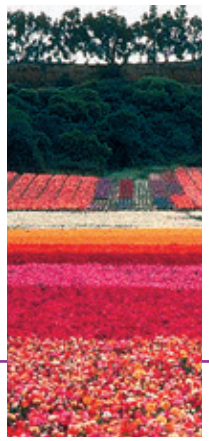


Light

HD 2102.1
HD 2102.2

HD2102.1 AND HD2102.2 PHOTO-RADIOMETERS

The **HD2102.1 and HD2102.2** are portable instruments with a large LCD display. They measure **illuminance, luminance, par and irradiance** (across VIS-NIR, UVA, UVB and UVC spectral regions or measurement of irradiance effective according to the UV action curve).
The probes are equipped with the SICRAM automatic detection module: in addition to detection, this unit of measurement selection is also automatic. The factory calibration data are already stored inside the instruments. In addition to instantaneous measurement the instruments calculate the acquired measurements time integral Q(t). Some thresholds can be associated with the integrated measurement and with the integration time, which can be set in the menu. When exceeded these thresholds cause the instrument to stop the integral calculation. The HD2102.2 instrument is a **datalogger**. It stores up to 38,000 samples with a one-channel probe and up to 14,000 samples with combined probes. These data can be transferred from the instrument to a PC via the connection of the multi-standard RS232C serial port and USB 2.0. Storing interval, printing and baud rate can be configured by using the menu.
The HD2102.1 and HD2102.2 models are equipped with an RS232C serial port and can transfer the acquired measurements in real time to a PC or to a portable printer. The Max, Min and Avg functions calculate the maximum, minimum or average values. Other functions include: the relative measurement REL, the HOLD function, and the automatic turning off that can also be excluded. **The instruments have IP66 protection degree.**

HD40.1

SWD10

INSTRUMENT TECHNICAL CHARACTERISTICS

Instrument

Dimensions (Length x Width x Height)	185x90x40mm
Weight	470g (complete with batteries)
Materials	ABS, rubber
Display	2x4½ digits plus symbols - 52x42mm Visible area: 52x42mm

Operating conditions

Operating temperature	-5…50°C
Storage temperature	-25…65°C
Working relative humidity	0…90%RH without condensation
Protection degree	**IP66**

Power

Batteries	4 1.5V type AA batteries
Autonomy	200 hours with 1800mAh alkaline batteries
Power absorbed with instrument off	20µA
Mains	Output mains adapter 12Vdc / 1000mA

Measuring unit	lux - fcd - lux·s - fcd·s - W/m² - µW/cm² J/m² - µJ/cm² - µmol/(m² s) - µmol/m² - cd/m² µW/lumen
Security of memorized data	Unlimited, independent of battery charge conditions

Time

Date and time	in real time
Accuracy	1min/month max drift

Measured values storage - model HD2102.2

Type (for single probes)	2000 pages containing 19 samples each
Type (for combined probes)	2000 pages containing 7 samples each
Quantity (for single probes)	total of 38000 samples
Quantity (for combined probes)	total of 14000 samples
Selectable storage interval	1s, 5s, 10s, 15s, 30s, 1min, 2min, 5min, 10min, 15min, 20min, 30min, 1 hour

Serial interface RS232C

Type	RS232C electrically isolated
Baud rate	Can be set from 1200 to 38400 baud
Data bit	8
Parity	None
Stop bit	1
Flow Control	Xon/Xoff
Serial cable length	Max 15m
Selectable printing interval	Immediate or 1s, 5s, 10s, 15s, 30s, 1min, 2min, 5min, 10min, 15min, 20min, 30min, 1 hour

USB interface - model HD2102.2

Type	1.1 - 2.0 electrically isolated

Connections

Input module for the probes	8-pole male DIN45326 connector
RS232 serial interface	8-pole MiniDin connector
USB serial interface	B-type MiniUSB connector
Mains adapter	2-pole connector (positive at centre)

Technical characteristics of photometric and radiometric probes equipped with SICRAM module for the connection to the instrument

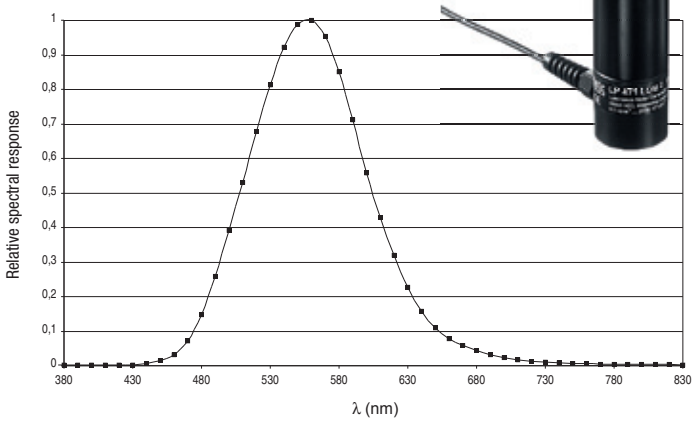
LP 471 PHOT probe for the measure of ILLUMINANCE				
Measuring range (lux):	0.10…199.99	…1999.9	…19999	…199.99·10³
Resolution (lux):	0.01	0.1	1	0.01·10³
Spectral range:	in agreement with standard photopic curve V(λ)			
Class	B			
Calibration uncertainty:	<4%			
f'_1 (in agreement with photopic response V(λ)):	<6%			
f_2 (response according to the cosine law):	<3%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	<0.5%			
f_5 (fatigue):	<0.5%			
α (temp. coefficient) f_6 (T)	<0.05%K			
Drift after 1 year:	<1%			
Working temperature:	0…50°C			
Reference Standards	CIE n.69 - UNI 11142			

Photometric probe for **ILLUMINANCE** measurement, spectral response in agreement with standard photopic vision, diffuser for cosine correction. Measurement range: 0.10 lux…200·10³ lux.

LP 471 LUM 2 probe for the measure of LUMINANCE				
Measuring range (cd/m²):	1.0…1999.9	…19999	…199.99·10³	…1999.9·10³
Resolution (cd/m²):	0.1	1	0.01·10³	0.1·10³
Optical angle:	2°			
Spectral range:	in agreement with standard photopic curve V(λ)			
Class	C			
Calibration uncertainty:	<5%			
f'₁ (in agreement with photopic response V(λ)):	<8%			
f₃ (linearity):	<1%			
f₄ (instrument reading error):	<0.5%			
f₅ (fatigue):	<0.5%			
α (temp. coefficient) f₆ (T)	<0.05%K			
Drift after 1 year:	<1%			
Working temperature:	0…50°C			
Reference Standards	CIE n.69 - UNI 11142			

Photometric probe for **LUMINANCE** measurement, spectral response in agreement with standard photopic vision, vision angle 2°.
Measurement range: 1.0 cd/m²…2000·10³ cd/m².

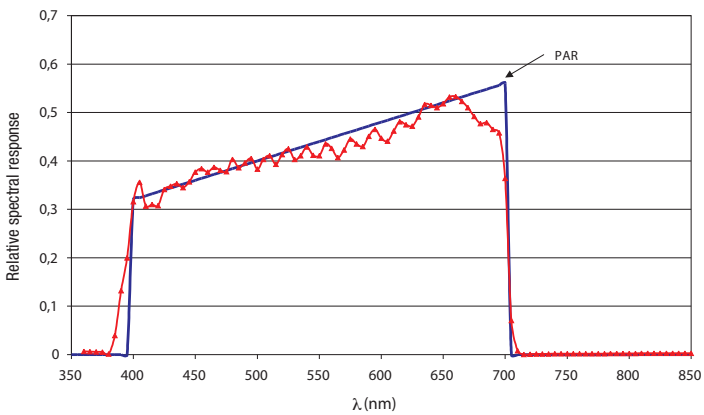
Typical response curve: LP 471 PHOT and LP 471 LUM2



LP 471 PAR quantum radiometric probe for the measure of the photon flow across the chlorophyll range PAR			
Measuring range (μmol·m⁻²s⁻¹):	0.10…199.99	200.0…1999.9	2000…10000
Resolution (μmol·m⁻²s⁻¹):	0.01	0.1	1
Spectral range:	400nm…700nm		
Calibration uncertainty:	<5%		
f₂ (response according to the cosine law):	<6%		
f₃ (linearity):	<1%		
f₄ (instrument reading error):	±1digit		
f₅ (fatigue):	<0.5%		
Drift after 1 year:	<1%		
Working temperature:	0…50°C		

Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range **PAR** (Photosynthetically Active Radiation 400nm…700nm), measurement in μmol/m²s.
Measurement range: 0.10 μmol·m⁻²s⁻¹…10·10³ μmol·m⁻²s⁻¹.

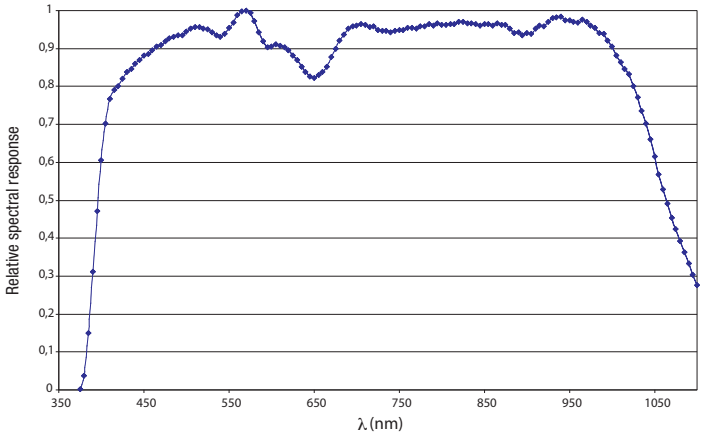
Typical response curve: LP 471 PAR



LP 471 RAD probe for the measure of IRRADIANCE				
Measuring range (W/m²):	1.0·10⁻³ …999.9·10⁻³	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution (W/m²):	0.1·10⁻³	0.001	0.01	0.1
Spectral range:	400nm…1050nm			
Calibration uncertainty:	<5%			
f₂ (response according to the cosine law):	<6%			
f₃ (linearity):	<1%			
f₄ (instrument reading error):	±1digit			
f₅ (fatigue):	<0.5%			
Drift after 1 year:	<1%			
Working temperature:	0…50°C			

Radiometric probe for **IRRADIANCE** measurement in the spectral range 400nm…1050nm, diffuser for cosine correction.
Measurement range: 1.0·10⁻³W/m²…2000W/m².

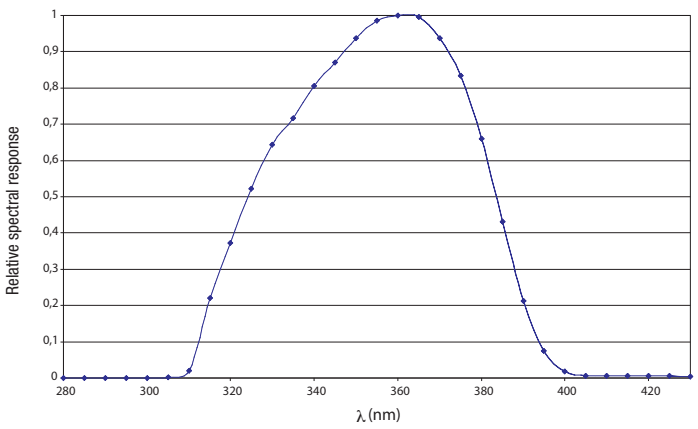
Typical response curve: LP 471 RAD



LP 471 UVA probe for the measure of UVA IRRADIANCE				
Measuring range (W/m²):	1.0·10⁻³ …999.9·10⁻³	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution (W/m²):	0.1·10⁻³	0.001	0.01	0.1
Spectral range:	315nm…400nm (**Peak 360nm**)			
Calibration uncertainty:	<5%			
f₃ (linearity):	<1%			
f₄ (instrument reading error):	±1digit			
f₅ (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			

Radiometric probe for **IRRADIANCE** measurement, in the 315nm…400nm, peak 360nm, **UVA** spectral range.
Measurement range: 1.0·10⁻³W/m²…2000W/m².

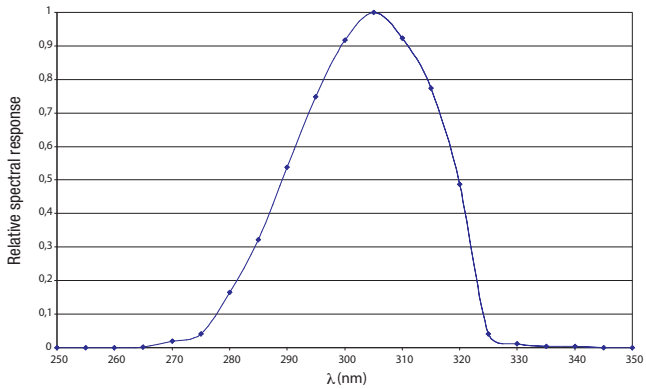
Typical response curve: LP 471 UVA



LP 471 UVB probe for the measure of UVB IRRADIANCE				
Measuring range (W/m²):	$1.0 \cdot 10^{-3}$ …$999.9 \cdot 10^{-3}$	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution (W/m²):	$0.1 \cdot 10^{-3}$	0.001	0.01	0.1
Spectral range:	280nm…315nm (Peak 305nm...310nm)			
Calibration uncertainty:	<5%			
f_3 (linearity):	<2%			
f_4 (instrument reading error):	±1digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			

Radiometric probe for **IRRADIANCE** measurement,
in the spectral range 280nm…315nm, peak 305nm ... 310nm,
Measurement range: $1.0 \cdot 10^{-3}$W/m²…2000W/m².

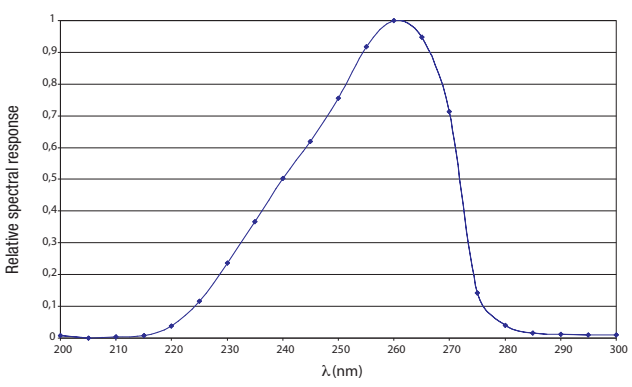
Typical response curve: LP 471 UVB



LP 471 UVC probe for the measure of UVC IRRADIANCE				
Measuring range (W/m²):	$1.0 \cdot 10^{-3}$ …$999.9 \cdot 10^{-3}$	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution (W/m²):	$0.1 \cdot 10^{-3}$	0.001	0.01	0.1
Spectral range:	220nm…280nm (**Peak 260nm**)			
Calibration uncertainty:	<5%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	±1digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			

Radiometric probe for **IRRADIANCE** measurement,
in the spectral range 220nm…280nm, peak 260nm,
UVC. Measurement range: $1.0 \cdot 10^{-3}$W/m²…2000W/m².

Typical response curve: LP 471 UVC



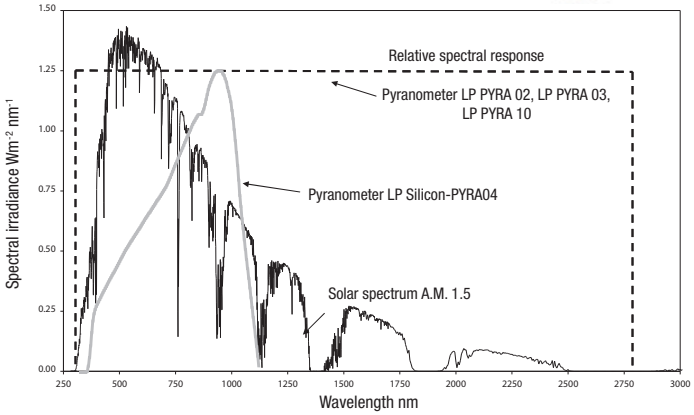
Combined probe LP 471 P-A with two sensors for the measure of ILLUMINANCE and UVA IRRADIANCE				
Illuminance				
Measuring range (lux):	0.10…199.9	…1999.9	…19999	…$199.99 \cdot 10^3$
Resolution (lux):	0.01	0.1	1	$0.01 \cdot 10^3$
Spectral range:	in agreement with standard photopic curve V(λ)			
α (temp. coefficient) f_6 (T)	<0.05%K			
Calibration uncertainty:	<4%			
f'_1 (in agreement with photopic response V(λ)):	<6%			
f_2 (response according to the cosine law):	<3%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	<0.5%			
f_5 (fatigue):	<0.5%			
Class:	B			
Drift after 1 year:	<1%			
Working temperature:	0…50°C			
Reference Standards	CIE n.69 - UNI 11142			

Please refer to the spectral response of the LP471PHOT probe

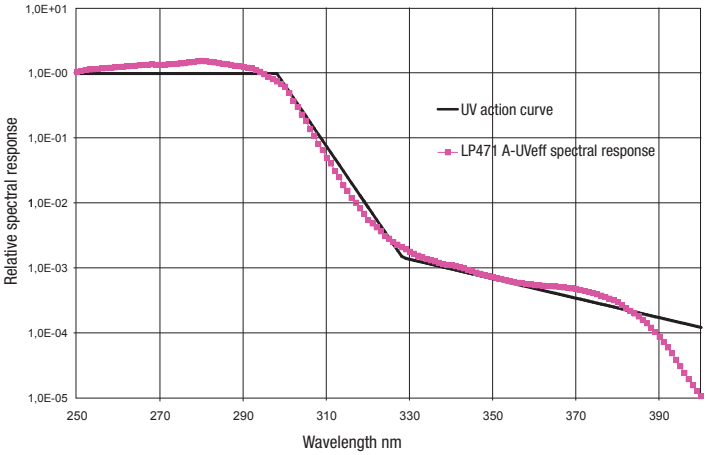
UVA Irradiance				
Measuring range (μW/cm²):	0.10…199.99	…1999.9	…19999	…$199.99 \cdot 10^3$
Resolution (μW/cm²):	0.01	0.1	1	$0.01 \cdot 10^3$
Spectral range:	315nm…400nm (Peak 360nm)			
Calibration uncertainty:	<5%			
f_2 (response according to the cosine law):	<6%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	±1digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			

Please refer to the spectral response of the LP471UVA probe

LP SILICON-PYRA probe for the measure of GLOBAL SOLAR RADIATION				
Measurement range (W/m²):	$1.0 \cdot 10^{-3}$ … $999.9 \cdot 10^{-3}$	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution (W/m²):	$0.1 \cdot 10^{-3}$	0.001	.01	0.01
Spectral range:	400 nm … 1100 nm			
Calibration uncertainty:	<3%			
f_2 (response according to the cosine law):	<3%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	±1 digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			

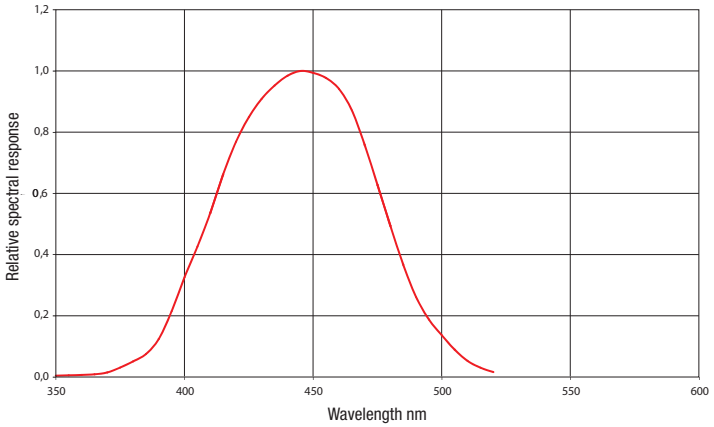


LP 471 A-UVeff probe for the measure of TOTAL EFFECTIVE IRRADIANCE weighted according to the UV action curve (CEI EN 60335-2-27)	
Total Effective Irradiance	
Measuring range (W_{eff}/m^2):	0.010 … 19.999
Resolution (W_{eff}/m^2):	0.001
Spectral range:	UV action curve for measuring erythema (250 nm…400 nm)
Calibration uncertainty:	<15%
f_3 (linearity):	<3%
f_4 (instrument reading error):	±1 digit
f_5 (fatigue):	<0.5%
Drift after 1 year:	<2%
Working temperature:	0…50°C
UV Irradiance	
Measuring range (W_{eff}/m^2):	0.1 … 1999.9
Resolution (W_{eff}/m^2):	0.1
Spectral range:	315 nm … 400 nm
UV_BC Irradiance	
Measuring range (W_{eff}/m^2):	0.010 … 19.999
Resolution (W_{eff}/m^2):	0.001
Spectral range:	250 nm … 315 nm



LP 471 BLUE probe for the measure of IRRADIANCE in spectral band of BLUE LIGHT				
Measurement range (W/m^2):	$1.0 \cdot 10^{-3}$… $999.9 \cdot 10^{-3}$	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution (W/m^2):	$0.1 \cdot 10^{-3}$	0.001	.01	0.01
Spectral range:	380 nm … 550 nm. Action curve for damages of Blue light B(λ)			
Calibration uncertainty:	<10%			
f_2 (response according to the cosine law):	<6%			
f_3 (linearity):	<3%			
f_4 (instrument reading error):	±1 digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			

Relative spectral response



The radiometric probe LP 471-BLUE measures irradiance (W/m^2) in spectral band of blue light. The probe consists of a photodiode plus an appropriate filter and it is provided with diffuser for proper measure in accordance with the cosine law. The spectral response curve of the probe allows to measure the radiation effective for damages caused by blue light (curve B(λ) according to the standards ACGIH / ICNIRP) in the spectral range from 380nm to 550nm. The radiation optics in this portion of the spectrum can produce photochemical damage to the retina. Another field of application is the monitoring of the probe irradiance from blue light used in the treatment of neonatal jaundice.

