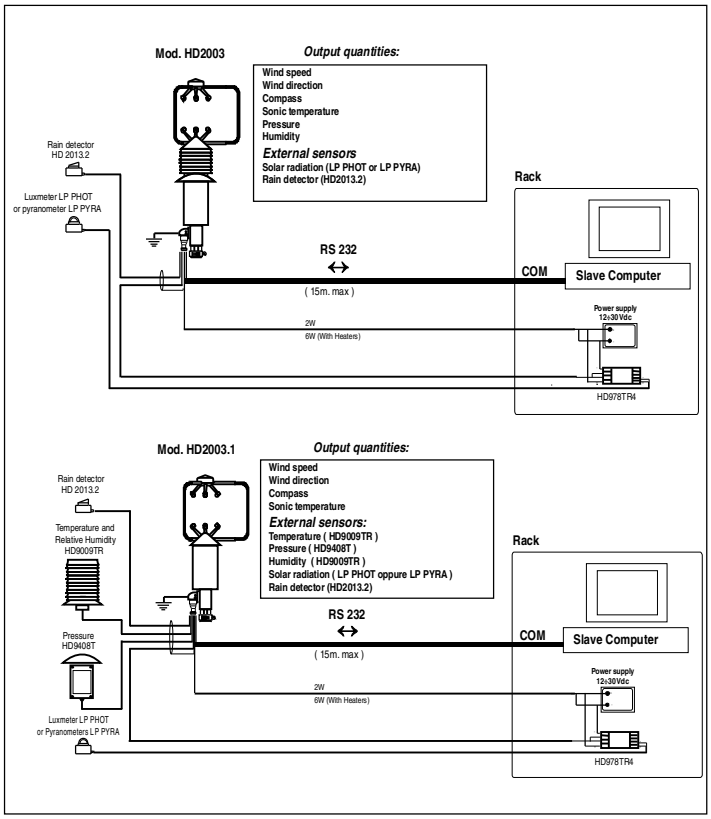
Technical specifications
Output quantities
- Anemometric parameters: Wind speed and direction, Sound Speed, Sonic Temperature, U-V-W Components
- Meteorological parameters: **(Model HD2003)** Pressure, Temperature, Relative Humidity
- Heading: Compass with magnetic Azimuth
- Moving Averages: 1÷60 sec./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

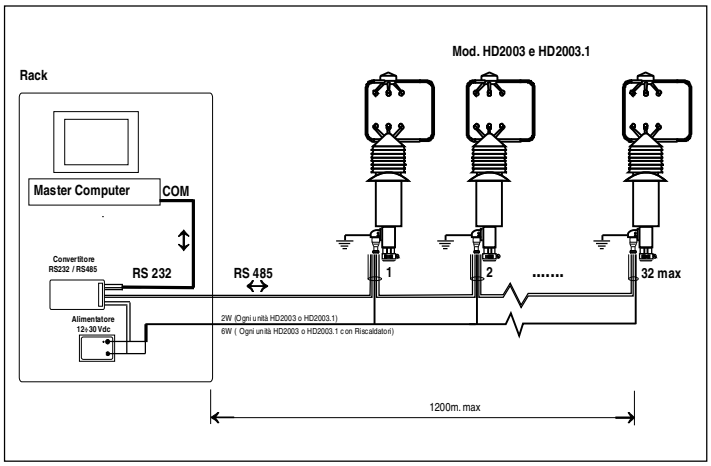


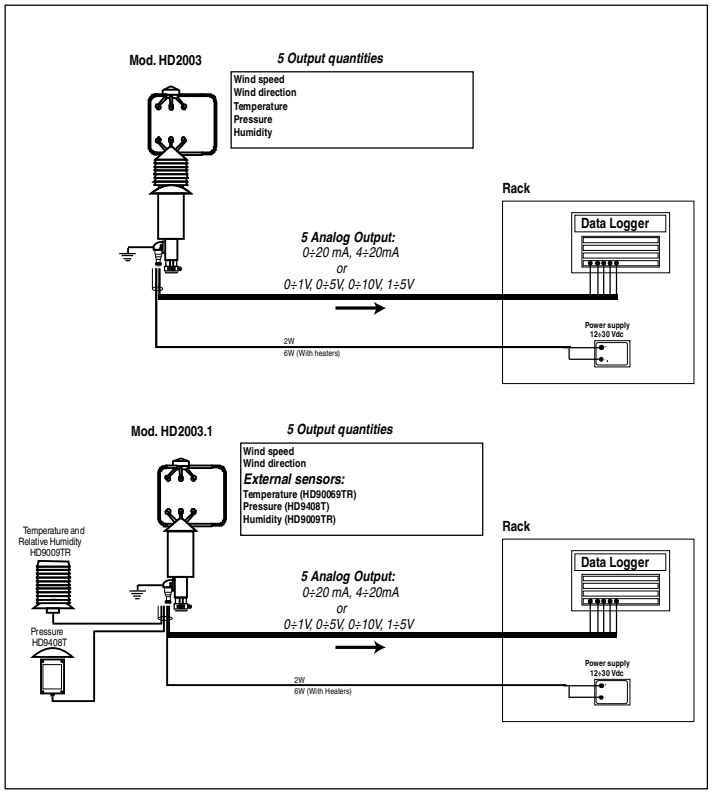
Ultrasonic Anemometer HD2003



Ultrasonic Anemometer HD2003.1







Wind Speed

• Measuring unit	m/s, cm/s, km/h, knots, mph
• Range	0÷65 m/s (234 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°
• Resolution	0.1 °
• Accuracy	± 1°