ORDERING CODES

HD2102.1: The kit consists of the instrument HD2102.1, 4 1.5V alkaline batteries, operating manual, case and DeltaLog9 software. **Probes and cable must be ordered separately.**

HD2102.2: The kit consists of the HD2102.2 **datalogger**, 4 1.5V alkaline batteries, operating manual, case and DeltaLog9 software. **Probes and cable must be ordered separately.**

HD2110CSNM: 8-pole connection cable MiniDin - Sub D 9-pole female for RS232C.

CP23: USB 2.0 connection cable type A - MiniUSB type B.

C.206: Cable for the connection of the instrument HD21…1 to the PC USB ports directly.

DeltaLog9: Software for download and management of the data on PC using Windows operating systems.

SWD10: Stabilized power supply at 230Vac/12Vdc-1000mA mains voltage.

HD40.1: Portable, serial input, 24 column thermal printer, 58mm paper width.

Probes complete with SICRAM module

LP 471 PHOT: Photometric probe for measuring **ILLUMINANCE** complete with SICRAM module, spectral response in agreement with standard photopic vision, Class B according to CIE n°69, diffuser for cosine correction. Measurement range: 0.10 lux…200·10^3 lux.

LP 471 LUM 2: Photometric probe for measuring **LUMINANCE** complete with SICRAM module, spectral response in agreement with standard photopic vision, vision angle 2°. Measurement range: 1.0 cd/m^2…2000·10^3 cd/m^2.

LP 471 PAR: Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range **PAR** (Photosynthetically Active Radiation 400nm…700nm) complete with SICRAM, measurement in µmol·m^{-2}s^{-1}, diffuser for cosine correction. Measurement range: 0.10µmol·m^{-2}s^{-1}…10·10^{3}µmol·m^{-2}s^{-1}.

LP 471 RAD: Radiometric probe for measuring **IRRADIANCE** equipped with SICRAM module; in the 400nm…1050nm spectral range, diffuser for cosine correction. Measurement range: 1.0·10^{-3}W/m^2…2000W/m^2.

LP 471 UVA: Radiometric probe for measuring **IRRADIANCE** equipped with SICRAM module; in the 315nm…400nm, peak 360nm, **UVA** spectral range, quartz diffuser for cosine correction. Measurement range: 1.0·10^{-3}W/m^2…2000 W/m^2.

LP 471 UVB: Radiometric probe for measuring **IRRADIANCE** equipped with SICRAM module, in the 280nm…315nm, peak 305nm ... 310nm, **UVB** spectral range, quartz diffuser for cosine correction. Measurement range: 1.0·10^{-3}W/m^2…2000 W/m^2.

LP 471 UVC: Radiometric probe for measuring **IRRADIANCE** equipped with SICRAM module, in the 220nm…280nm, peak 260nm, **UVC** spectral range, quartz diffuser for cosine correction. Measurement range: 1.0·10^{-3}W/m^2…2000 W/m^2.

LP 471 BLUE: Radiometric probe for measuring **IRRADIANCE** (W/m^2) in spectral band of blue light equipped with SICRAM module. Spectral range: 380 nm…550 nm, quartz diffuser for cosine correction. Measurement range: 1.0·10^{-3}Weff /m^2 … 2000 Weff /m^2.

LP 471 P-A: Combined probe for measuring **ILLUMINANCE** (lux), with standard photopic response, and **IRRADIANCE** (µW/cm^2) in the UVA spectral range (315...400 nm, with peak at 360 nm). Both the sensors are equipped with diffuser for the correction according to the cosine law.
Illuminance measuring range: 0.10 lux … 200·10^3 lux
Irradiance measuring range: 1.0 mW/m^2 … 2000 W/m^2.
This probe provides the ratio between UVA irradiance and illuminance in µW/lumen (quantity of interest in museums). The probe is equipped with SICRAM module and cable 2m long.

LP 471 A-UVeff: Combined probe for measuring the **TOTAL EFFECTIVE IRRADIANCE** (W/m^2) weighted according to the UV action curve. The probe is made of two sensors for the correct measure of the Total Effective Irradiance in the range 250...400nm. Both these sensors are equipped with a diffuser for the correction according to the cosine law.
This probe supplies the Total effective irradiance (Eeff), the UV-CB effective irradiance and the UVA Irradiance.
Total effective irradiance measuring range: 0.010 W/m^2 … 20 W/m^2.
B_C effective irradiance measuring range: 0.010 W/m^2 … 20 W/m^2.
UVA irradiance measuring range: 0.1 W/m^2 … 2000 W/m^2.
The probe is equipped with the SICRAM module and a cable 2m long.

LP 471 PYRA 02…, LP PYRA 03…, LP PYRA 10…, LP 471 Silicon-PYRA…
See page **LG-7**

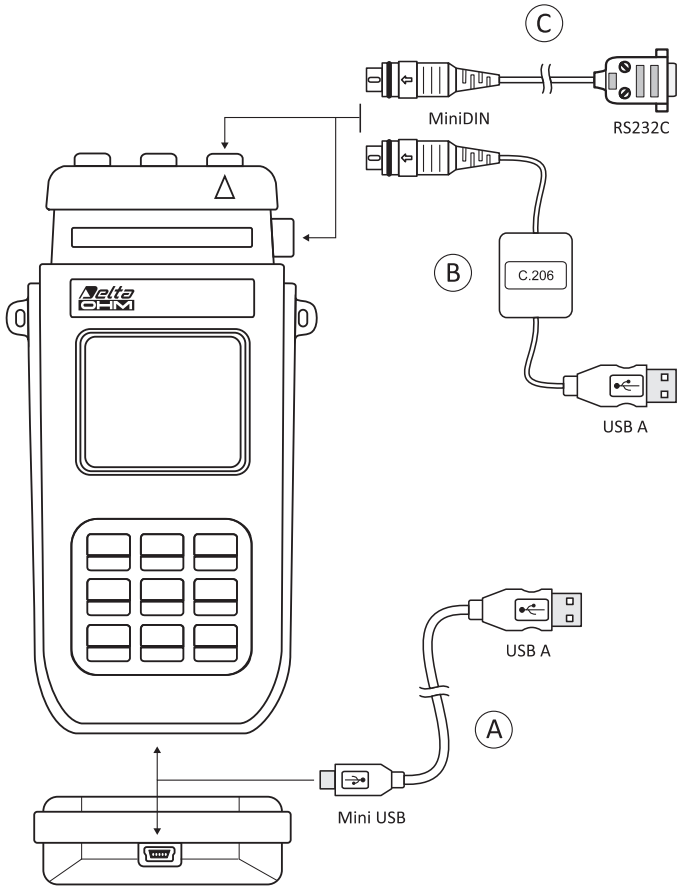
LP BL: Base with levelling device for all the above-described probes except for the probes LP 471 LUM 2 and LP 471 PYRA.

LP BL3: Jointed support for all the above-described probes except for LP 471 LUM 2 and LP 471 PYRA.

A The models of portable data logger series HD21xx.2 has been implemented with a new serial port miniUSB type HID (Human Interface Device).
When making the connection to the PC by the USB cable type A - Mini USB B-type coded CP23, **no USB driver installation is requested.**

B For the connection of the models **HD21xx.1** to the RS232 port of your PC, the USB/serial converter is available (code **C.206**). The converter is equipped with its own drivers that have to be installed before connecting the converter to the PC (please see the details in the CDRom supplied with the converter).

C The port with the MiniDIN connector which is present on every model is an RS232C type. By means of the cable coded HD2110CSNM, an RS232 port of a PC or the HD40.1 printer can be connected.



PROBES LP 471 PYRA 02.5 / LP 471 PYRA 02.10 - LP 471 PYRA 03.5 / LP 471 PYRA 03.10 - LP 471 PYRA 10.5 / LP 471 PYRA 10.10 - LP471 SILICON-PYRA

The LP 471 PYRA… probes consist of a pyranometer LP PYRA 03, LP PYRA 02 or LP PYRA 10 equipped with the SICRAM module and a 5m or 10m cable for the connection of the pyranometer to the instruments DO9847, HD2102.2, HD2102.1 and HD2302.0, so to get the reading in W/m² directly on the instrument's display.
The LP PYRA 03 is a second class pyranometer, the LP PYRA 02 is a first class pyranometer and the LP PYRA 10 is a "Secondary standard", all according to ISO 9060. The instruments are supplied with their Calibration Report and M12 4-pole output connector. The manuals of the pyranometers LP PYRA 03, LP PYRA 02 and LP PYRA 10 are available in our website www.deltaohm.com: "Instruments > Environmental Analysis".

The SICRAM module of the LP 471 PYRA... shows the same serial number of the pyranometer and its setting takes into account the sensitivity shown on the calibration report of the pyranometer, therefore it is not possible to use the same module to perform measurements with different pyranometers.

ORDERING CODES

LP 471 PYRA 10.5: The probe consists of a Secondary Standard class pyranometer LP PYRA 10 with a cable 5m long and the SICRAM module. It is supplied with the ISO 9001 calibration report of the pyranometer connected to the cable and the SICRAM module. The probe can be connected to the instruments HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 10)

LP 471 PYRA 10.10: The probe consists of a Secondary Standard class pyranometer LP PYRA 10 with a cable 10m long and the SICRAM module. It is supplied with the ISO 9001 calibration report of the pyranometer connected to the cable and the SICRAM module. The probe can be connected to the instruments HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 10)

LP 471 PYRA 02.5: The probe consists of a first class pyranometer LP PYRA 02 with a cable 5m long and the SICRAM module. It is supplied with the ISO 9001 calibration report of the pyranometer connected to the cable and the SICRAM module. The probe can be connected to the instruments HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 02)

LP 471 PYRA 02.10: The probe consists of a first class pyranometer LP PYRA 02 with a cable 10m long and the SICRAM module. It is supplied with the ISO 9001 calibration report of the pyranometer connected to the cable and the SICRAM module. The probe can be connected to the instruments HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 02)

LP 471 PYRA 03.5: The probe consists of a second class pyranometer LP PYRA 03 with a cable 5m long and the SICRAM module. It is supplied with the ISO 9001 calibration report of the pyranometer connected to the cable and the SICRAM module. The probe can be connected to the instruments HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 03)

LP 471 PYRA 03.10: The probe consists of a second class pyranometer LP PYRA 03 with a cable 10m long and the SICRAM module. It is supplied with the ISO 9001 calibration report of the pyranometer connected to the cable and the SICRAM module. The probe can be connected to the instruments HD2302.0, HD2102.1, HD2102.2 and DO9847.
For technical specs, see the website www.deltaohm.com at the section Environmental Analysis (LP Pyra 03)

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


LP 471 PYRA 03.5


LP 471 PYRA 02.5
LP 471 PYRA 10.5

RADIOMETRIC-PHOTOMETRIC PROBES FOR PORTABLE INSTRUMENTS

COD.	Description	
LP471PHOT	Photometric probe for measuring the **ILLUMINANCE**, spectral response according to the photopic curve, **class B according to CIE N° 69**, cosine correction diffuser. Measuring range: 0.10 lux…200·10^3 lux.	
LP471LUM2	Photometric probe for measuring the **LUMINANCE**, spectral response according to the photopic curve, angular field 2°. Measuring range: 1.0 cd/m^2…2000·10^3 cd/m^2.	
LP471PAR	Quantum-radiometric probe for measuring the PHOTONS FLOW in the chlorophyll field **PAR** (photosynthetically Active Radiation 400nm…700 nm), µmol m^{-2}s^{-1} measure, cosine correction diffuser. Measuring range 0.10 µmol m^{-2}s^{-1}…10·10^3 µmol m^{-2}s^{-1}	
LP471RAD	Radiometric probe for measuring the **IRRADIANCE** in the spectral range 400nm…1050nm, cosine correction diffuser. Measuring range: 1.0·10^{-3} mW/m^2…2000 W/m^2.	
LP471UVA	Radiometric probe for measuring the **IRRADIANCE** in the **UVA** spectral range 315nm…400nm, peak at 360nm, quartz diffuser for cosine correction. Measuring range: 1.0·10^{-3} mW/m^2 … 2000 W/m^2.	
LP471UVB	Radiometric probe for measuring the **IRRADIANCE** in the **UVB** spectral range 280nm…315nm, peak at 305nm ... 310nm, quartz diffuser for cosine correction. Measuring range: 1.0·10^{-3} mW/m^2 … 2000 W/m^2.	
LP471UVC	Radiometric probe for measuring the **IRRADIANCE** in the **UVC** spectral range 220nm…280nm, peak at 260nm, quartz diffuser for cosine correction. Measuring range: 1.0·10^{-3} W/m^2 … 2000 W/m^2.	
LP471BLUE	Radiometric probe for measuring the **EFFECTIVE IRRADIANCE** in the spectral range of the Blue light 380nm…550nm, diffuser for cosine correction. Measuring range: 1.0·10^{-3} W/m^2 … 2000 W/m^2.	

RADIOMETRIC-PHOTOMETRIC PROBES FOR PORTABLE INSTRUMENTS

COD.	Description	
LP471P-A	Combined probe for measuring **ILLUMINANCE** (lux), with standard photopic response, and **IRRADIANCE** ($\mu W/cm^2$) in the UVA spectral range (315...400 nm, with peak at 360 nm). Both the sensors are equipped with diffuser for the correction according to the cosine law. Illuminance measuring range: 0.10 lux … $200 \cdot 10^3$ lux. Irradiance measuring range: 1.0 mW/m^2 … 2000 W/m^2. This probe provides the ratio between UVA irradiance and illuminance in µW/lumen (quantity of interest in museums).	
LP471A-UVeff	Combined probe for measuring the **TOTAL EFFECTIVE IRRADIANCE** (W/m^2) weighted according to the UV action curve. The probe is made of two sensors for the correct measure of the Total Effective Irradiance in the range 250...400nm. Both these sensors are equipped with a diffuser for the correction according to the cosine law. This probe supplies the Total effective irradiance (Eeff), the UV-CB effective irradiance and the UVA irradiance. Total effective irradiance measuring range: 0.010 W/m^2 … 20 W/m^2. B_C effective irradiance measuring range: 0.010 W/m^2 … 20 W/m^2 UVA irradiance measuring range: 0.1 W/m^2 … 2000 W/m^2	
LP471 Silicon-Pyra	Pyranometer with silicon photodiode for measuring the **GLOBAL SOLAR IRRADIANCE**, diffuser for cosine correction. Spectral range 400…1100 nm. Measuring range: $1.0 \cdot 10^{-3}$…2000 W/m^2. Fixed cable 5m long, terminated with open wires.	
LP471PYRA	The probes LP 471 PYRA… consist of a pyranometer LP PYRA 03, LP PYRA 02 or LP PYRA 10 and a SICRAM module equipped with a 5 or 10m cable for the connection to the instruments DO9847, HD2102.1, HD2102.2, HD2302.0 and get a reading expressed directly in W/m^2. LP PYRA 03 is a second class pyranometer; LP PYRA 02 is a first class pyranometer; LP PYRA 10 is a "Secondary Standard" pyranometer.	
LP BL	Supporting and leveling base for the LP471… probes. NOT suitable for LP 471 LUM2 and LP 471 PYRA.	
LP BL3	Adjustable wall support for the LP471… probes. NOT suitable for LP 471 LUM2 and LP 471 PYRA.	

HD2302.0
PHOTO-RADIOMETER

The HD2302.0 is a portable instrument with a large LCD display. It measures **illuminance**, **luminance**, **PAR** and **irradiance** (across VIS-NIR, UVA, UVB and UVC spectral regions or measurement of irradiance effective according to the UV action curve). The probes are equipped with the SICRAM automatic detection module: in addition to detection, the unit of measurement selection is also automatic. The factory calibration data are already memorized inside the instruments. The Max, Min and Avg function calculate the maximum, minimum or average values. Other functions include: the relative measurement REL, the HOLD function, and the automatic turning off that can also be excluded. **The instruments have IP67 protection degree.**

INSTRUMENT TECHNICAL CHARACTERISTICS

Instrument

Dimensions (Length x Width x Height)	140x88x38mm
Weight	160g (complete with batteries)
Materials	ABS
Display	2x4½ digits plus symbols - 52x42mm Visible area: 52x42mm

Operating conditions

Operating temperature	-5…50°C
Storage temperature	-25…65°C
Working relative humidity	0…90%RH without condensation
Protection degree	**IP67**

Power

Batteries	3 1.5V type AA batteries
Autonomy	200 hours with 1800mAh alkaline batteries
Power absorbed with the instrument off	20µA

Measuring unit lux - fcd - µmol/m²·s - cd/m² - W/m² - µW/cm² µW/lumen

Connections

Input module for the probes 8-pole male DIN45326 connector

Technical characteristics of photometric and radiometric probes equipped with SICRAM module for the connection the instrument.

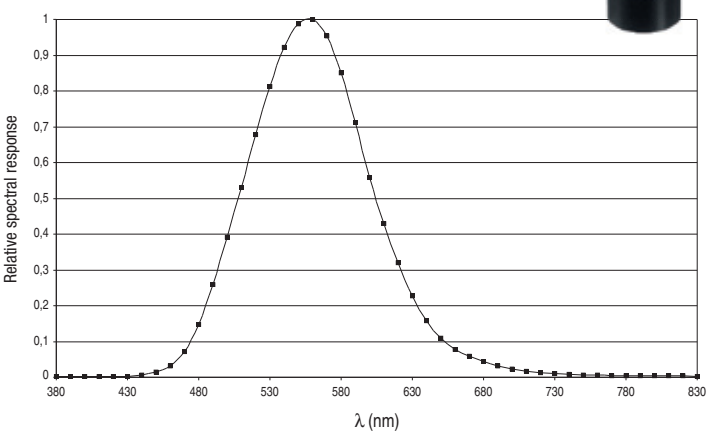
LP 471 PHOT probe for the measure of ILLUMINANCE				
Measuring range (lux):	0.10…199.99	…1999.9	…19999	…199.99·10³
Resolution (lux):	0.01	0.1	1	0.01·10³
Spectral range:	in agreement with standard photopic curve V(λ)			
α (temp. coefficient) f_6 (T)	<0.05%K			
Calibration uncertainty:	<4%			
f'_1 (in agreement with photopic response V(λ)):	<6%			
f_2 (response according to the cosine law):	<3%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	<0.5%			
f_5 (fatigue):	<0.5%			
Class	B			
Drift after 1 year:	<1%			
Working temperature:	0…50°C			
Reference Standards	CIE n.69 - UNI 11142			

Photometric probe for **ILLUMINANCE** measurement, spectral response in agreement with standard photopic vision, diffuser for cosine correction. Measurement range: 0.10 lux…200·10³ lux.

LP 471 LUM 2 probe for the measure of LUMINANCE				
Measuring range (cd/m²):	1.0…1999.9	…19999	…199.99·10³	…1999.9·10³
Resolution (cd/m²):	0.1	1	0.01·10³	0.1·10³
Optical angle:	2°			
Spectral range:	in agreement with standard photopic curve V(λ)			
α (temp. coefficient) f_6 (T)	<0.05%K			
Calibration uncertainty:	<5%			
f'_1 (in agreement with photopic response V(λ)):	<8%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	<0.5%			
f_5 (fatigue):	<0.5%			
Class	C			
Drift after 1 year:	<1%			
Working temperature:	0…50°C			
Reference Standards	CIE n.69 - UNI 11142			

Photometric probe for **LUMINANCE** measurement, spectral response in agreement with standard photopic vision, vision angle 2°. Measurement range: 1.0 cd/m²…2000·10³ cd/m².

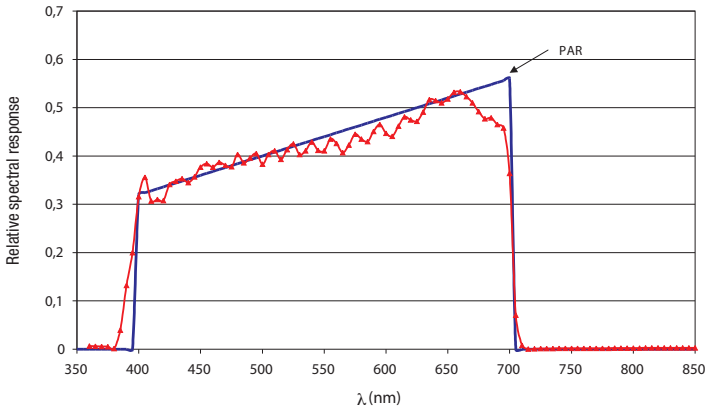
Typical response curve: LP 471 PHOT and LP 471 LUM2



LP 471 PAR quantum radiometric probe for the measure of the photon flow across the chlorophyll range PAR			
Measuring range (µmol·m^{-2}s^{-1}):	0.10…199.99	200.0…1999.9	2000…10000
Resolution (µmol·m^{-2}s^{-1}):	0.01	0.1	1
Spectral range:	400nm…700nm		
Calibration uncertainty:	<5%		
f_2 (response according to the cosine law):	<6%		
f_3 (linearity):	<1%		
f_4 (instrument reading error):	±1digit		
f_5 (fatigue):	<0.5%		
Drift after 1 year:	<1%		
Working temperature:	0…50°C		

Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range **PAR** (Photosynthetically Active Radiation 400nm…700nm), measurement in µmol/m^{2}s. Measurement range: 0.10 µmol·m^{-2}s^{-1}…10·10^3 µmol·m^{-2}s^{-1}.

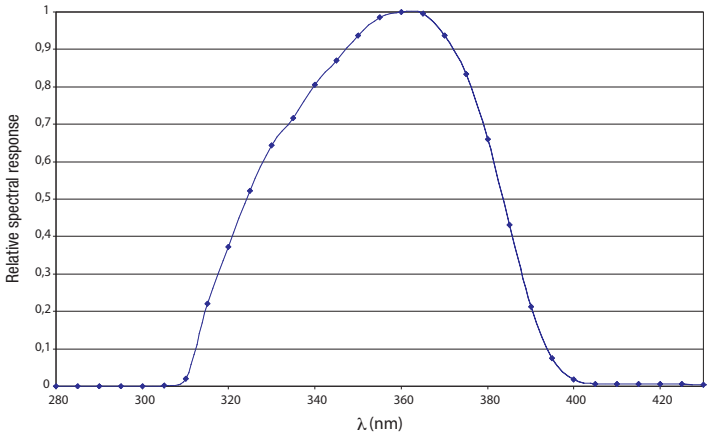
Typical response curve: LP 471 PAR



LP 471 UVA probe for the measure of UVA IRRADIANCE				
Measuring range (W/m^2):	1.0·10^{-3} …999.9·10^{-3}	1.000 …19.999	20.00 …199.99	200.0 …1999.9
Resolution (W/m^2):	0.1·10^{-3}	0.001	0.01	0.1
Spectral range:	315nm…400nm (Peak 360nm)			
Calibration uncertainty:	<5%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	±1digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			

Radiometric probe for **IRRADIANCE** measurement, in the 315nm…400nm, peak 360nm, UVA spectral range. Measurement range: 1.0·10^{-3}W/m^2…2000W/m^2.

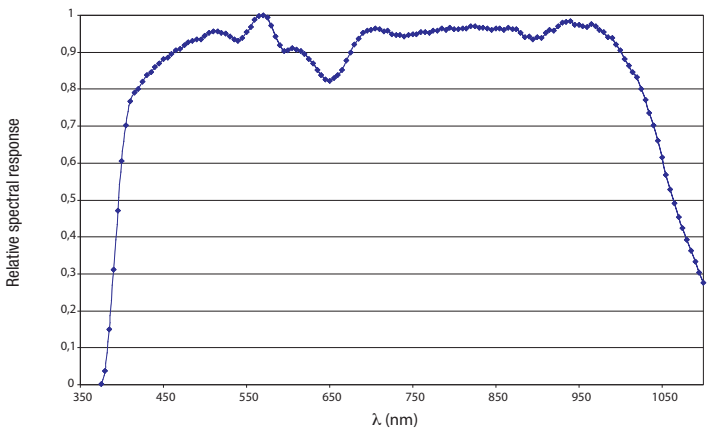
Typical response curve: LP 471 UVA



LP 471 RAD probe for the measure of IRRADIANCE				
Measuring range (W/m^2):	1.0·10^{-3} …999.9·10^{-3}	1.000 …19.999	20.00 …199.99	200.0 …1999.9
Resolution (W/m^2):	0.1·10^{-3}	0.001	0.01	0.1
Spectral range:	400nm…1050nm			
Calibration uncertainty:	<5%			
f_2 (response according to the cosine law):	<6%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	±1digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<1%			
Working temperature:	0…50°C			

Radiometric probe for **IRRADIANCE** measurement in the spectral range 400nm…1050nm, diffuser for cosine correction. Measurement range: 1.0·10^{-3}W/m^2…2000W/m^2.

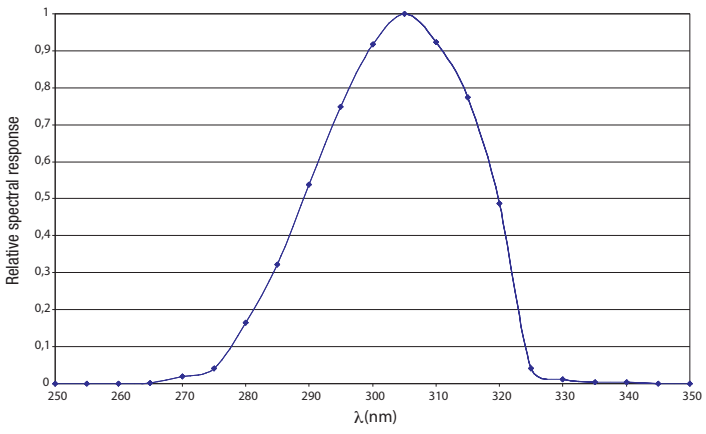
Typical response curve: LP 471 RAD



LP 471 UVB probe for the measure of UVB IRRADIANCE				
Measuring range (W/m^2):	1.0·10^{-3} …999.9·10^{-3}	1.000 …19.999	20.00 …199.99	200.0 …1999.9
Resolution (W/m^2):	0.1·10^{-3}	0.001	0.01	0.1
Spectral range:	280nm…315nm (Peak 305nm...310nm)			
Calibration uncertainty:	<5%			
f_3 (linearity):	<2%			
f_4 (instrument reading error):	±1digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			

Radiometric probe for **IRRADIANCE** measurement, in the spectral range 280nm…315nm, peak 305nm ... 310nm, Measurement range: 1.0·10^{-3}W/m^2…2000W/m^2.

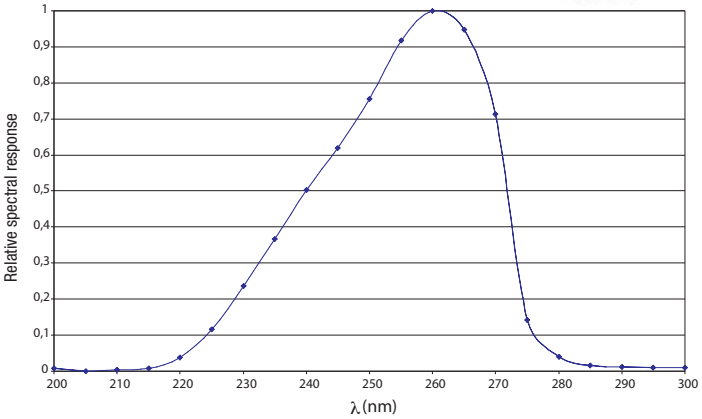
Typical response curve: LP 471 UVB



LP 471 UVC probe for the measure of UVC IRRADIANCE				
Measuring range (W/m²):	$1.0 \cdot 10^{-3}$ …$999.9 \cdot 10^{-3}$	1.000 …19.999	20.00 …199.99	200.0 …1999.9
Resolution (W/m²):	$0.1 \cdot 10^{-3}$	0.001	0.01	0.1
Spectral range:	220nm…280nm (Peak 260nm)			
Calibration uncertainty:	<5%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	±1digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			

Radiometric probe for **IRRADIANCE** measurement, in the spectral range 220nm…280nm, peak 260nm, UVC. Measurement range: $1.0 \cdot 10^{-3}$W/m²…2000W/m².

Typical response curve: LP 471 UVC



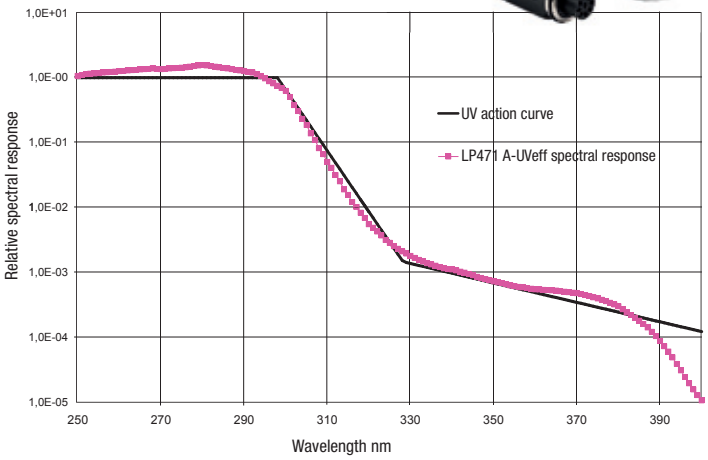
Combined probe LP 471 P-A with two sensors for the measure of ILLUMINANCE and UVA IRRADIANCE				
Illuminance				
Measuring range (lux):	0.10…199.9	…1999.9	…19999	…$199.99 \cdot 10^3$
Resolution (lux):	0.01	0.1	1	$0.01 \cdot 10^3$
Spectral range:	in agreement with standard photopic curve V(λ)			
α (temp. coefficient) f_6 (T)	<0.05%K			
Calibration uncertainty:	<4%			
f'₁ (in agreement with photopic response V(λ)):	<6%			
f_2 (response according to the cosine law):	<3%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	<0.5%			
f_5 (fatigue):	<0.5%			
Class:	B			
Drift after 1 year:	<1%			
Working temperature:	0…50°C			
Reference Standards	CIE n.69 - UNI 11142			

Please refer to the spectral response of the LP471PHOT probe

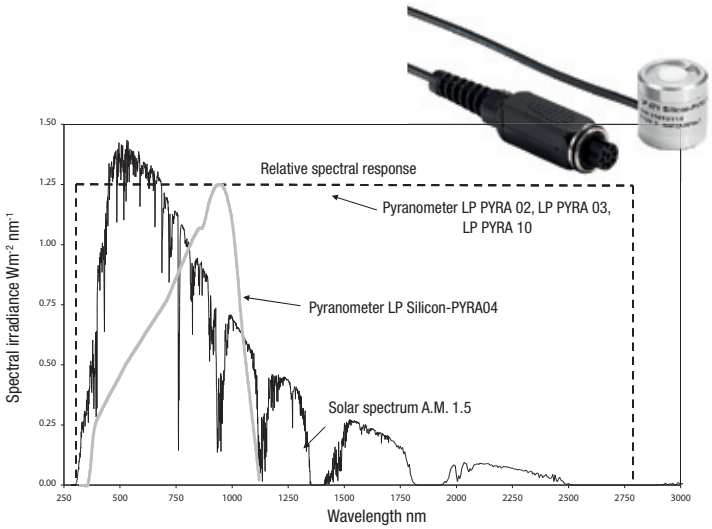
UVA Irradiance				
Measuring range (μW/cm²):	0.10…199.99	…1999.9	…19999	…$199.99 \cdot 10^3$
Resolution (μW/cm²):	0.01	0.1	1	$0.01 \cdot 10^3$
Spectral range:	315nm…400nm (Peak 360nm)			
Calibration uncertainty:	<5%			
f_2 (response according to the cosine law):	<6%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	±1digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			

Please refer to the spectral response of the LP471UVA probe

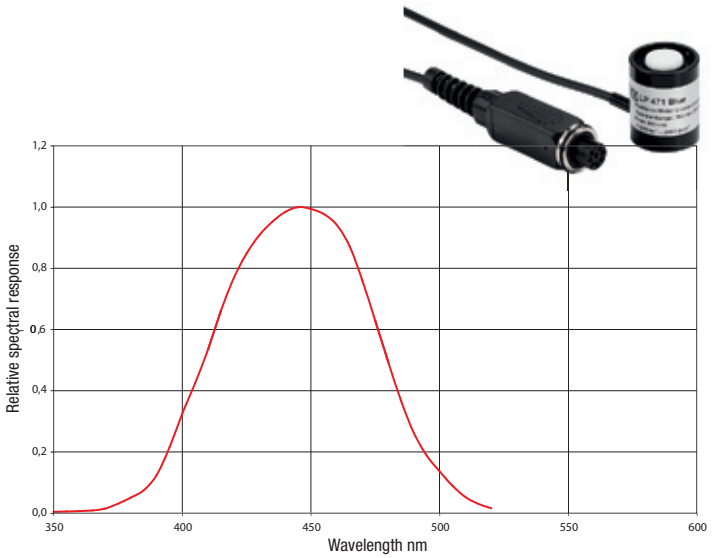
LP 471 A-UVeff probe for the measure of TOTAL EFFECTIVE IRRADIANCE weighted according to the UV action curve (CEI EN 60335-2-27)	
Total Effective Irradiance	
Measuring range (W_{eff}/m²):	0.010 … 19.999
Resolution (W_{eff}/m²):	0.001
Spectral range:	UV action curve for measuring erythema (250 nm…400 nm)
Calibration uncertainty:	<15%
f_3 (linearity):	<3%
f_4 (instrument reading error):	±1 digit
f_5 (fatigue):	<0.5%
Drift after 1 year:	<2%
Working temperature:	0…50°C
Reference standard	CEI EN 60335-2-27
UVA Irradiance	
Measuring range (W_{eff}/m²):	0.01 … 1999.9
Resolution (W_{eff}/m²):	0.1
Spectral range:	315 nm … 400 nm
UV_BC Irradiance	
Measuring range (W_{eff}/m²):	0.010 … 19.999
Resolution (W_{eff}/m²):	0.001
Spectral range:	250 nm … 315 nm



LP SILICON-PYRA probe for the measure of GLOBAL SOLAR RADIATION				
Measurement range (W/m²):	$1.0 \cdot 10^{-3}$… $999.9 \cdot 10^{-3}$	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution (W/m²):	$0.1 \cdot 10^{-3}$	0.001	.01	0.01
Spectral range:	400 nm … 1100 nm			
Calibration uncertainty:	<3%			
f_2 (response according to the cosine law):	<3%			
f_3 (linearity):	<1%			
f_4 (instrument reading error):	±1 digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			



LP 471 BLUE probe for the measure of IRRADIANCE in spectral band of BLUE LIGHT				
Measurement range (W/m²):	$1.0 \cdot 10^{-3}$… $999.9 \cdot 10^{-3}$	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution (W/m²):	$0.1 \cdot 10^{-3}$	0.001	.01	0.01
Spectral range:	380 nm … 550 nm. Action curve for damages of Blue light B(λ)			
Calibration uncertainty:	<10%			
f_2 (response according to the cosine law):	<6%			
f_3 (linearity):	<3%			
f_4 (instrument reading error):	±1 digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0…50°C			



The radiometric probe LP 471-BLUE measures irradiance (W/m²) in spectral band of blue light. The probe consists of a photodiode plus an appropriate filter and it is provided with diffuser for proper measure in accordance with the cosine law. The spectral response curve of the probe allows to measure the radiation effective for damages caused by blue light (curve B(λ) according to the standards ACGIH / ICNIRP) in the spectral range from 380nm to 550nm. The radiation optics in this portion of the spectrum can produce photochemical damage to the retina. Another field of application is the monitoring of the probe irradiance from blue light used in the treatment of neonatal jaundice.

ORDERING CODES

HD2302.0: The kit consists of the instrument HD2302.0, 3 1.5V alkaline batteries, operating manual, case. **The probes must be ordered separately**.

Probes complete with SICRAM module (see page LG-7)

LP 471 PHOT: Photometric probe for measuring **ILLUMINANCE** complete with SICRAM module, spectral response in agreement with standard photopic vision, Class B according to CIE n°69, diffuser for cosine correction. Measurement range: 0.10 lux…$200 \cdot 10^3$ lux.

LP 471 LUM 2: Photometric probe for measuring **LUMINANCE** complete with SICRAM module, spectral response in agreement with standard photopic vision, vision angle 2°. Measurement range: 1.0 cd/m²…$2000 \cdot 10^3$ cd/m².

LP 471 PAR: Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range **PAR** (Photosynthetically Active Radiation 400nm…700nm) complete with SICRAM, measurement in $\mu mol \cdot m^{-2}s^{-1}$, diffuser for cosine correction. Measurement range: $0.10 \mu mol \cdot m^{-2}s^{-1}$…$10 \cdot 10^3 \mu mol \cdot m^{-2}s^{-1}$.

LP 471 RAD: Radiometric probe for measuring **IRRADIANCE** equipped with SICRAM module; in the 400nm…1050nm spectral range, diffuser for cosine correction. Measurement range: $1.0 \cdot 10^{-3}$W/m²…2000W/m².

LP 471 UVA: Radiometric probe for measuring **IRRADIANCE** equipped with SICRAM module; in the 315nm…400nm, peak 360nm, **UVA** spectral range, quartz diffuser for cosine correction. Measurement range: $1.0 \cdot 10^{-3}$W/m²…2000 W/m².

LP 471 UVB: Radiometric probe for measuring **IRRADIANCE** equipped with SICRAM module, in the 280nm…315nm, peak 305nm ... 310nm, **UVB** spectral range, quartz diffuser for cosine correction. Measurement range: $1.0 \cdot 10^{-3}$W/m²…2000 W/m².