Digital Outputs

• Communications	RS-232 full duplex, Multidrop RS-485 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

Power supply

• Range	12 ÷ 30 VDC
• Power	<2W (typically 110mA @ 15Vdc) <6W Models with heaters and environment temperature not lower than ñ10°C

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

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
Range: -40 + 60°C
Resolution 0.1°C
Accuracy ± 0.2°C, ± 0.15°C of reading

Relative Humidity
Capacitive sensor
Analog output (0 ÷ 100% RH): 0÷20mA, 4÷20mA, 0÷1V, 0÷5V, 1÷5V, 0÷10V
Range: 0 ÷ 100% RH
Resolution 0.1 % RH
Accuracy ± 2% RH @ 23°C un 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
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 RS-232 and RS-485. 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 RS-232 and RS-485. 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.

HD200.1R: 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

HD2003.77: Clamping for mast ∅ 40mm

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

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

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

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

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

HD2003.75: Flange for ∅ 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 ∅ 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 ∅ 40mm (HD2003.77 – HD2003.79)

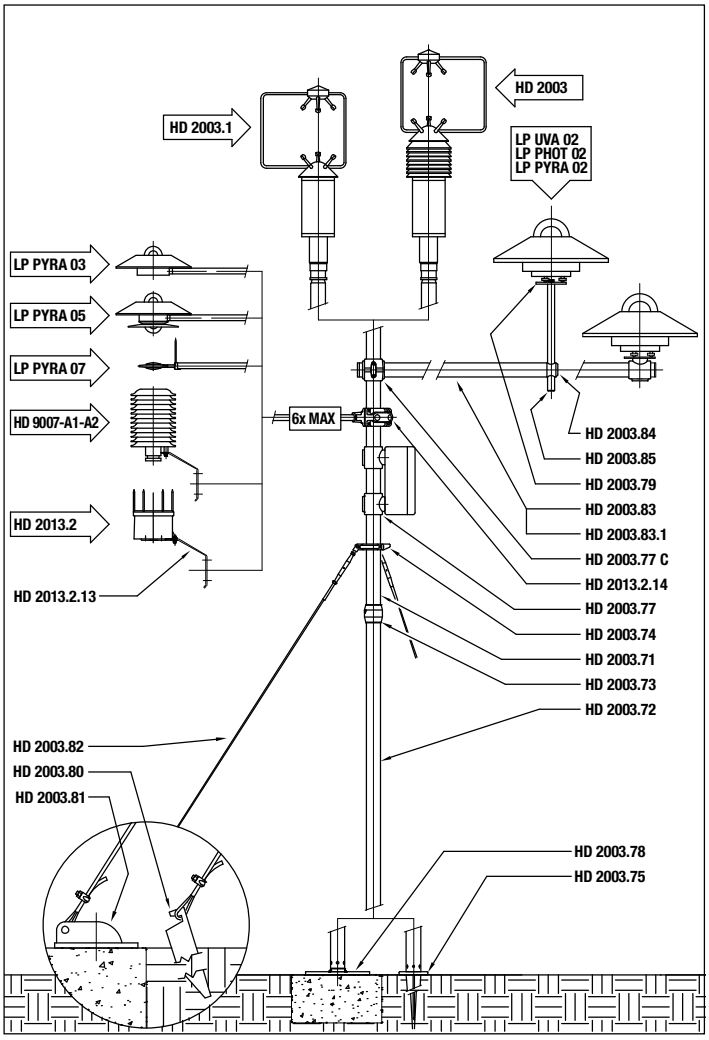
HD2003.83: Transverse mast L=150 cm

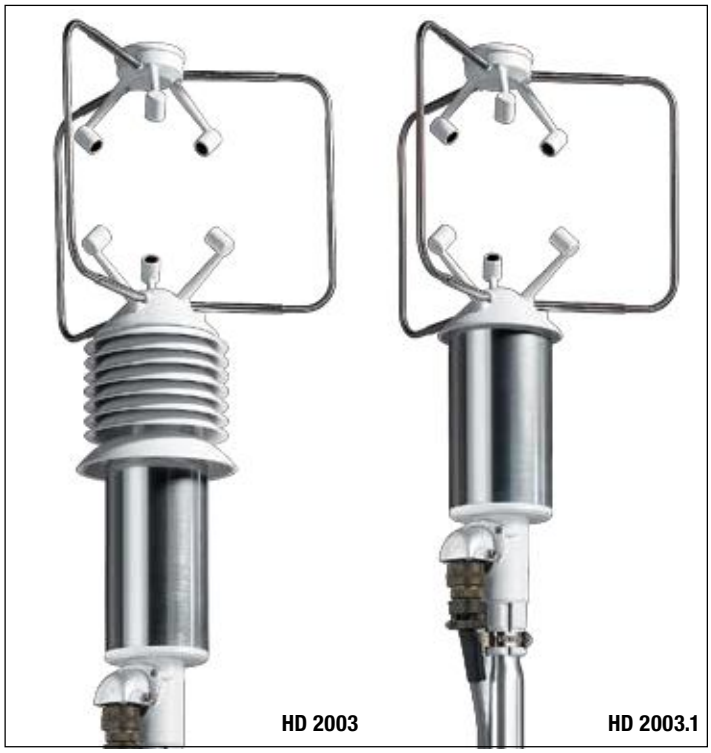
HD2003.83.1: Transverse mast L=75 cm

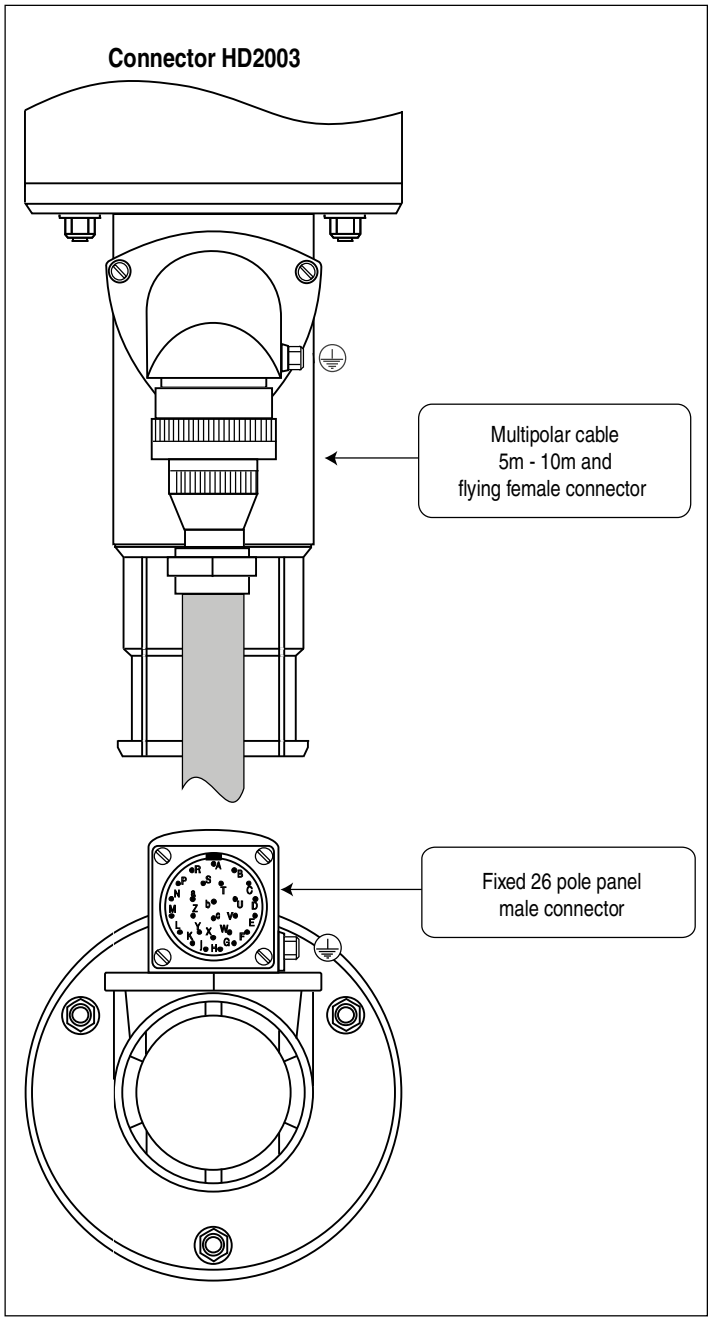
HD2003.85K: Fixing kit with adjustable height to mount pyranometers on ∅ 40mm mast (HD2003.84 – HD2003.85 – HD2003.79)

Please specify also the following:

- **Model HD2003**: optional range of pressure sensor 600 ÷ 1100 mbar (Factory Default = 800 ÷ 1100 mbar)
- **Model HD2003**: if you need to employ additional output quantities, by external sensors with **analog output 0÷1V**. 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 you need to employ additional external sensors with **analog output 0÷1V**. 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.







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 post having a diameter from 30 to 50mm; the post 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. Clean the sensor regularly with a cotton flock soaked in distilled water; in case of ingrained dirt, mild cleansers can be used in moderation.
The sensor is fragile, as it is placed on an alumina rest, thus handle it with care!