LP 471 UVC: Radiometric probe for measuring **IRRADIANCE** equipped with SICRAM module, in the 220nm…280nm, peak 260nm, **UVC** spectral range, quartz diffuser for cosine correction. Measurement range: $1.0 \cdot 10^{-3}$W/m²…2000 W/m².

LP 471 BLUE: Radiometric probe for measuring **IRRADIANCE** (W/m²) in spectral band of blue light equipped with SICRAM module. Spectral range: 380 nm…550 nm, quartz diffuser for cosine correction. Measurement range: $1.0 \cdot 10^{-3}$Weff /m² … 2000 Weff /m².

LP 471 P-A: Combined probe for measuring **ILLUMINANCE** (lux), with standard photopic response, and **IRRADIANCE** (μW/cm²) in the UVA spectral range (315...400 nm, with peak at 360 nm). Both the sensors are equipped with diffuser for the correction according to the cosine law.
Illuminance measuring range: 0.10 lux … $200 \cdot 10^3$ lux
Irradiance measuring range: 1.0 mW/m² … 2000 W/m².
This probe provides the ratio between UVA irradiance and illuminance in μW/lumen (quantity of interest in museums). The probe is equipped with SICRAM module and cable 2m long.

LP 471 A-UVeff: Combined probe for measuring the **TOTAL EFFECTIVE IRRADIANCE** (W/m²) weighted according to the UV action curve. The probe is made of two sensors for the correct measure of the Total Effective Irradiance in the range 250...400nm. Both these sensors are equipped with a diffuser for the correction according to the cosine law.
This probe supplies the Total effective irradiance (Eeff), the UV-CB effective irradiance and the UVA Irradiance.
Total effective irradiance measuring range: 0.010 W/m² … 20 W/m².
B_C effective irradiance measuring range: 0.010 W/m² … 20 W/m².
UVA irradiance measuring range: 0.1 W/m² … 2000 W/m².
The probe is equipped with the SICRAM module and a cable 2m long.

LP 471 PYRA 02…, LP PYRA 03…, LP PYRA 10…, LP 471 Silicon-PYRA…
See page **LG-7**

LP BL: Base with levelling device for all the above-described probes except for the probes LP 471 LUM 2 and LP 471 PYRA.

LP BL3: Jointed support for all the above-described probes except for LP 471 LUM 2 and LP 471 PYRA.

DO 9721

DO9721
QUANTUM PHOTO-RADIOMETER AND THERMOMETER DATA-LOGGER

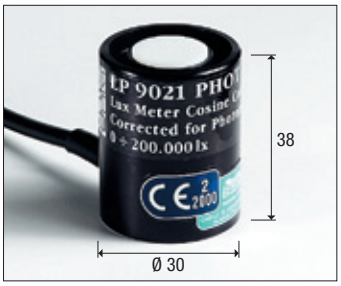
The **DO 9721** quantum photo-radiometer and thermometer data logger has been designed for measuring illuminance, irradiance, luminance and temperature. The instrument has two inputs, A and B, and automatically detects the sensors, whether illuminance, irradiance, luminance or temperature and can provide a view of the difference between the two inputs. As the probes are interchangeable, it is possible to choose the most suitable combination for all applications without having to recalibrate the instrument. The **DO 9721** can take illuminance measurements in lux and in fcd (foot-candle), irradiance measurements in W/m^2, in µW/cm^2 and in µmol·m^{-2}s^{-1}, luminance measurements in cd/m^2 and temperature measurements in °C or °F.
With the data logger function the instrument stores up to 30,000 readings with selectable sampling interval from 1 second to 12 hours.
The data acquired can then be downloaded to a Personal Computer or a printer by means of the opto-insulated serial line RS232C. For each value stored the date and time of acquisition are indicated; each acquisition block is ended with a report which provides the maximum, minimum and mean values. With the Serial Output function it is possible to obtain the instantaneous values measured by the instrument at the output of the serial line RS232C, in order to send them to a printer or a computer. Other functions such as Hold (which blocks the display), Rel (for taking relative measurements), Record (for storing the maximum, minimum and mean values) and Q (integration in time of the measurements with alarm threshold) further enrich the instrument's performance. Thanks to its versatility and to its storage capacity, the instrument is suitable for a wide variety of applications, both in the field and in the laboratory.

PROBE CONNECTION
The instrument **DO 9721** has two circular DIN 45326 8-pole connectors (A and B) which allow the connection of Delta Ohm probes for measuring temperature, type TP 870, and probes for measuring the photometric and radiometric intensity, type LP 9021. The probe model should be chosen according to the specific application.

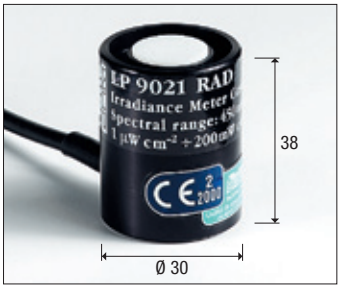
INSTRUMENT TECHNICAL DATA

Inputs / type of measurement	2: photometric / radiometric or temperature
Connector	DIN 45326 8-pole
Measuring range	
Photometric measurements	0.1...200.000 lux
	1...20.000 fcd
	1...2.000.000 cd/m^2
Radiometric measurements	1·10^{-3}...2000 W/m^2
	0.1...200.000 µW/cm^2
	0.1...200.000 µmol·m^{-2}s^{-1}
Q energy	depends on the active measurements unit
Integration time	19 hours, 59 minutes, 59 seconds
No. conversions per second	2
Working temperature	-5...+50°C
Working relative humidity	0...90% R.H. (no condensation)
Serial output	RS232C 300...19200 baud (galvanically insulated)
Display	Double LCD 12.5 mm
Functions	Auto power off / Autorange / Hold / Record Maximum / Minimum / Mean / Relative A-B / Energy
Memory	512kB (FLASH) corr. to 30,000 measurements
Power supply	9Vdc alkaline battery
Autonomy	Approx. 30 hours (continuous duty)
Weight / dimensions	320 gr. / 215x73x38 mm

ORDERING CODES
DO 9721: Instrument, user's manual, carrying case, DeltaLog1 software, 9V battery. **Probes and cables must be ordered separately**.



LP 9021 PHOT: Photometric probe for measuring **ILLUMINANCE;** photopic filter in compliance with CIE n° 69 - UNI 11142, diffuser for correction according to the cosine law.

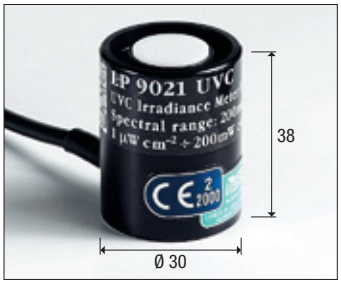


LP 9021 RAD: Radiometric probe for measuring the **IRRADIANCE** of artificial light sources, irradiance of the sun.

LP 9021 PAR: Quantum-radiometric probe for measuring the PHOTONS FLOW in the chlorophyll field PAR (photosynthetically Active Radiation 400nm…700nm), µmol·m^{-2}s^{-1} measure, cosine correction diffuser.

LP 9021 UVA: Radiometric probe for measuring **IRRADIANCE** in the ultraviolet field. Suitable for measuring radiation in the ultraviolet region **A**.

LP 9021 UVB: Radiometric probe for measuring **IRRADIANCE** in the ultraviolet field. Suitable for measuring radiation in the ultraviolet region **B**.



LP 9021 UVC: Radiometric probe for measuring **IRRADIANCE** in the ultraviolet field. Suitable for measuring radiation in the ultraviolet region **C**.

LP 9021 LUM2: Probe for measuring **LUMINANCE**, measuring range from 1 to 1999·10³ cd/m². Measuring angle 2°. CIE filter for correction of the response according to the human eye, CIE n°69-UNI11142.

LP BL: Stand for supporting and levelling probes, except for LP 9021 LUM2.

TP 870.0: Immersion temperature probe, Pt100 sensor, diam. 3x230 mm, measuring range -50...+250°C.

TP 870C.0: Contact temperature probe, Pt100 sensor, diam. 4x230 mm, measuring range -50...+250°C.

TP 870P.0: Penetration temperature probe, Pt100 sensor, diam. 4x150 mm, measuring range -50...+250°C.

TP 870A.0: Air temperature probe, Pt100 sensor, diam. 4x230 mm, measuring range -50...+250°C.

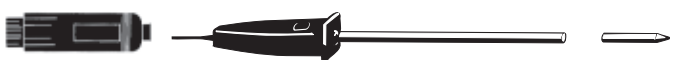
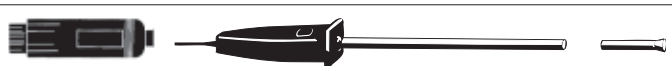
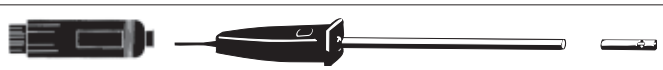
C.205: Serial connection cable with USB connector for PC and Sub-D 9-pole connector for the instrument. The cable has a built-in USB/RS232 converter and connects the instrument **DO 9721** directly to the USB port of the PC.

9CPRS232: Sub D 9-pole Female/Female RS232 null-modem cable for **DO 9721**.

LP BL

Probe Model	Measuring range	Spectral measuring range	Calibration uncertainty
LP 9021 PHOT	0.1 ... 200000 lux	CIE N°69 Class C	<4%
LP 9021 RAD	1mW/m² ... 2000 W/m²	450 ... 950nm	<5%
LP 9021 PAR	0.1 µmol $m^{-2}s^{-1}$ ... 20000 µmol $m^{-2}s^{-1}$	400 ... 700nm	<5%
LP 9021 UVA	1 mW/m² ... 2000 W/m²	315 ... 400nm	<5%
LP 9021 UVB	1 mW/m² ... 2000 W/m²	280 ... 315nm	<5%
LP 9021 UVC	1 mW/m² ... 2000 W/m²	200 ... 280nm	<5%
LP 9021 LUM2	1 ... 2 · 10⁶ cd/m²	CIE N°69 Class C	<5%

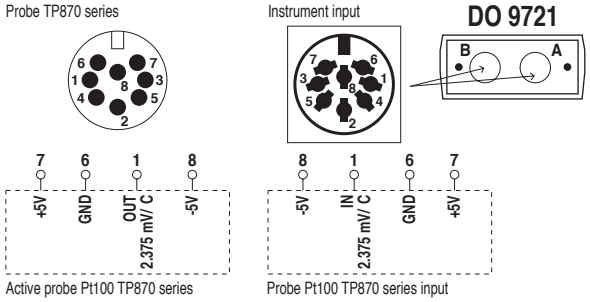
INSTRUMENT UNCERTAINTY			
	at 25°C +/-	**from -5°C to 50°C +/-**	**Measuring range +/-**
Instrument base uncertainty	0.1% ... 1 digit	0.2% ... 1 digit	
Temperature measure of instrument with probe	0.6°C 0.4°C 2°C	0.6°C + 0.01°C/°C 0.4°C + 0.01°C/°C 2°C + 0.01°C/°C	-50 … + 50°C +50 … +200°C +200 … + 400°C

TEMPERATURE PROBES OF THE SERIES TP870				
Code	Description	Drawing	τ Sec.	Temp/°C
TP 870.0	Immersion probe ø 3 x 230 mm		3"A	-50/+250
TP 870P.0	Penetration probe ø 4 x 150 mm		3"A	-50/+250
TP 870C.0	Contact probe ø 4 x 230 mm		12"C	-50/+250
TP 870A.0	Air probe ø 4 x 230 mm		3"B	-50/+250

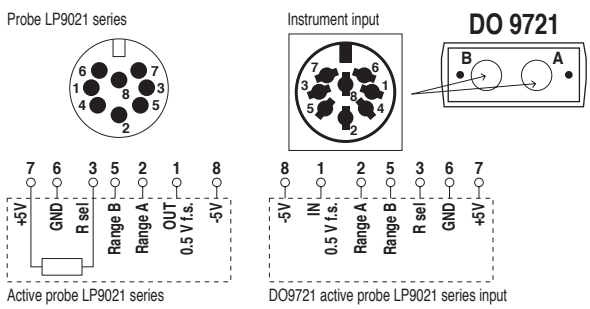
A) Time constant in water at 100 ° C / **B)** Time constant detected in contact with metal surface at 200 ° C / **C)** Time constant in air at 100 ° C.
Notes: Time constant to respond to the 63% of the temperature variation.

1 Input A, DIN 45326 8-pole connector.
2 HOLD symbol, the measurement refers to the moment in which the HOLD key was pressed.
3 Battery symbol: flashes during RECORD function, permanently lit if the battery is running low.
4 REL symbol, indicates that the instrument is making a relative measurement.
5 Serial Out/Memory. Fixed symbol: the instrument is storing. Flashing symbol: serial output is enabled.
6 MED symbol: the display shows the mean values found during RCD function.
7 Q: instrument in Q-energy function, flashes when it has reached the limit.
8 Time: the display indicates the integration time, if flashing it has reached the time programmed for integration.
9 Lux: the led indicates that the measurement is in lux.
10 $\mu W/cm^2$: the led indicates that the measurement is in $\mu W/cm^2$.
11 $\mu mol \cdot m^{-2} s^{-1}$: the led indicates that the measurement is in $\mu mol \cdot m^{-2} s^{-1}$.
12 REL key: shows the difference between the current value and the value stored when the REL key is pressed.
13 HOLD key for blocking the reading.
14 Unit A key: for selecting the measurement unit for input A, depending on the probe fitted. When turned to P0 mode, it sets the Q-energy and Time limits for input A.
15 Serial Output: activates data transmission at the RS232C serial output.
16 ▲ (Memory clear): increases the parameters in programming mode; when held down it erases the "RCD" memory; when pressed with P1, it erases the permanent memory.
17 PROG key: activates the programs P0... P1... P... of the different instrument functions.
18 Connector for RS232C (SUB D male 9 pole).
19 Input B, DIN 45326 8-pole connector.
20 Symbol 10^3: indicates multiplication factor 10^3 for the respective channel.
21 Symbols A and B: for magnitudes Q and T indicate the channel selected.
22 A-B: the bottom display shows the difference between A and B. The top display shows A.
23 MIN symbol: the display shows the minimum values found during RCD function.
24 MAX symbol: the display shows the maximum values found during RCD function.
25 °C: the led indicates that the temperature measurement is in degrees centigrade.
26 °F: the led indicates that the temperature measurement is in degrees Fahrenheit.
27 fcd: the led indicates that the measurement is in fcd (foot-candle).
28 W/m^2: the led indicates that the measurement is in W/m^2.
29 cd/m^2: the led indicates that the measurement is in cd/m^2.
30 On/Off key: for switching the instrument on or off.
31 Unit B key: for selecting the measurement unit for input B, depending on the probe fitted. When turned to P0 mode, it sets the Q-energy and Time limits for input B.
32 A-B key: shows the difference between the inputs.
33 Data Call key (Max-Min-Med-Q-Time): recalls on the display the maximum, mean, minimum, Q and Time values of each input.
34 ▼ (RCD): starts and stops the RECORD function, in programming mode it decreases the parameter shown.
35 ENTER key: starts and stops storage, confirms the parameters set during programming.

A) Amplified temperature probe with Pt100 platinum-sensitive element



B) Probes for photometric and radiometric measurements



LP PHOT 01
LP PAR 01
LP RAD 01
LP UVA 01
LP UVB 01
LP UVC 01

LP PHOT 01, LP RAD 01, LP PAR 01, LP UVA 01, LP UVB 01, LP UVC 01 PHOTOMETRIC/RADIOMETRIC PROBES WITH mV SIGNAL OUTPUT. LP PHOT 01S WITH RS485 MODBUS-RTU OUTPUT

The probes of the series LP…01 allow measurement of photometric and radiometric quantities such as illuminance (lux), irradiance (W/m^2) across VIS-NIR, UVA, UVB, UVC spectral regions, the number of photons per time unit and area in the PAR region (400nm ... 700nm).
In probes LP….01 there is no need for external power supply. Output signal in mV is given through a resistor shunting the photodiode ends. Photocurrent generated by the photodiode when hit by light, is converted to a potential difference, which is read by a voltmeter. Once the DDP (Potential Difference) has been read, the measured value can be calculated through the calibration factor. **All probes are individually calibrated and the calibration factor is shown both on the probe housing and on the user manual and is specific to that probe.**
LP…01 probes are equipped with cosine corrected diffuser. In probes for UV measurements the diffuser is made of sanded quartz, for the other probes, the diffuser is commonly made of acrylic material or teflon® (LP PHOT 01). LP ... 01 probes **are suitable for indoor applications** which requires the constant monitoring of the quantities specified. The output signal can be amplified or converted into a 4...20mA or 0...10Vdc signal by using a converter of the series HD978TR3 (4...20mA) and HD978TR4 (0...10Vdc) for DIN rail attachment, or the wall mounting types HD978TR5 (4...20mA) and HD978TR6 (0...10Vdc).

Installing the probes

Once the installation place has been decided, the connections between the probe and the voltmeter should be provided; the voltmeter should have proper scales of measurement. The connection diagram of the probe output cables is shown in the user manual. For measurements in weather and agriculture stations or in nursery-gardening systems, the probe reference plane should be mounted parallel to the ground; in this case, the probe shall be mounted on a LP BL (optional) support provided with bubble level.

Probe description

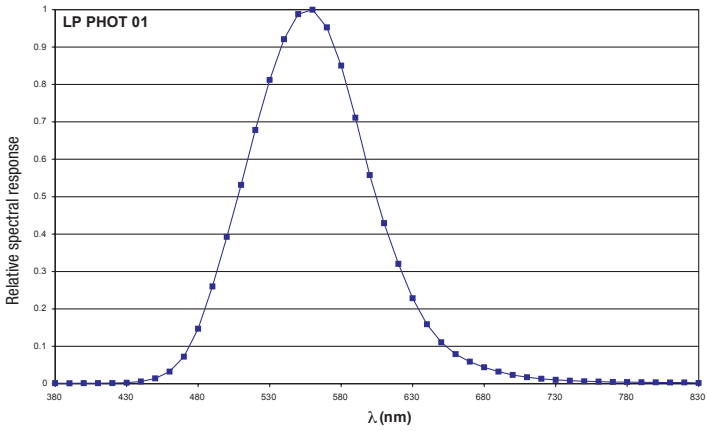
LP PHOT 01:

The LP PHOT 01 probe measures illuminance (lux) defined as the ratio between the luminous flux (lumen) passing through a surface and the surface area (m^2).
The spectral response curve of a photometric probe is equal to the one of the human eye, known as standard photopic curve V(λ). The difference in spectral response between LP PHOT 01 and the standard photopic curve V(λ) is calculated by means of the error f_1'. The calibration of the probe is performed by comparing it to a luxmeter calibrated by a Primary Metrological Institute. All calibration procedures follow the CIE publication No 69 (1987) "Method of Characterizing Illuminance Meters and Luminance Meters". **The calibration is carried out by illuminating the probe with a standard illuminant A.**

TECHNICAL SPECIFICATIONS

Typical sensitivity:	0.5 ... 1.5 mV/klux
Spectral range:	V(λ)
Calibration accuracy:	<4%
f'$_1$ (V(λ) match error):	<6%
f_2 (cosine response/directional error):	<3%
f_3 (linearity):	<1%
f_5 (fatigue):	<0.5%
Operating temperature:	0...50°C
Output impedance:	0.5 ...1 kΩ

Typical spectral response LP PHOT 01



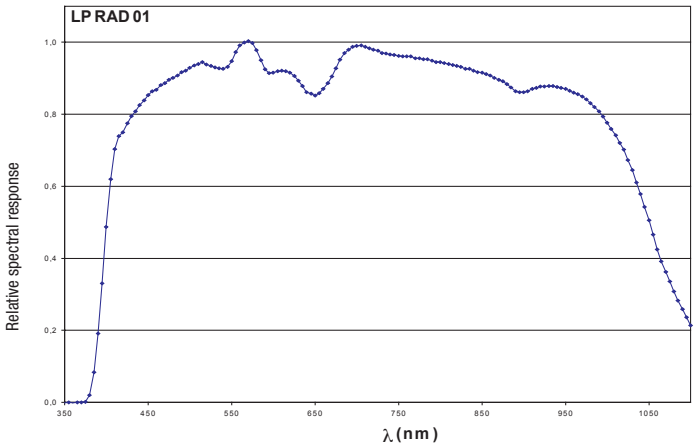
LP RAD 01:

The LP RAD 01 probe measures irradiance (W/m^2) defined as the ratio between the radiant flux (W) passing through a surface and the surface area (m^2) in the VIS-NIR (400nm...1050nm) spectral range. These particular features apply to an instrument suitable for measurements in visible and near infrared fields. **Probe calibration is carried out by using 577 and 579 nm lines** of a Xe-Hg lamp, filtered through a special interferential filter.

TECHNICAL SPECIFICATIONS

Typical sensitivity:	2.6 µV/(µW/cm^2)
Measuring range:	0 ... 200 mW/cm^2
Spectral range:	≈400nm...≈1050nm
Calibration accuracy:	<6%
f_2 (cosine response/directional error):	<6%
Operating temperature:	0 ... 50°C
Output impedance:	1 kΩ

Typical spectral response LP RAD 01



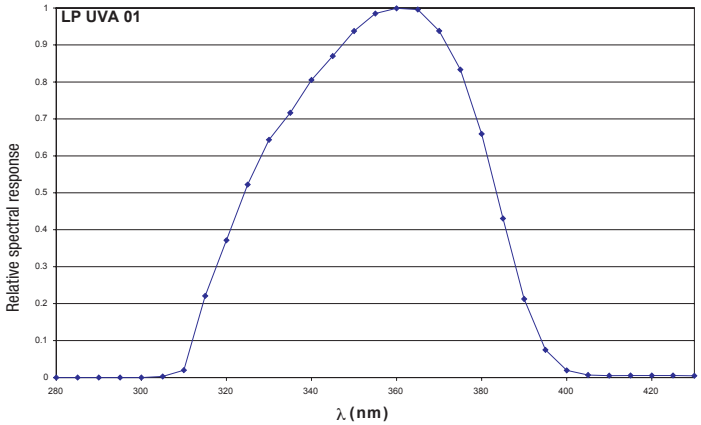
LP UVA 01:

The LP UVA 01 probe measures irradiance (W/m^2) defined as the ratio between the radiant flux (W) passing through a surface and the surface area (m^2) in the UVA (315 nm ... 400 nm) spectral range. Thanks to a new type of photodiode, LP UVA 01 is blind to visible and infrared light.
Probe calibration is carried out by using a 365 nm line of a Xe-Hg lamp, filtered through a special interferential filter. Measurement is carried out by comparison with the primary standards, assigned to Delta Ohm Metrological Laboratory.
This probe can be used in all processes where ultraviolet lamp emission needs to be monitored: resins and adhesives polymerization, as well as tanning lamps.

TECHNICAL SPECIFICATIONS

Typical sensitivity:	2.6 µV/(µW/cm²)
Measuring range:	0...200 mW/cm²
Typical spectral range:	peak at ≈360 nm and FWHM 60 nm
Calibration accuracy:	<6%
Working temperature:	0...50°C
Output impedance:	1 kΩ

Typical spectral response LP UVA 01



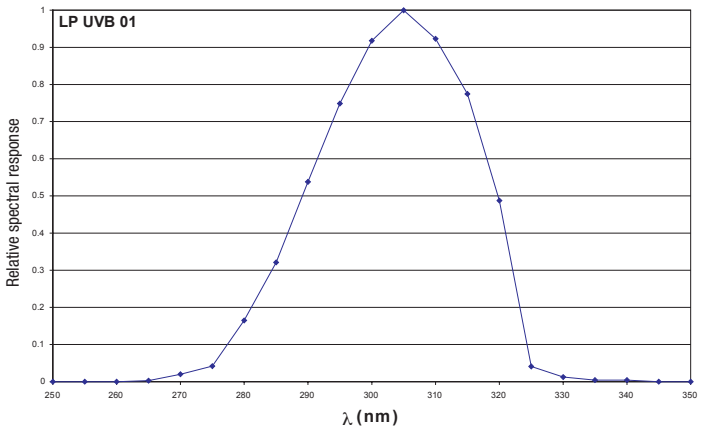
LP UVB 01:

The LP UVB 01 probe measures irradiance (W/m²) defined as the ratio between the radiant flux (W) passing through a surface and the surface area (m²) in the UVB (280 nm ...315 nm) spectral range. Thanks to a new type of photodiode, LP UVB 01 is blind to visible and infrared light. **Probe calibration is carried out by using a 313 nm line** of a Xe-Hg lamp, filtered through a special interferential filter. Measurement is carried out by comparison with the primary standards, assigned to Delta Ohm Metrological Laboratory.

TECHNICAL SPECIFICATIONS

Typical sensitivity:	0.19 µV/(µW/cm²)
Measuring range:	0...200 mW/cm²
Typical spectral range:	peak at ≈ 305 nm and FWHM 31 nm
Calibration accuracy:	<8%
Working temperature:	0...50°C
Output impedance:	2 kΩ

Typical spectral response LP UVB 01



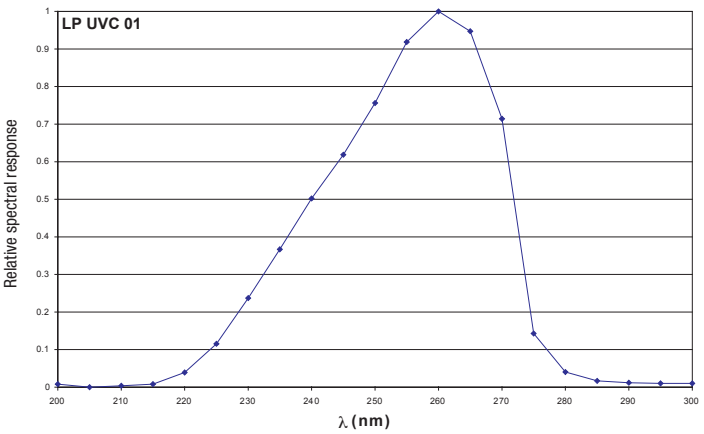
LP UVC 01:

The LP UVC 01 probe measures irradiance (W/m²) defined as the ratio between the radiant flux (W) passing through a surface and the surface area (m²) in the UVC (200nm ...280nm) spectral range. Thanks to a new type of photodiode, LP UVC 01 is blind to visible and infrared light. **The probe calibration is carried out by measuring irradiance coming from an Hg lamp at 254nm.**

TECHNICAL SPECIFICATIONS

Typical sensitivity:	0.19 µV/(µW/cm²)
Measuring range:	0...200 mW/cm²
Typical spectral range:	peak at 260 and FWHM 32nm
Calibration accuracy:	<10%
Working temperature:	0...50°C
Output impedance:	2 kΩ

Typical spectral response LP UVC 01



LP PAR 01:

The LP PAR 01 probe measures the ratio between the number of photons that strike a surface in one second, in the 400nm ... 700nm spectral range and the surface area (m²). This quantity is defined as PAR: Photosynthetically Active Radiation.

The probe calibration is carried out by using an halogen lamp, with a known spectral irradiance in a specific spectral range.

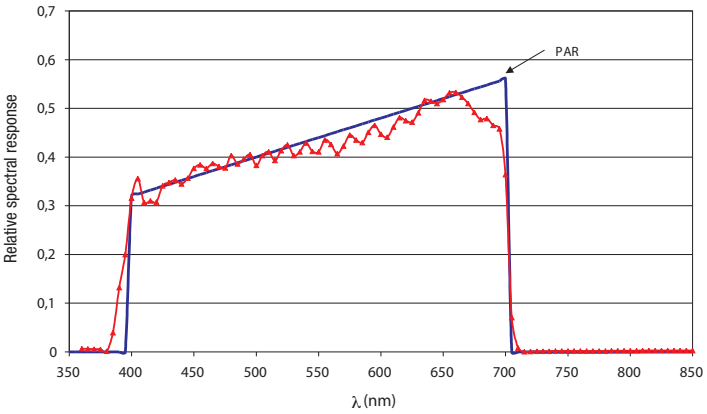
Temperature slightly affects the probe spectral response.

The diffuser and the probe particular structure, allow the response to the variation of the light incidence angle on the diffuser, to be cosine corrected.

TECHNICAL SPECIFICATIONS

Typical sensitivity:	30 µV/(µmol·m⁻²s⁻¹)
Measuring range:	0...5000 µmol·(m⁻²s⁻¹)
Typical spectral range:	400 nm ... 660 nm
Calibration accuracy:	<6%
f_2 (cosine response/directional error):	<6%
Operating temperature:	0...50°C
Output impedance:	1 kΩ

Typical spectral response LP PAR 01



Ordering codes:

LP PHOT 01: Photometric probe for measuring ILLUMINANCE, CIE photopic filter, diffuser for correction according to the cosine law. mV per klux output, cable 5m long.

LP RAD 01: Radiometric probe for measuring IRRADIANCE, diffuser for correction according to the cosine law. mV per mW/cm² output, cable 5m long.

LP PAR 01: Radiometric probe for measuring PHOTONS FLUX in the range of PAR (Photosynthetically Active Radiation). Cosine correction. mV per µmol/m²s output, cable 5m long.

LP UVA 01: Radiometric probe for measuring IRRADIANCE in the UVA (315…400nm). µV/µWcm⁻² output, cable 5m long.

LP UVB 01: Radiometric probe for measuring IRRADIANCE in the UVB (280…315nm). µV/µWcm⁻² output, cable 5m long.

LP UVC 01: Radiometric probe for measuring IRRADIANCE in the UVC (200…280nm). µV/µWcm⁻² output, cable 5m long.

LP BL: Base with levelling device. On request for assembly with the probes at the time of placing the order.

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

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

HD978TR5: Configurable signal converter amplifier with 4...20mA (20...4mA) output. Input measuring range -10...+60mV. Default setting 0...20mV. Minimum measuring range 2mV.

HD978TR6: Configurable signal converter amplifier with 0...10Vdc (10...0Vdc) output. Input measuring range -10...+60mV. Default setting 0...20mV. Minimum measuring range 2mV.

LP PHOT 01S

Transmitter with MODBUS-RTU RS485 output for the probe LP PHOT 01

The transmitter LP PHOT 01S converts the mV analog signal generated by the illumination probe LP PHOT 01 into a digital signal suitable to be transmitted over a serial line RS485 with MODBUS-RTU protocol. All connections are made via screw terminals accessible by removing the top cover of the transmitter. The container is designed for wall mounting.

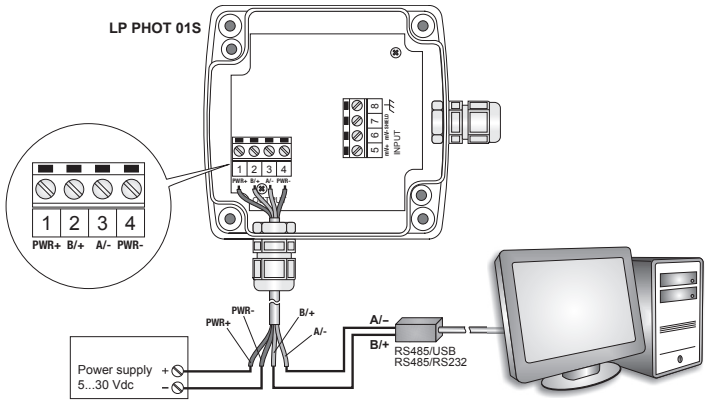
Technical specifications

Measuring range of the probe LP PHOT 01	Low range: 0…10.000 lux (default) High Range: 0…200.000 lux
Resolution	1 lux (low range) / 10 lux (high range)
Output	RS485 (1 Unit Load) with MODBUS-RTU protocol, non isolated
Power supply	5…30 Vdc
Housing dimensions	80 x 84 x 44 mm
Protection degree	IP 66
Working Temperature / %RH	-30…+70 °C / 0…90% U.R. without condensation
Storage temperature	-40…+80 °C

Setting the RS485 communication parameters of the transmitter

Before connecting the transmitter to the RS485 network, assign an address and set the communication parameters, if different from those preset by the factory.

The parameter setting is done by connecting the transmitter to the PC via optional RS48, with integrated converter RS485/USB. In order to use the cable the USB drivers should be installed on your PC. Alternatively, instead of the cable RS48, it is possible to use a generic RS485/RS232 or RS485/USB converter.



Notes on the USB driver installation:

With operating systems Windows 7 and Windows 8, before installing the driver, restart the PC by disabling the driver signing request. During the restart, press F8 to display the menu "*Advanced Boot Options*", then select the "*Disable Driver Signature Enforcement*".

With a 64-bit operating system, even after installation, the request of the driver signing must be disabled every time the PC is restarted.

Procedure for setting the parameters.

1. The transmitter should be powered off.
2. Start a program of serial communication standards, such as Hyperterminal. set the number of the COM port to which the transmitter should be connected, set the Baud Rate to 57600 and the communication parameters as follows:
   Data bits: 8 Parity: None Stop bits: 2
3. Power the transmitter on and wait for the reception of the character &, then send (within 10s from the instant the transmitter is powered on), the @ command and press the enter key.

Note: If the transmitter does not receive the **@** command within 10 seconds since when powered, it automatically switches the RS485 MODBUS on. In this case, it is necessary to remove and restore power to the transmitter.

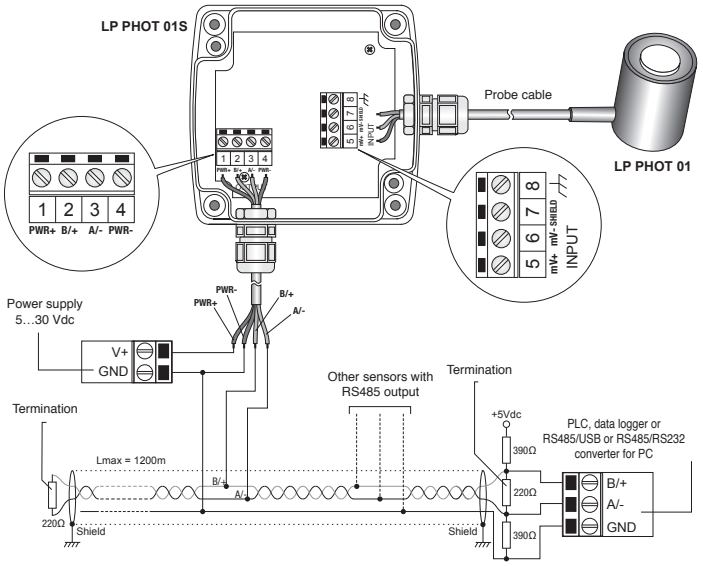
4. Send the command **CAL USER ON**.
   Note: The command CAL USER ON turns off after 5 minutes of inactivity.
5. Send the serial commands reported in the following table to set the parameters of RS485 MODBUS:

Command	Response	Description
CMAnnn	&|	Set address RS485 a nnn Between 1 and 247 Preset to 1
CMBn	&|	Set Baud Rate RS485 n=0 ⇒ 9600 n=1 ⇒ 19200 Preset to 1 ⇒ 19200
CMPn	&|	Sets transmission mode RS485 n=0 ⇒ 8-N-1 (8 data bit, no parity, 1 stop bit) n=1 ⇒ 8-N-2 (8 data bit, no parity, 2 stop bit) n=2 ⇒ 8-E-1 (8 data bit, no parity, 1 stop bit) n=3 ⇒ 8-E-2 (8 data bit, no parity, 2 stop bit) n=4 ⇒ 8-O-1 (8 data bit, no parity, 1 stop bit) n=5 ⇒ 8-O-2 (8 data bit, no parity, 2 stop bit) Preset to 2 ⇒ 8-E-1
CMWn	&|	Sets receiving mode after RS485 transmission n=0 ⇒ Violates the protocol and goes in Rx mode right after Tx n=1 ⇒ Respects the protocol and waits 3.5 characters after Tx Preset on 1 ⇒ Respects the protocol

6. It is possible to check the parameter settings by sending the following commands:

Command	Response	Description
RMA	*Address*	Reads the RS485 address
RMB	*Baud Rate*	Reads RS485 Baud Rate 0 ⇒ 9600 1 ⇒ 19200
RMP	*Tx Mode (0,1,2,3,4,5)*	Reads RS485 transmission mode 0 ⇒ 8-N-1 1 ⇒ 8-N-2 2 ⇒ 8-E-1 3 ⇒ 8-E-2 4 ⇒ 8-0-1 5 ⇒ 8-0-2
RMW	*Rx Mode (0,1)*	Reads receiving mode after RS485 transmission 0 ⇒ Violates the protocol and goes in Rx mode right after Tx 1 ⇒ Respects the protocol and waits 3.5 characters after Tx

Connection diagram for the operating mode



Terminal	Symbol	Function
1	PWR+	Positive Power Supply
2	B/+	RS485 B/+
3	A/-	RS485 A/-
4	PWR-	Negative Power Supply
5	mV+	Positive input signal in mV
6	mV-	Negative input signal in mV
7	SHIELD	Probe cable shield
8	⏚	Grounding

In order to get the maximum accuracy, it is recommended not to extend the shielded cable that came with the LP PHOT 01. It is also recommended not to pass the wiring in the vicinity of power cables (motors, induction ovens, inverters, etc…).

In RS485 connection, the instruments are connected via a shielded twisted pair cable for signals and a third wire for grounding. At the two ends of the network must present the line terminations. To polarize the line during periods of non-transmission, use the resistors connected among the signal lines and the power supply.

The maximum number of devices connected to the line (Bus) RS485 depends on the load characteristics of the devices to be connected. The RS485 standard requires that the total load does not exceed 32 unit loads (Unit Loads). The load of a transmitter LP PHOT 01S is equal to 1 unit load.

If the total load is greater than 32 unit loads, divide the network into segments and then put in a segment and the next a signal repeater. The beginning and end of each segment must be applied for line termination.

Operating mode
The transmitter enters the RS485 MODBUS-RTU mode after 10 seconds after turning on. During the first 10 seconds after turning on, the unit does not respond to any requests from the "master" MODBUS unit. After 10 seconds, it is possible to send requests to the transmitter MODBUS

Reading the measurements by using the MODBUS-RTU protocol
It is possible to read the measured values by the transmitter by using code function 04h (Read Input Registers). The following table lists the information available with the appropriate register address:

Address	Quantity	Format
2	Illuminance in lux (low range) or lux/10 (high range)	16 Integer
3	Status register bit 0 = 1 ⇒ measure illuminance in error bit 2 = 1 ⇒ error in the configuration data bit 3 = 1 ⇒ error in the program memory	16 Integer
4	Average illuminance in lux (low range) or lux/10 (high range) The average of the last 4 measurements	16 Integer
5	Value of the input signal in µV (low range) or µV/10 (high range)	16 Integer

Setting the sensitivity of the probe and the measurement range
The measuring range preset in the transmitter is 0…10,000 lux (low range), normally suitable for indoor measurements. If it has to be higher, for example in the case of outdoor measurements, it can be set to 0...200,000 lux (high range). The two ranges meet different resolutions: 1 lux for the low range, 10 lux for the high range.
The setting of the value of the probe sensitivity is required in case of replacement of the probe connected to the transmitter with a new probe with different sensitivity.
In order to set the sensitivity of the probe and the measurement range, proceed as follows:
1. Start when the transmitter is not powered.
2. Connect the transmitter to your PC via **optional RS48 cable**.
3. Start a standard serial communication program, such as Hyperterminal. Set the number of the COM port to which the transmitter has to be connected, set the Baud Rate to 57600 and communication parameters as follows:
   Data Bits: 8
   Parity: None
   Stop bit: 2
4. Power the transmitter on and wait for the reception of the character **&**, then send (within 10 s from the instant the transmitter is powered on) the **@** command and press the **enter** key. Note: If the transmitter does not receive the **@** command within 10 seconds since when powered, it automatically switches to the RS485 MODBUS. In this case it is necessary to remove and restore the power to the transmitter.
5. Send the command **CAL START**.