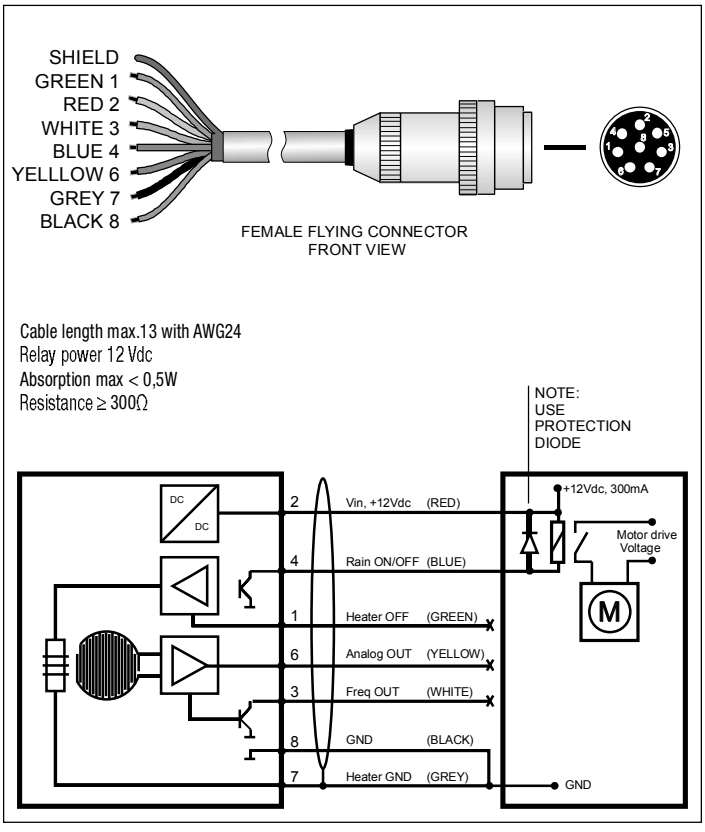


Fig. 1

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

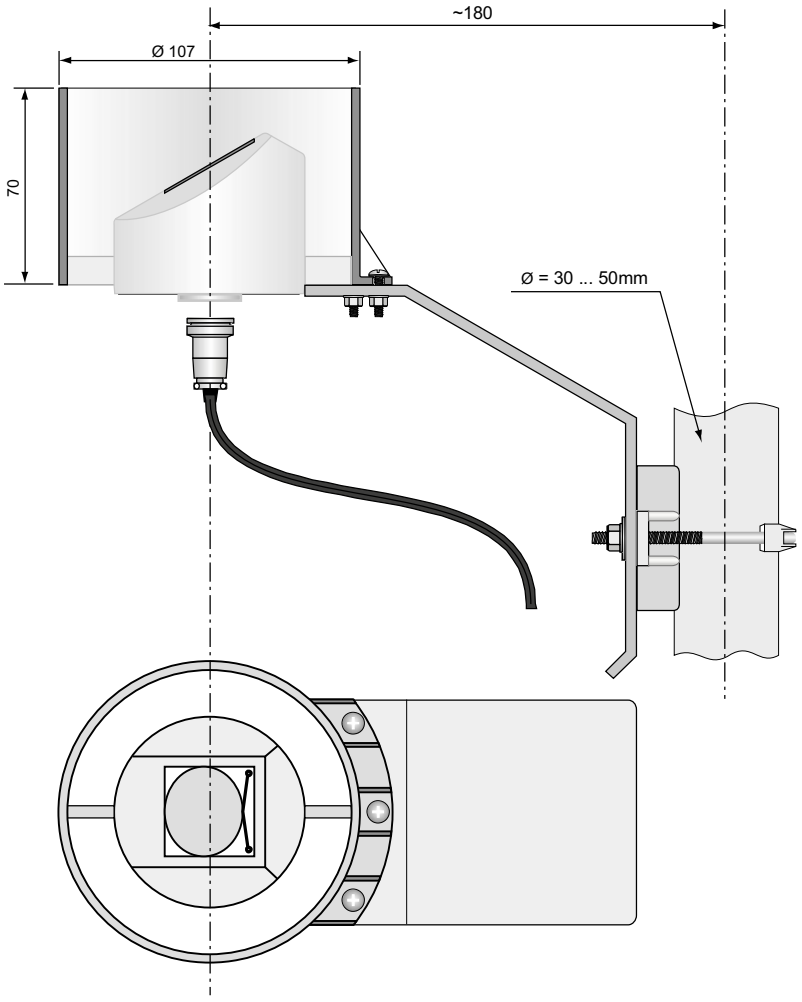
		Pin	
Power supply (+)	Red	2	+12 Vdc
Rain ON/OFF	Blue	4	Rain ON/OFF
Heater OFF	Green	1	Heather OFF
Analogue Output	Yellow	6	Analogue Output
Frequency Output	White	3	Frequency Output
Electronics Earth	Black	8	GND
Heater Earth	Grey	7	GND Heather

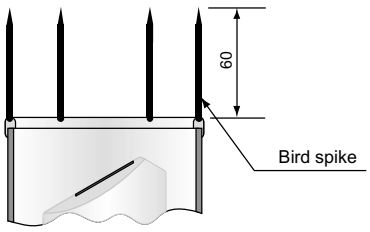
Ordering Codes

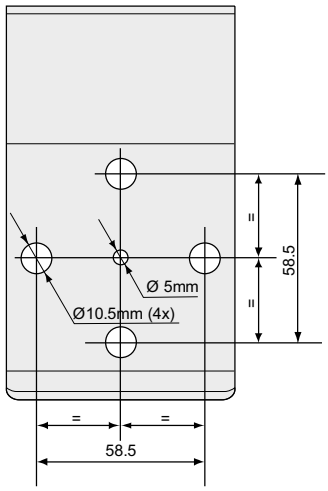
HD2013.2: Rain detector equipped with mounting bracket. 8-pole connector output according to IEC 60130-9 **IP68**. Complete with flying female connector. **Connection cable has to be ordered separately**.

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 HD2013-D** DeltaOhm or by a pulse counter.

View of tipping bucket

Electrical connection

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 teflon® paint.

The HD2013R, the version with a heater, operates using either 12Vdc or 24Vdc voltage and uses about 35W. 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.

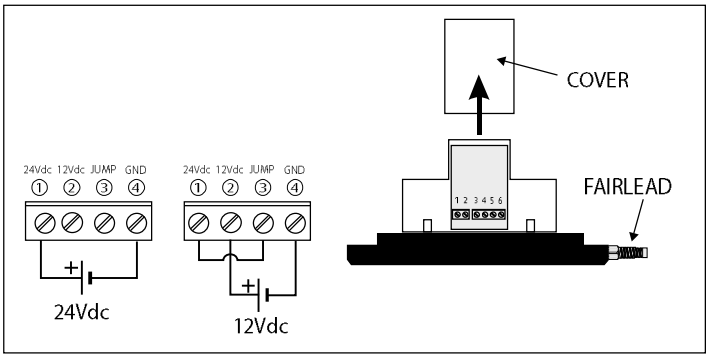


Fig. 1 Electric connection.

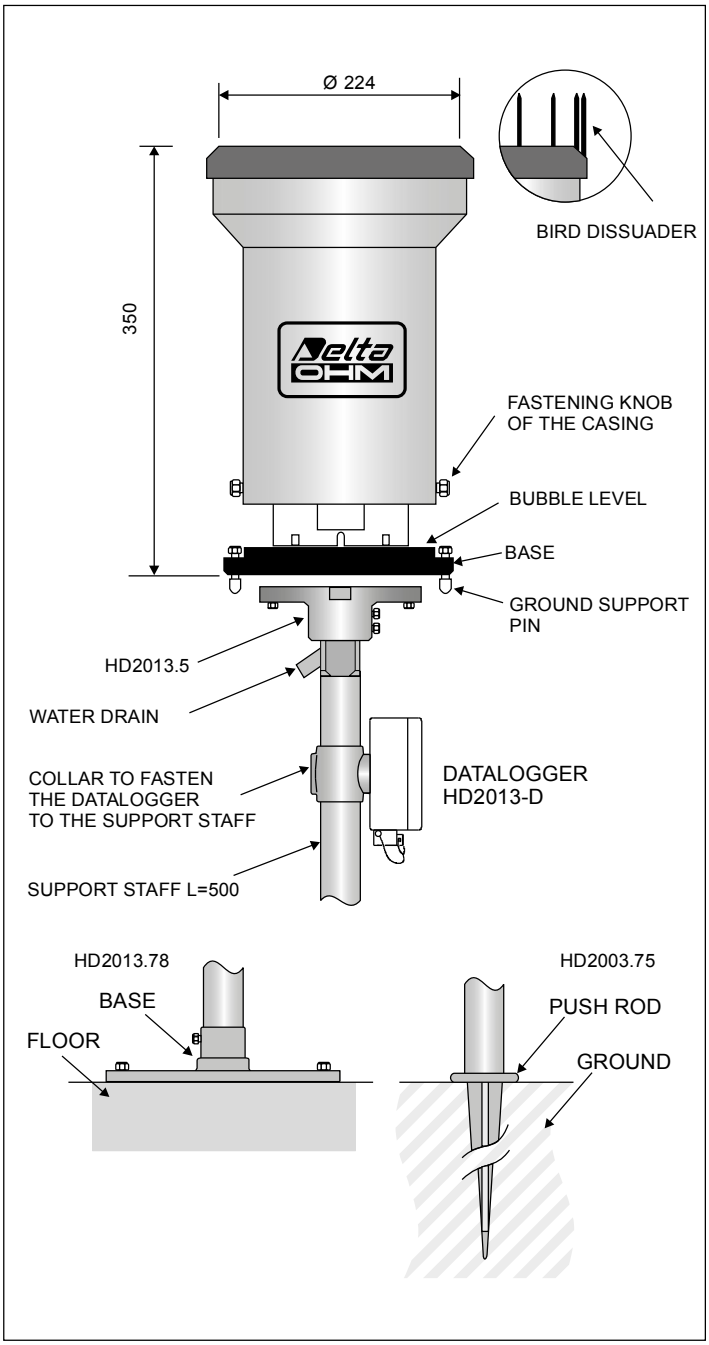


Fig. 2 Mechanical dimensions, and floor or ground fastening system.