Note: The command CAL START turns off after 5 minutes of inactivity.

6. Send the following serial commands:

Command	Response	Description
CLSnnn	&I	Sets the sensitivity of the probe to the value nnn in µV/klux
02E	&I	Sets a low range (0…10.000 lux, resolution 1 lux)
02D	&I	Sets a high range (0…200.000 lux, resolution 10 lux)

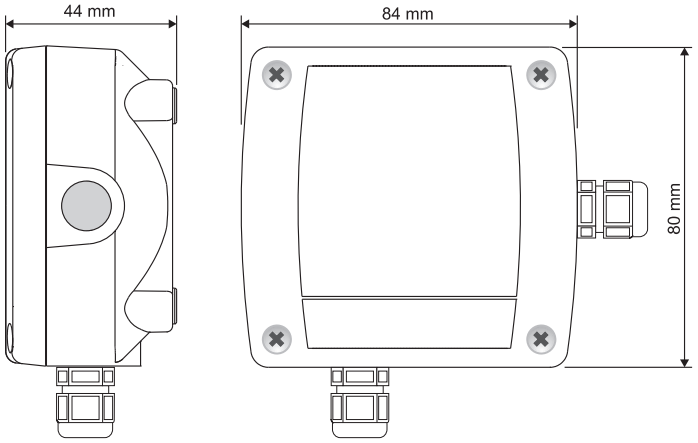
7. It is possible to check the setting of the sensitivity of the probe and of the measurement range by sending the following commands:

Command	Response	Description
RLS	& nnnI	Reads the set sensitivity in µV/klux
RO	hhI	Reads the configuration bite: bit 2 = 0 ⇒ high range (0…200.000 lux, resolution 10 lux) bit 2 = 1 ⇒ low range (0…10.000 lux, resolution 1 lux) *the bit 2 is the third bit from the right of the configuration byte*

Note: the reading of the settings with the controls and RLS and RO does not require sending the command CAL START.

At the end of the settings, turn off and on the transmitter to activate the operating mode RS485 MODBUS-RTU.

Dimensions



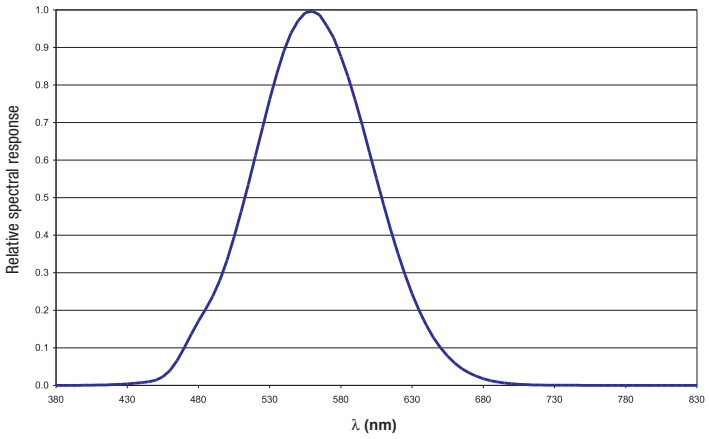
Ordering codes
LP PHOT 01S: Transmitter with RS485 MODBUS-RTU for the illumination probe LP PHOT 01. Measuring range: 0...10,000 lux with resolution 1 lux or 0...200,000 lux with resolution 10 lux. Connections with screw terminals. Housing for wall mounting. Power supply 5...30 Vdc. Equipped with illumination probe LP PHOT 01.
RS48: Connecting cable to PC for the configuration of the MODBUS parameters. Equipped with integrated converter RS485/USB. Free leads from the instrument, USB type A connector on the PC side.

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

TECHNICAL SPECIFICATIONS:

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

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



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

Photo-radiometric probes with output signal in mV or standard output 4...20mA or 0...10Vdc. The probes of the series LP…03 **for outdoor use** allow to measure photometric and radiometric quantities such as: illuminance (lux), irradiance (W/m²) in the near ultraviolet spectral region VIS-NIR, UVA, UVB, and the photon flow across the PAR region (400nm...700nm). The probes with mV output do not require any power supply. The output signal is obtained from a resistance that short-circuits the terminal of the photodiode. The ratio of generated photocurrent to incident light power is converted into a Difference of Potential that can be read by a voltmeter. Once the DDP (Difference of Potential) is known, the measured value can be calculated through the calibration factor. **All probes are individually calibrated and the calibration factor is also shown on the probe housing**. The probes with normalized output current 4...20mA or voltage 0...10Vdc or RS485 MODBUS RTU output require external power supply. The probe LP UVB 03 is available only with standard output voltage 0...5Vdc and requires external power supply. All probes of the series LP…03 are equipped with diffuser for cosine correction and protection dome. **M12 male 4-pole connector (M12 8-pole connector for the LP UVB 03).** Cables with female connectors and with 2, 5 or 10m length available on request.

LP PHOT 03

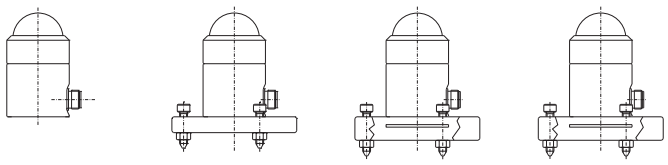
The probe LP PHOT 03 measures illuminance (lux), defined as the ratio between the luminous flux (lumen) passing through a surface and the surface area (m²).
The spectral response curve of a photometric probe is similar to the human eye curve, known as standard photopic curve V(λ). The difference in spectral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

ORDERING CODE

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

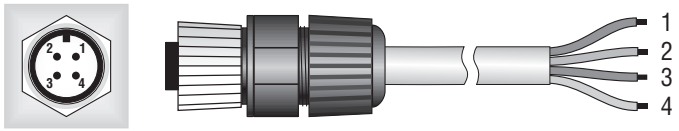
LP PHOT ☐
- **03** = mV / klux
- **03BL** = mV / klux output, base with levelling device
- **03BLAC** = base with levelling device output 4...20 mA
- **03BLAV** = base with levelling device output 0...10 V

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



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

WIRING DIAGRAM
4-pole wire CPM12AA4…



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

LPPHOT 03, LP PHOT 03BL

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

LP PHOT 03BLAV

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

LP PHOT 03BLAC

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

LP RAD 03

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

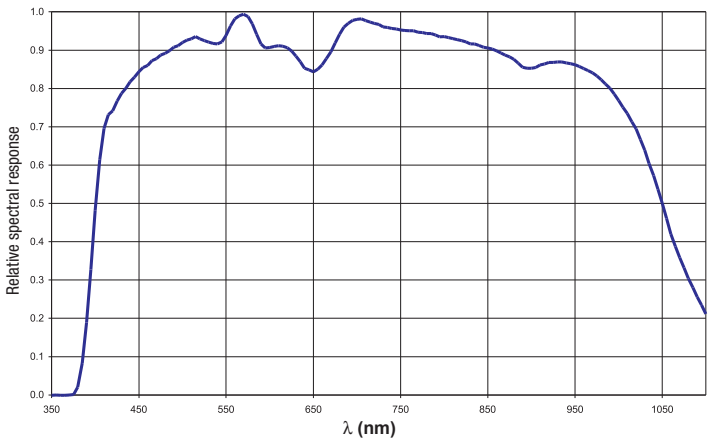
TECHNICAL SPECIFICATIONS

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

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

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

Typical spectral response curve **LP RAD 03**



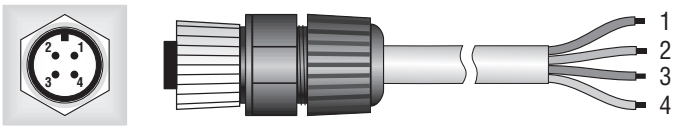
ORDERING CODE

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

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

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

WIRING DIAGRAM
4-pole wire CPM12 AA4…



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

LP RAD 03, LP RAD 03BL

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

LP RAD 03BLAV

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

LP RAD 03BLAC

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

LP PAR 03

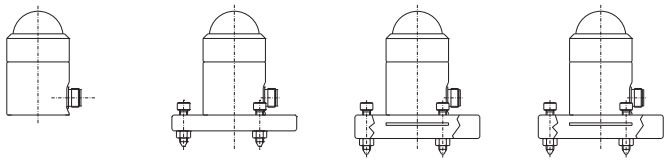
The probe LP PAR 03 measures the ratio between the number of photons that strike a surface in one second, in the 400nm...700nm spectral range and the surface area (m²).
This quantity is defined as PAR: Photo-synthetically Active Radiation.
The probe calibration is carried out by using an halogen lamp,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

TECHNICAL SPECIFICATIONS

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

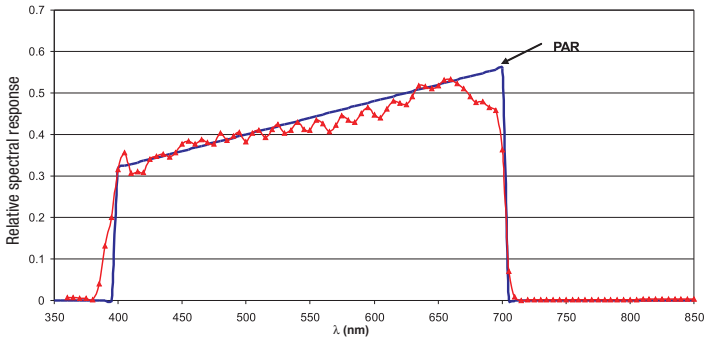
Version with normalized output 4...20mA: 4mA = 0 µmol($m^{-2}s^{-1}$), 20mA = 5000 µmol($m^{-2}s^{-1}$)
Version with normalized output 0...10Vdc: 0V = µmol($m^{-2}s^{-1}$), 10V = 5000 µmol($m^{-2}s^{-1}$)

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



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

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



ORDERING CODE

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

LP PAR ☐

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

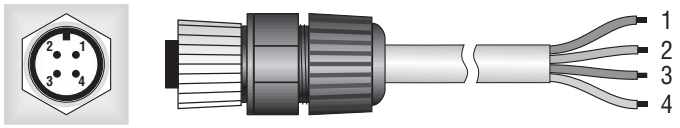
CABLE:

CPM12 AA4 ☐

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

WIRING DIAGRAM

4-pole wire CPM12 AA4…



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

LP PAR 03, LP PAR 03BL

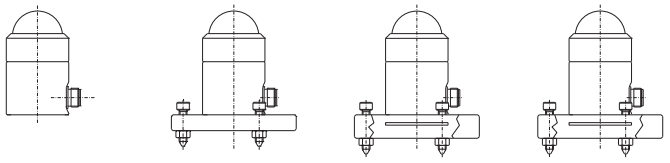
Connector	Function	Color
1	Positive (+)	Red
2	Negative (-)	Blue
3	Not connected	White
4	Shield	Black

LP PAR 03BLAV

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

LP PAR 03BLAC

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



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

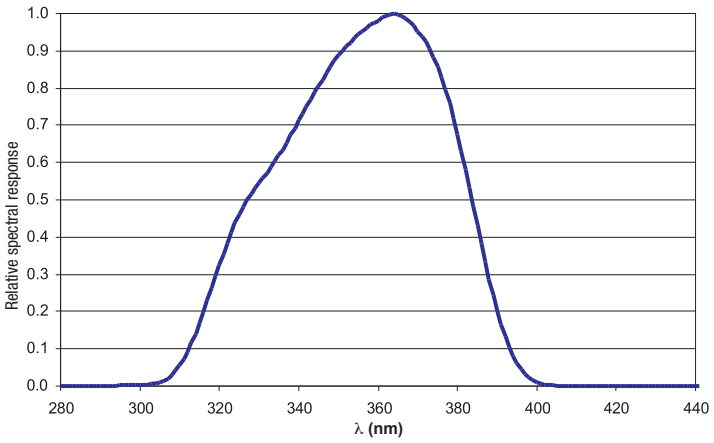
LP UVA 03

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

TECHNICAL SPECIFICATIONS

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

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



ORDERING CODE

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

LP UVA ☐

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

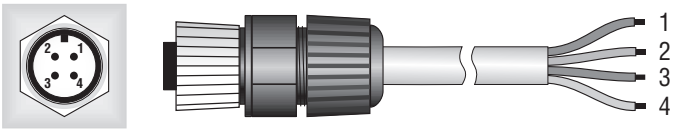
CABLE:

CPM12 AA4 ☐

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

WIRING DIAGRAM

4-pole wire CPM12 AA4…



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

LP UVA 03, LP UVA 03BL

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

LP UVA 03BLAV

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

LP UVA 03BLAC

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

LP UVB 03BLAV

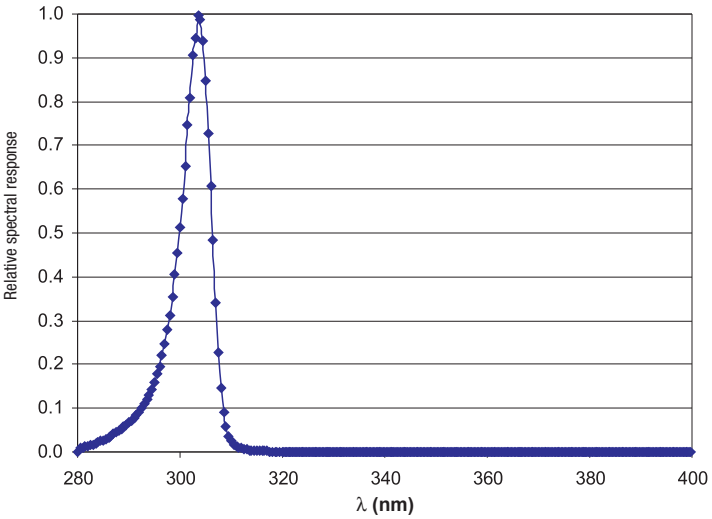
The LP UVB 03BLAV probe measures global irradiance (W/m²) on a surface area (m²) in the UVB (280 nm...315 nm) spectral region. In particular, the spectral sensitivity is focused at 305 nm, with a bandwidth (FWHM) of 5nm. The global irradiance is the result of the sum of direct solar irradiance and of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

Typical output 0...5Vdc.

TECHNICAL SPECIFICATIONS

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

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



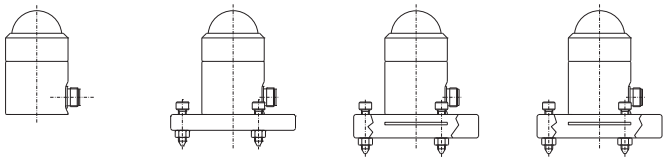
ORDERING CODE

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

LP UVB ☐ — **03BLAV** = 0...5 V, complete with levelling device

CABLE:

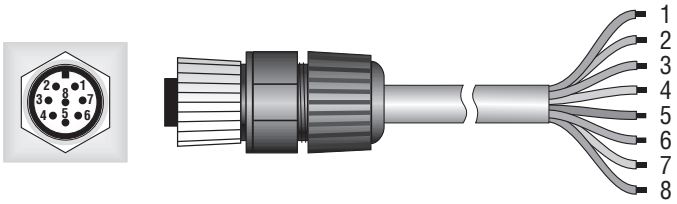
CPM12 AA8 ☐ —
2 = length 2m
5 = length 5m
10 = length 10m



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

WIRING DIAGRAM

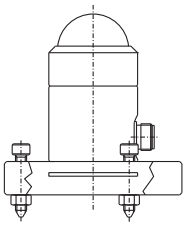
8-pole wire CPM12 AA8…



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

LP UVB 03BLAV

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



LP UVB 03BLAV

ACCESSORIES

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

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

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

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

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

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

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

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

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

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

HD 778 TCAL: Voltage generator in the range -60mVdc…+60mVdc, **controlled by PC through the RS232C serial port**, **DELTALOG-7** software for setting K, J, T, N thermocouple transmitters and HD978TR3, HD978TR4, HD978TR5, HD978TR6 converters.

LP PHOT 03S

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

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

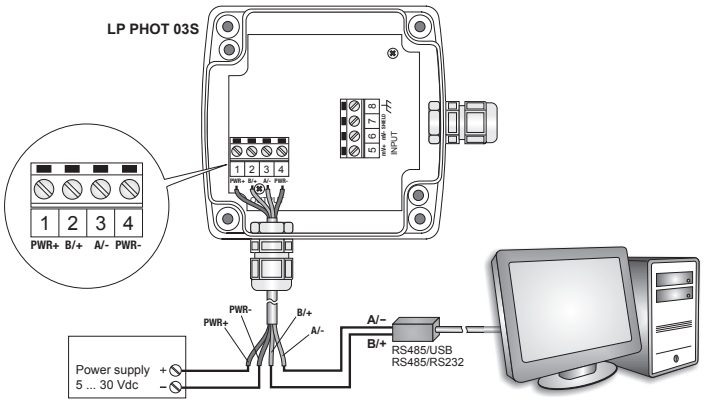
Technical characteristics

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

Setting the RS485 communication parameters of the transmitter

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

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



USB drivers installation notes:

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

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

Procedure for setting the parameters

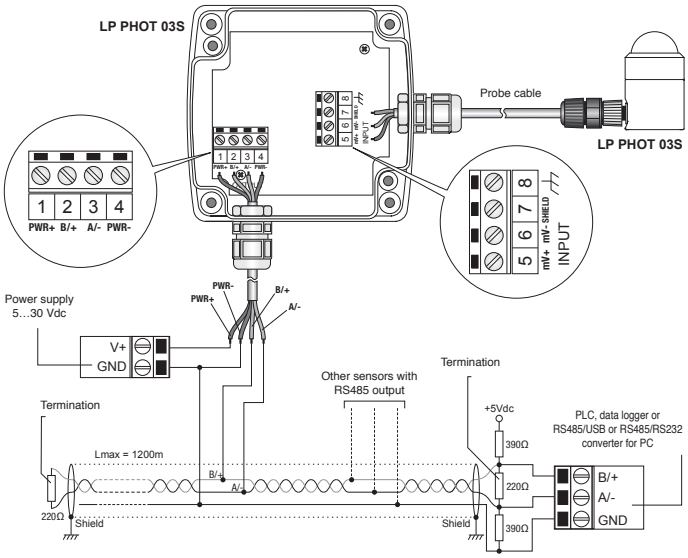
1. Start with the transmitter not powered.
2. Start a standard serial communication program, such as Hyperterminal. Set the COM port number to which the transmitter will be connected, set the Baud Rate to 57600 and the communication parameters as follows:
   Data Bits: 8 Parity: None Stop Bits: 2
3.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

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

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

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

Operating mode connection



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

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

Operating mode

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

Reading of the measures with the MODBUS-RTU protocol

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

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

Setting the probe sensitivity and the measuring range

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

1. Start with the transmitter not powered.
2. Connect the transmitter to the PC by using **the optional RS48 cable.**
3. Start a standard serial communication program, such as Hyperterminal. Set the COM port number to which the transmitter will be connected, set the Baud Rate to 57600 and the communication parameters as follows:
   Data Bits: 8
   Parity: None
   Stop Bits: 2
4. Switch the transmitter on and wait to receive the & character, then send (within 10 s from power on) the @ command and press Enter.
   Note: if the transmitter does not receive the @ command within 10 seconds from power on, the RS485 MODBUS mode is automatically activated. In such a case, it is necessary to switch off and on again the transmitter.
5. Send the command **CAL START.**
   Note: the command CAL START is disabled after 5 minutes of inactivity.
6. Send the following serial commands:

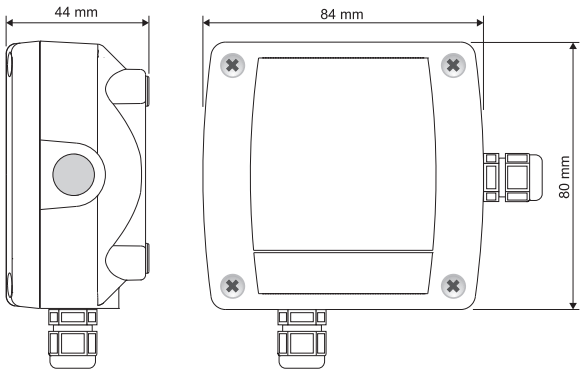
Command	Response	Description
CLSnnn	&|	Set the probe sensitivity to the value nnn in µV/klux nnn indicates a 3 or 4-digit integer number between 500 and 2500
02E	&|	Set low range (0…10,000 lux, 1 lux resolution)
02D	&|	Set high range (0…200,000 lux, 10 lux resolution)

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

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

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

Dimensions



Ordering codes

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

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

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

Working principle

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

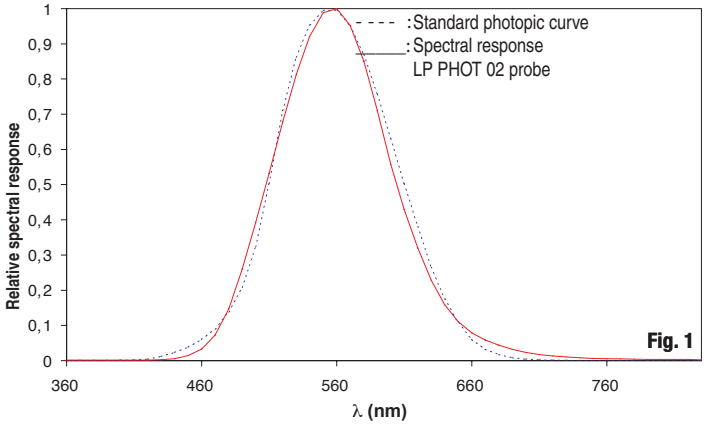


Fig. 1

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

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

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

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

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

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

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

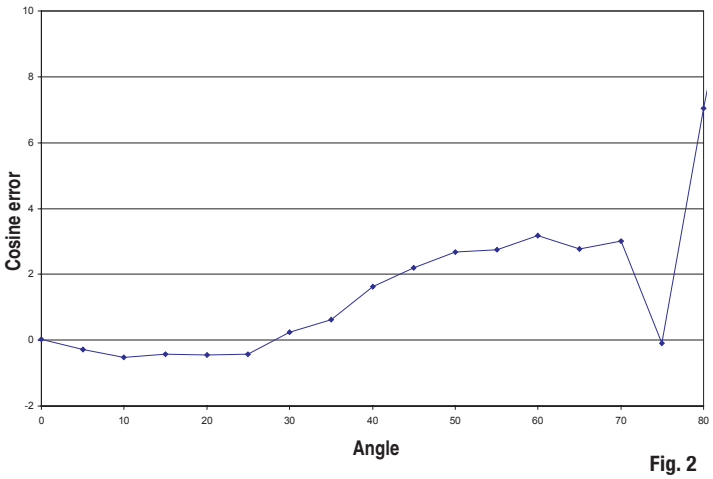


Fig. 2

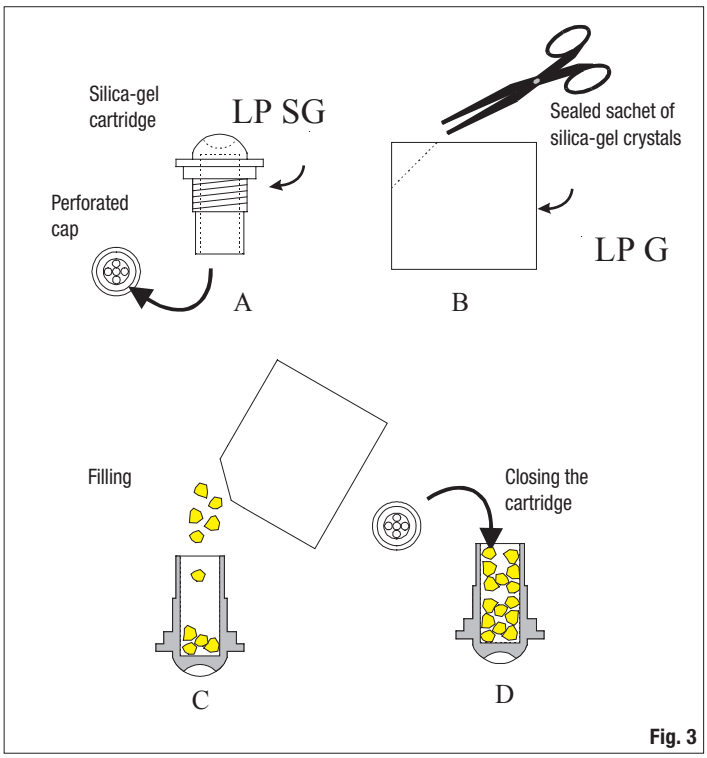


Fig. 3

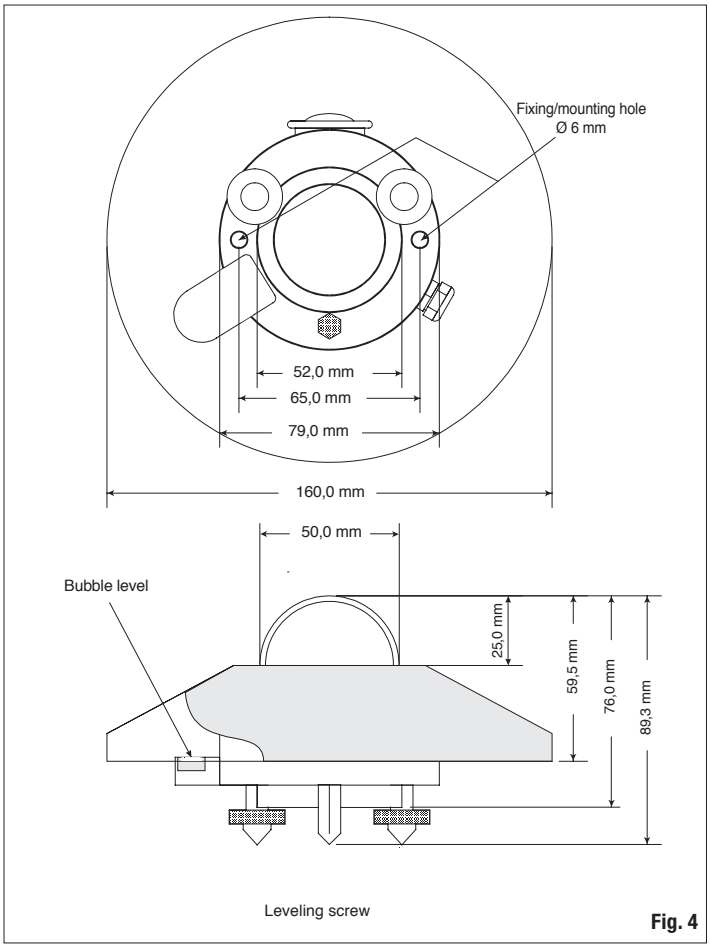
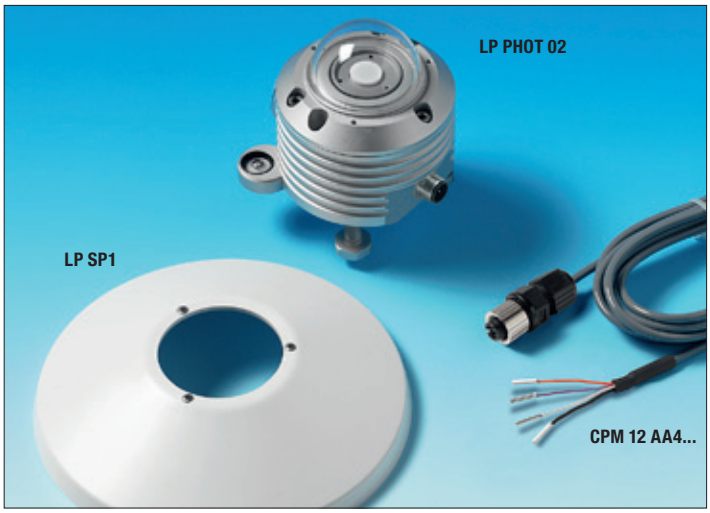
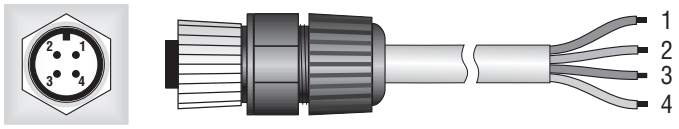


Fig. 4



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

WIRING DIAGRAM LP PHOT 02



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

LP PHOT 02

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

LP PHOT 02 AC

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

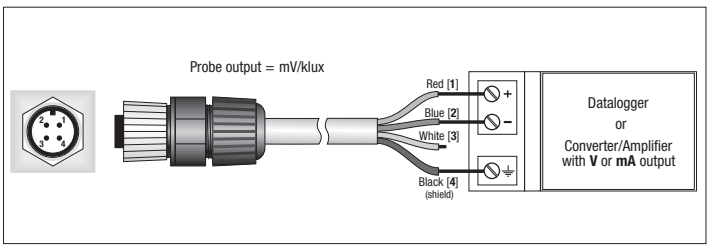
LP PHOT 02 AV

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

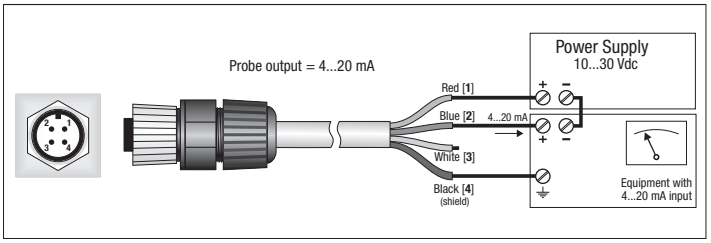
- To allow cleaning the outer dome regularly and carrying out the instrument maintenance, LP PHOT 02 should be mounted in easily reachable places. At the same time, you should check that no building, tree, or any other obstacle exceeds the horizontal plane where the luxmeter is mounted. In case this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

WIRING DIAGRAM CONNECTION

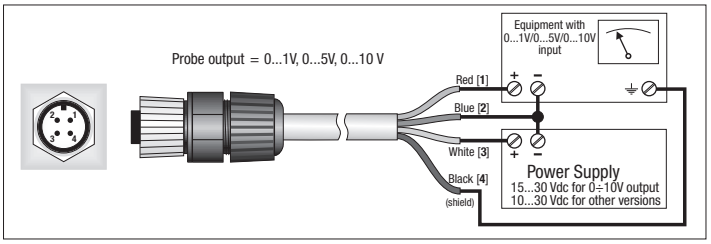
LP PHOT 02



LP PHOT 02 AC



LP PHOT 02 AV



LP PHOT 02 Electrical Connections and requirements for electronic readout devices

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

Maintenance:

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

Calibration and measurements:

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

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

$$E_e = DDP/S$$

where;

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

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

Technical specifications:

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

ORDERING CODES

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

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

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

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

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

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

LP G: Packet with 5 silica gel spare cartridge.

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

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

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

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

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

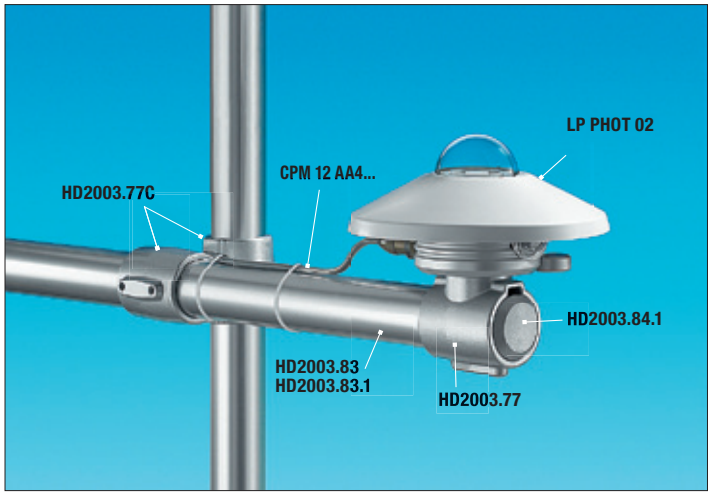
HD978TR3: Configurable signal converter amplifier with 4...20mA (20...4mA) output. Input range -10...+60mVdc. **Standard configuration 0...20mVdc**. Minimum measuring range 2mVdc. 2- DIN modules for 35mm rail. **Configurable with HD778 TCAL**

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

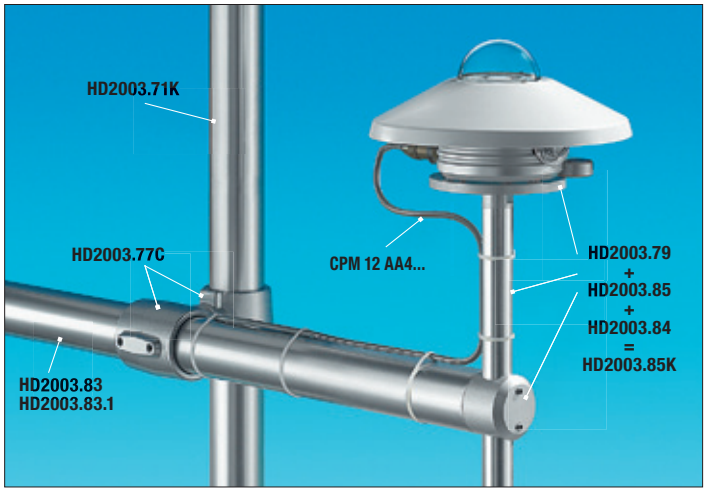
HD978TR4: Configurable signal converter amplifier with 0...10Vdc (10...0Vdc) output. Input range -10...+60mVdc. **Standard configuration 0...20mVdc**. Minimum measuring range 2mVdc. 2- DIN modules for 35mm rail.. **Configurable with HD778 TCAL**

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

HD778TCAL: Voltage generator in the range -60mVdc…+60mVdc, **controlled by PC through the RS232C serial port**, **DELTALOG-7** software for setting K, J, T , N thermocouple transmitters and HD978TR3, HD978TR4, HD978TR5, HD978TR6 converters.



LP PHOT 02



LP PHOT 02

LP UVA 02

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

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

Working Principle
LP UVA 02 radiometer is based on a solid state sensor, the spectral match with the desired curve is obtained using special filter. The relative spectral response is reported on figure 3.
In order to protect the diffuser from the dust, LP UVA 02 is equipped with a 50mm glass dome. The cosine low response is obtained with a particular shaped PTFE diffuser. In figure 4 the cosine error versus angle of incident is reported.
The excellent cosine law response of LP UVA 02 allow to use the radiometer at any sun's zenith angle. (The diffused component of the UVA increases as the sun moves away from the zenith, so the error on direct component due to imperfect response according to the cosine becomes negligible on the measurement of global irradiance).

Installation and Mounting of the Radiometer for the Measurement of Global Radiation:
Before installation, refill the cartridge containing silica-gel crystals. Silica gel absorbs humidity in the dome chamber and prevents (in particular climatic conditions) internal condensation forming on the internal walls of the domes and measurement alteration.
Do not touch the silica gel crystals with your hands while refilling the cartridge. Carry out the following instructions in an environment as dry as possible:

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

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

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

Electrical Connection and Requirements for Electronic Readout Devices:

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

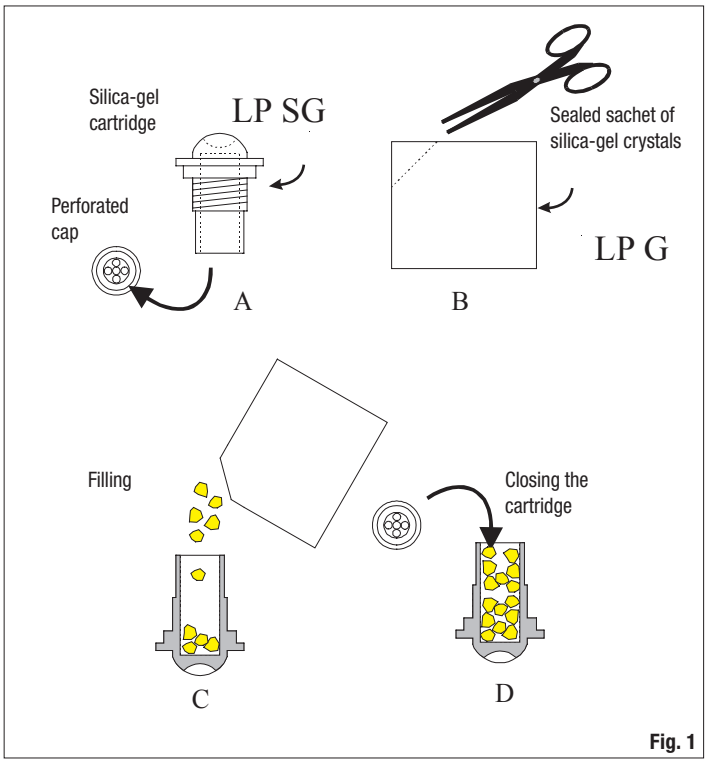


Fig. 1

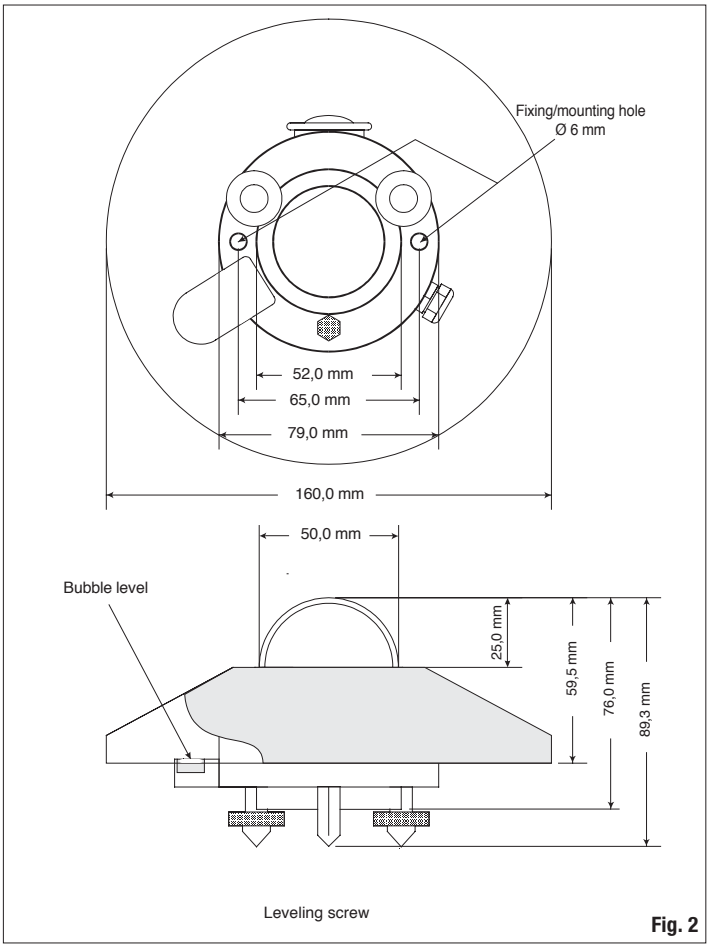
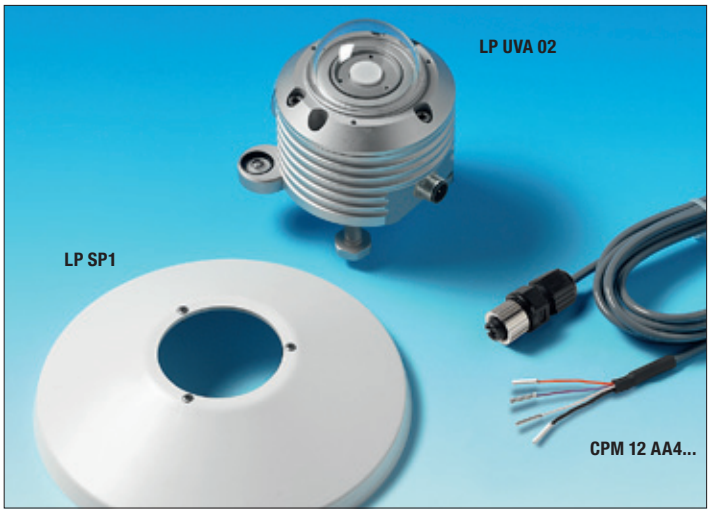