INSTALLATION AND MAINTENANCE

Upon request the rain gauge can be supplied ready calibrated at 0.1 - 0.2 or 0.5 mm of rain per commutation of the bucket: 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 500 mm above the ground. Other sizes above the ground are available on request.

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.

Electric connection

For the version without heater use a two-wired lead, for the version with heater use a four-wired lead. Slide the cable through the fairlead and fasten it with the cable-holder located near the entry hole at the base of the rain gauge.

The correct configuration of the connections is illustrated in figure 1. **The rain gauge output, available on terminals 5 and 6, must be connected to the rain gauge datalogger HD2013-D input** (please see the details in the instrument's description) **or to a pulse counter or to a datalogger**.

The heated version requires power for the resistors: the mode of connection depends on the level of power used (12Vdc or 24Vdc) and must be made in the manner reported in fig. 1.

The 24Vdc power must be connected between terminals 1 (+) and 4 (-), while for 12Vdc power use terminals 2 (+) and 4 (-) with a jumper between the terminals 1 and 3. If the connection are set correctly, a led placed near the terminals will be lit up.

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% / 35W	---
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	± 2% between 20÷300 mm/h	
Operating temperature range	-20°C ... +60°C	+4°C … +60°C
Heater intervention temperature	+4°C	---
Protection degree	IP67	
Collector area	400 cm²	

ORDER CODES

HD2013: Rain gauge with tipping bucket, area 400 cm², for temperatures from +4°C to +60°C; resolution on request, at the time of placing the order 0.1 - 0.2 or 0.5 mm. Output contact normally closed.

HD2013R: Rain gauge with tipping bucket, area 400 cm², for temperatures from -25 to +60°C; resolution on request, at the time of placing the order 0.1 - 0.2 or 0.5 mm. Output contact normally closed. Power voltage 12Vdc or 24Vdc ±10% / absorption 35W.

HD2013.18: Bird dissuader.

HD2013.5K: Accessory kit for installation of the 500 mm raised from ground rain gauge, formed by a support plate for the staff, support staff L=500 mm, fastening screws.

HD2013.75: Base with tip for the ground to support the raised from ground rain gauge (to add to the Accessory kit HD2013.5K).

HD2013.78: Level base for fastening the raised from ground rain gauge (to add to the Accessory kit HD2013.5K).

HD2013.77/40: Flange to fasten the datalogger to the support staff.

Tip for ground for rain gauge raised from ground

Support plate for rain gauge raised from ground

Rain gauge installed on the ground.

Rain gauge with bird dissuader.

Bubble level

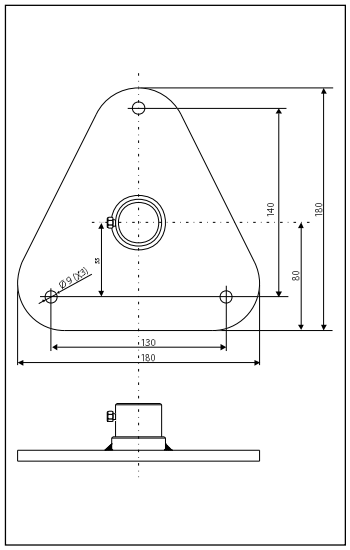


Fig. 3 Base for ground fastening HD2013.78

HD 2013-D
DATALOGGER TO MEASURE RAINFALL

HD2013-D is a datalogger that has been specifically developed to capture and memorize weather and atmospheric precipitation trends. Together with the capacious memory, its long life Lithium battery guarantees remarkable recording capacity without it being necessary for the user to intervene. The large display not only provides the total and partial precipitations in real time, in both millimetres and inches, but also the environment temperature. It is supplied with **DeltaLog6** dedicated software, using which all the instrument's parameters can be set. It is connected to the PC **through an RS232C serial port** using the cable supplied. HD2013-D can be connected to the most popular types of rain gauges using NC or NO output contact.
For software installation and running, please refer to the documentation on the instrument's accompanying CD-ROM.

Important note: in order to make the instrument completely waterproof, buttons have not been used but reed relays were chosen instead. These can be operated with a magnet. The magnet is fixed to the end of a small aluminium handle, and this is connected to the case. After use the magnet, must be put away and stored in its housing.
On the instrument front there are two areas indicated in red corresponding to **"Clear/Up"** and **"Select/Set"**: the magnet should be placed on these areas to perform the instrument programming operations. Placing the magnet for some time on the red zone and then subsequently withdrawing it is the equivalent of activating a button. For the sake of simplicity, in the instrument description which follows, this operation will be called: **"activation of the Clear/Up button", "activation of the Select/Set button".**

Installation and connections
The HD2013-D case has an IP67 degree of protection. The two function keys that allow the instrument to be controlled are formed of reed contacts operated externally by using a magnet supplied with the instrument.
In the lower part of the case there are two connectors for the rain gauge (three-pole male connector in the centre of the case) and the PC's RS232C serial port (five-pole male connector on the right). At the bottom of the case there are two holes so that the instrument can be fastened to a wall. As raised rain gauge it can be fasten to the support staff through the base HD2003.77.

Operation
The datalogger counts and memorizes the emptying of the rain gauge's small bucket through a magnet activating a reed relay on each emptying: each commutation corresponds to a quantity of rain equal to the rain gauge resolution. The following resolutions can be set using the DeltaLog6 software: from 0.050 to 1.599mm of rain. Furthermore, by using the software the type of reed contact closing can be selected. This depends on the type of rain gauge: it can either be normally closed (NC) or normally open (NO) In both cases an alarm display is set in case the small bucket, after its rotation, does not go back to the expected rest position according to the type of contact selected.
The datalogger stores the ambient temperature at a fixed interval of 15'.

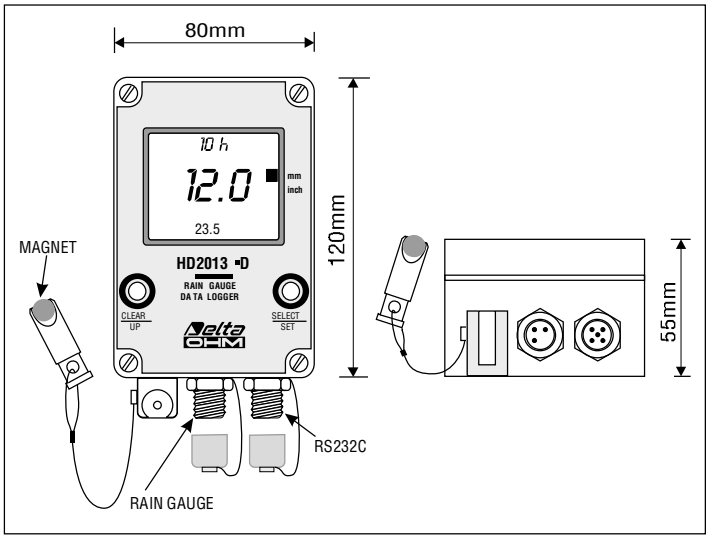


Fig. 4 General view and mechanical dimensions.

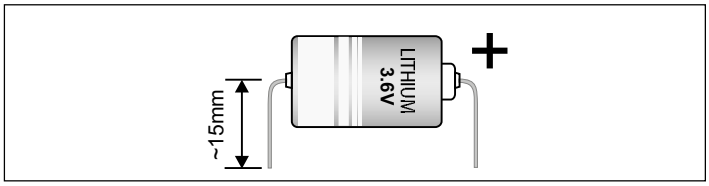


Fig. 5 3.6V Lithium battery

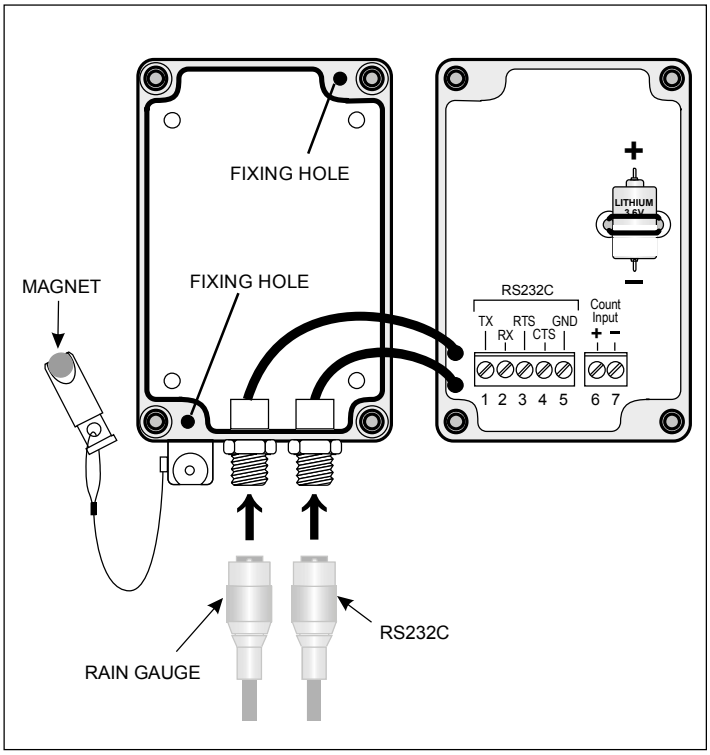


Fig. 6 Inside the instrument

Keyboard description

In normal operating conditions the HD2013-D display shows the hour and minutes on the top line, the precipitation quantity since last reset (partial precipitations), and the temperature detected by the sensor located inside the case.

By operating directly on the instrument buttons it is possible to:

- Display the total precipitation quantity since the last reset or since the last battery change
- Modify date and time
- Reset the partial rain quantity.

The functions performed by the two buttons are described:

Clear/UP BUTTON

The menu can be accessed by starting from the normal functioning mode and activating the button for **more than 3 seconds:** the words "ZERO CNT OR MENU" are then displayed.

At this point further action on the same button resets the partial counter (CLEAR function): the display returns to normal functioning mode displaying the complete day, month, year date and the partial count at zero once.

Should you be inside the parameters modification menu, the same button increases the current value.

Select/SET BUTTON

Select the menu parameter to be modified: the top line on the display shows the selected parameter while the middle line shows the current value. The parameter displayed can be increased by using the CLEAR/UP button; the new setting can be confirmed by using the SELECT/SET button.

On entering the menu (the words "ZERO CNT OR MENU" appear on the display), pressing the SELECT/SET button causes a circular routine to present the following parameters in this same order:

YEAR: modification of the year
MON: modification of the month
DAY: modification of the day
HOUR: modification of the hour
MIN: modification of the minutes
SEC: modification of the seconds
TOT: displays the total quantity of precipitation

On further activating the SELECT/SET button the normal functioning mode returns.

When one of the items is displayed by pressing the CLEAR/UP button its value can be increased.

To confirm the new setting press the SELECT/SET button.

The detailed description of the steps necessary for the modification of the minutes are outlined as an example below.

To enter the menu from the normal measurement condition press the CLEAR/UP button for three seconds. When the display shows "ZERO CNT OR MENU", press the SELECT/SET button five times until the current minutes are displayed (**YEAR >> MON >> DAY >> HOUR >> MIN**). Using the CLEAR/UP button means the displayed minutes can be increased up to the new value. This can be confirmed using the SELECT/SET button.

Device for data logger setting

Battery replacement

HD2013-D is powered by a 3.6V type ½AA Lithium battery with axial rheophores. The battery's charge status is constantly monitored and shown on the HD2013 display. When the symbol begins to blink it means the charge level is no longer sufficient to power the instrument and the battery needs replacing.

Proceed as follows:

1. Download the data and disconnect the instrument from the PC;
2. Unscrew the four screws on the front cover;
3. Release the battery from the ring fastening it to the printed circuit and take it out of its housing;
4. Cut the rheophores of the new battery to a length of about 15 mm.
5. Put the new battery in **making sure the polarity is correct as outlined in fig. 5**
6. Fasten it with the elastic ring and close the cover with the screws.

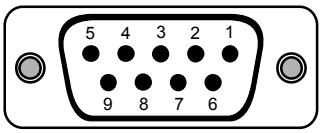
Connection to the PC

HD2013-D can be connected to a PC with a Windows operating system via serial cable or by using a cable connected directly to the instrument's internal terminal block (RS232); the temperature and rain data contained in the datalogger memory can be discharged by using the **DeltaLog6 software** and the data can be displayed in graphic or tabular form.

The connector located at the base of the instrument is used with the supplied serial cable.

The internal terminal block can only be used if a longer serial cable is ordered. Note that in this case the cable length cannot exceed 15 metres. The connection is outlined in the following table:

HD2013-D terminal block	Sub D 9-pole female serial connector
1 - TX	3
2 - TX	2
3 - RTS	7
4 - CTS	8
5 - GND	5



Technical characteristics

Power	Replaceable 3.6V type ½AA Lithium battery
Type of event recorded	NC or NO contact that the program is able to select. Ambient temperature at a fixed interval of 15'. An alarm is generated (it can be disabled) if the contact remains in an unstable condition for more than 3 seconds.
Resolution	From 0.050 to 1.599mm/sample
Storage capacity	93000 samples (equal to 18600mm of rain with a resolution of 0.2mm/sample) 2 years of temperature with a fixed interval of 15'
PC interface	Insulated RS232C serial port – 9600 baud
Display indications	Partial rain in millimetres or inches Total rain in millimetres or inches Environment temperature °C/°F
Operating temperature range	-20°C ... +60°C
Protection degree	IP67
Software supplied	DeltaLog6

ORDER CODES

HD2013-D: Rain gauge datalogger with LCD display; reads and records up to 93000 impulses, given each time the bucket is emtied. Visualizes and up-dates the internal temperature every minute and saves it every 15 minutes. Insulated RS232C serial output, DeltaLog6 software supplied. 3.6V Lithium battery power. IP67 protection degree

CP2013.2P: One meter 3-pole cable to connect the rain gauge to the HD2013-D fixed to the support staff.

CP2013/RS232: 5-pole cable / RS232C to download data from datalogger to PC.

HD2013.77/40: Flange to fasten the datalogger to the support staff.