Fig. 2



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

Calibration and Measurements:

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

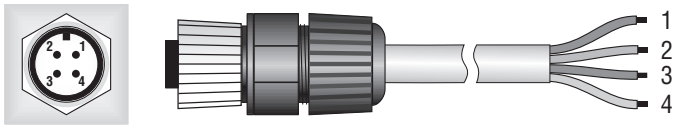
- Once the difference of potential (DDP) has been measured at the ends of the sensor, the E_e irradiance is obtained applying the following formula:

$$E_e = DDP/S$$

Where:

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

WIRING DIAGRAM LP UVA 02



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

LP UVA 02

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

LP UVA 02 AC

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

LP UVA 02 AV

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

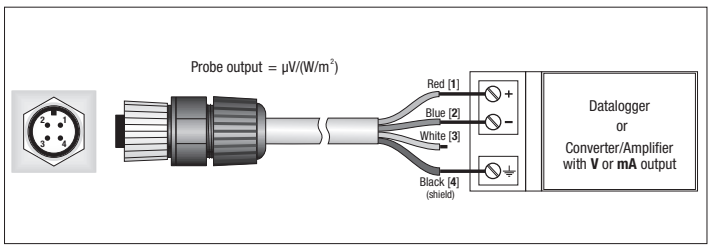
Maintenance:

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

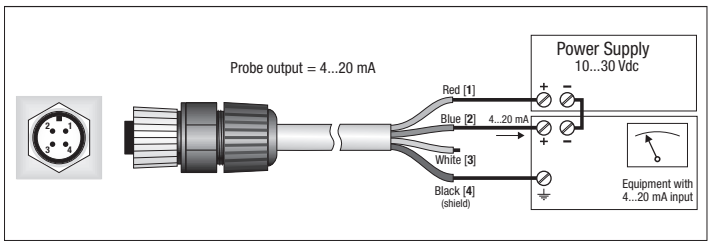
Because of the high rise/fall in temperature between day and night, some condensation might appear on the radiometer dome. To minimize the condensation growth, the radiometer is provided with a cartridge containing desiccant material: Silica gel. The efficiency of the Silica gel crystals decreases in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

CONNECTION DIAGRAMS

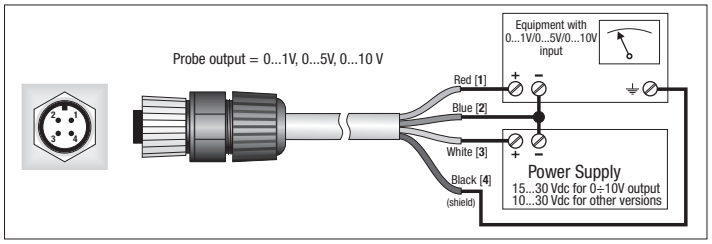
LP UVA 02



LP UVA 02 AC



LP UVA 02 AV



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

Technical Specifications:

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

ORDERING CODES

LP UVA 02: Radiometric probe for the outdoor measurement of UVA irradiance (315…400nm), complete with LP SP1 protection, silica gel cartridge, 2 spare sachets with silica gel crystals, bubble level, M12 4-pole connector and Calibration Report. **2m, 5m or 10m cables with connectors available on request.**

LP UVA 02AC: Amplified radiometric probe for the outdoor measurement of UVA irradiance (315…400nm), **4...20mA output (0…200W/m²)**, integrated transmitter amplifier, **power supply 10…30Vdc**. Complete with M12 4-pole connector and Calibration Report. **2m, 5m or 10m cables with connectors available on request.**

LP UVA 02AV: Amplified radiometric probe for the outdoor measurement of UVA irradiance (315…400nm), **0...1Vdc, 0...5Vdc, 0...10Vdc output (0…200W/m²)**, integrated transmitter amplifier, **power supply 10…30Vdc**. **(15..30Vdc for 0…10Vdc output).** Complete with M12 4-pole connector and Calibration Report. **2m, 5m or 10m cables with connectors available on request.**

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

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

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

LP G: Packet with 5 silica gel spare cartridge.

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

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

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

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

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

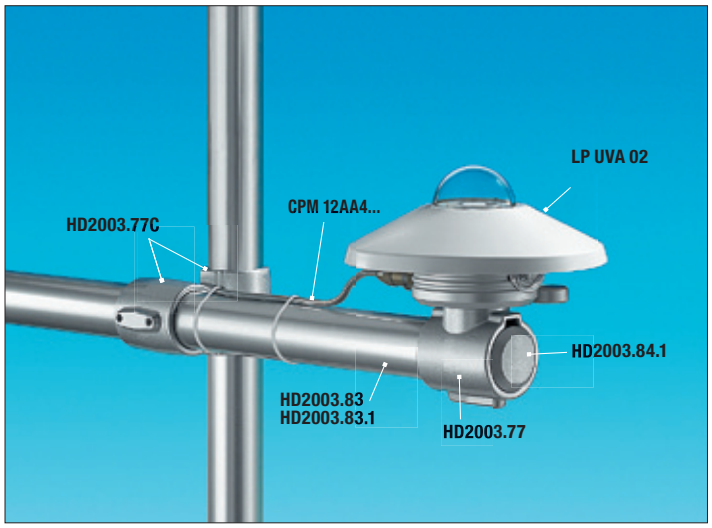
HD978TR3: Configurable signal converter amplifier with 4...20mA (20...4mA) output. Input range -10...+60mVdc. **Standard configuration 0...20mVdc**. Minimum measuring range 2mVdc. 2- DIN modules for 35mm rail. **Configurable with HD778 TCAL**

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

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

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

HD778TCAL: Voltage generator in the range -60mVdc…+60mVdc, **controlled by PC through the RS232C serial port**, **DELTALOG-7:** software for setting K, J, T , N thermocouple transmitters and HD978TR3, HD978TR4, HD978TR5, HD978TR6 converters.



LP UVA 02

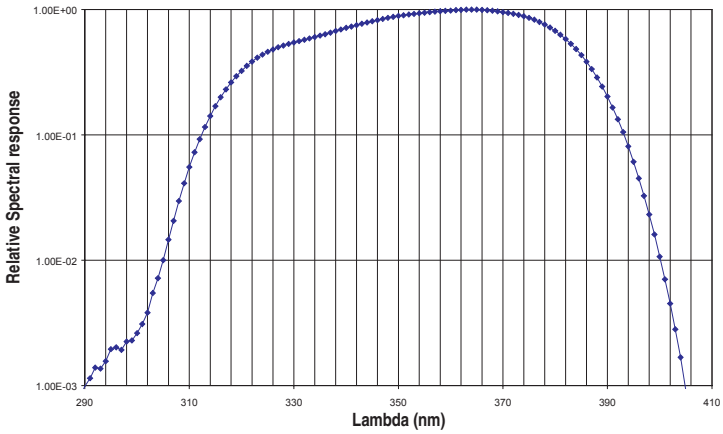


Fig. 3

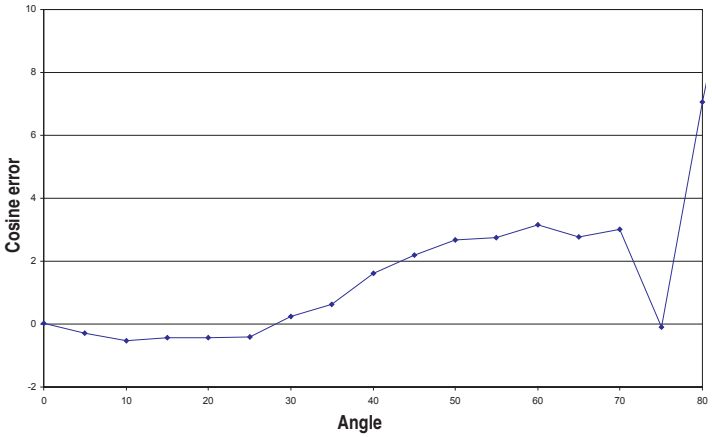


Fig. 4

LP UVB 02

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

Working Principle

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

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

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

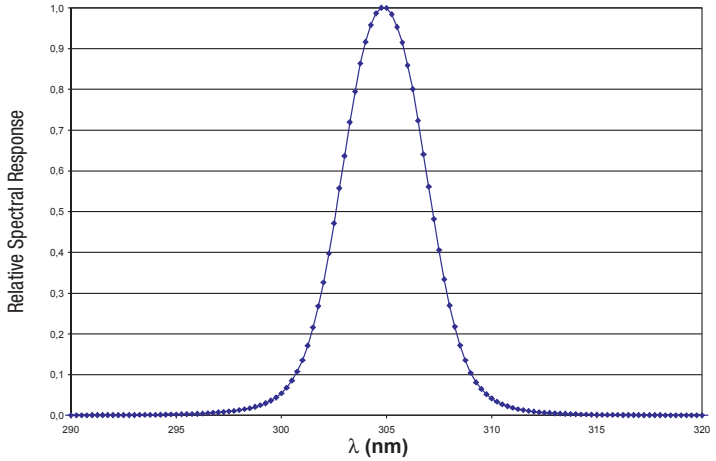


Fig. 1A

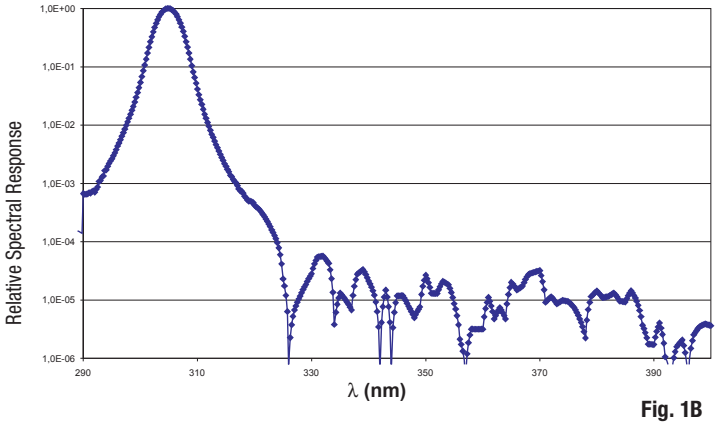


Fig. 1B

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

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

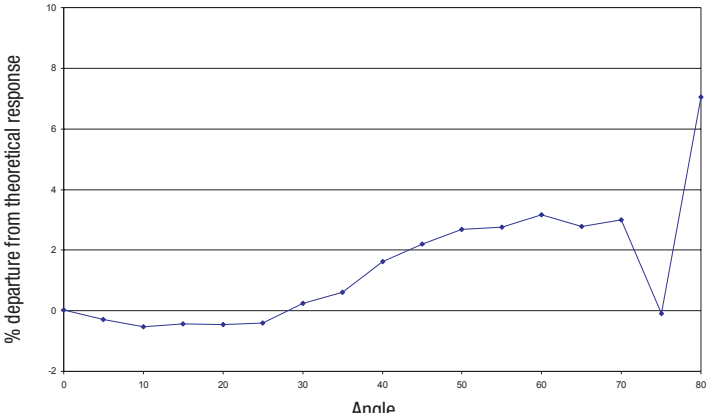


Fig. 2

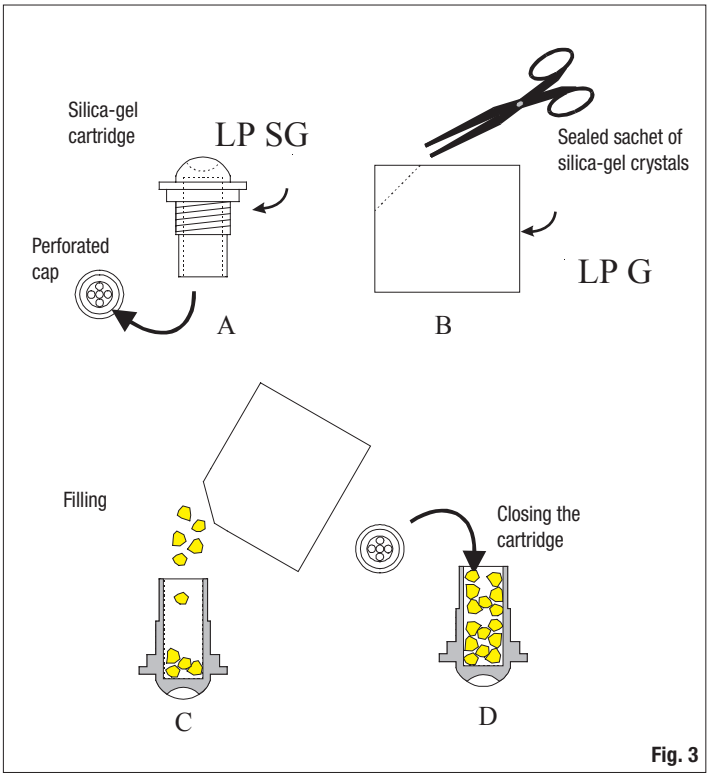


Fig. 3

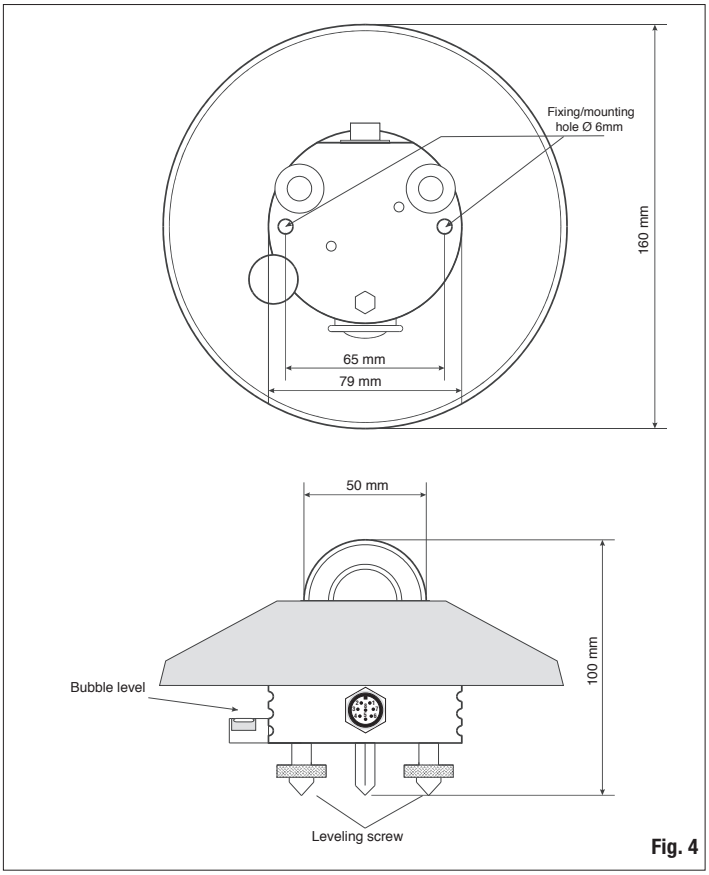


Fig. 4

Installation and Mounting of the Radiometer for the Measurement of the Global Radiation
Before installing the radiometer refill the cartridge containing the silica-gel crystals. Silica gel absorbs humidity in the dome chamber; in case of particular climatic conditions this humidity can cause condensation on the internal side of the dome and then modify the measurement. Do not touch the silica gel crystals with your hands and do not wet them while refilling the cartridge. Carry out the following instructions in an environment as dry as possible:

1- loosen the three screws that fix the white shade disk
2- unscrew the silica gel cartridge using a coin
3- remove the cartridge perforated cap
4- open the sachet containing the silica gel (supplied with the radiometer)
5- fill the cartridge with the silica-gel crystals
6- close the cartridge with its own cap, paying attention that the sealing O-ring be properly positioned and undamaged
7- screw the cartridge to the radiometer body using a coin
8- **check that the cartridge is screwed tightly** (if not, the silica-gel life will be reduced)
9- position the shade disk and tighten it with the screws
10- the radiometer is ready for use

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

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

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

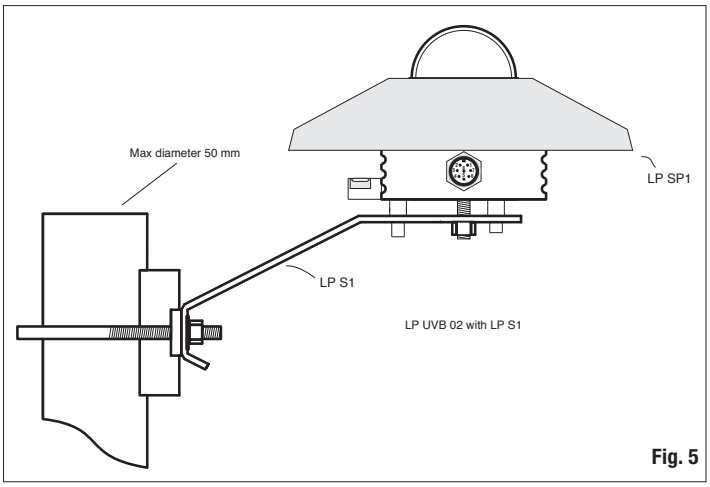


Fig. 5

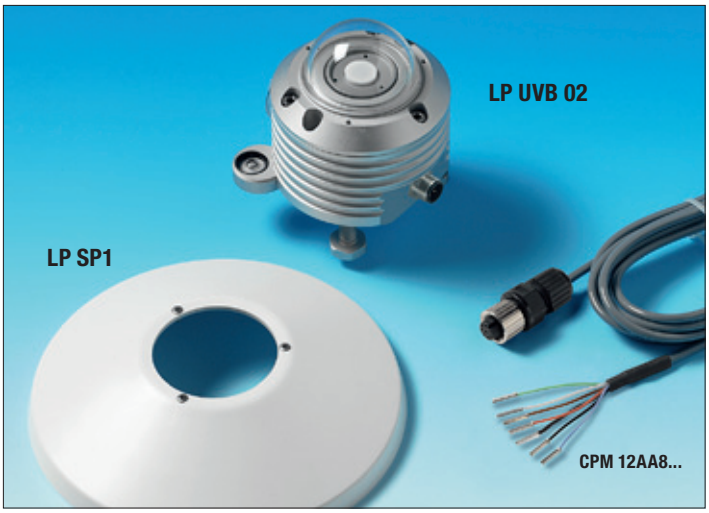
Electrical Connections and Requirements for Electronic Readout Devices
The connections on the output connector are indicated below:

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

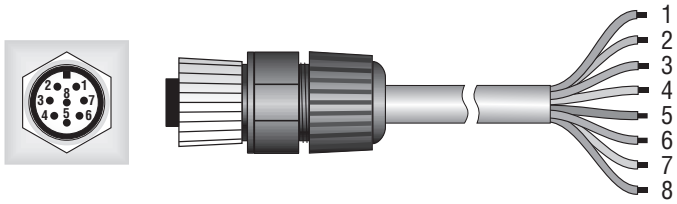
• The LP UVB 02 has to be connected either to a voltmeter or to a data acquisition system with input impedance greater than 10kΩ. Typically, the radiometer output signal, when exposed to the sun, does not exceed 1 volt. In order to better exploit the radiometer features, the readout instrument should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

The connection scheme is shown in figure 6.
The UV-resistant cable (supplied on request) has 6 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. In this case the performed reading is highly overestimated. To minimize



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 UVB 02 CONNECTION DIAGRAMS

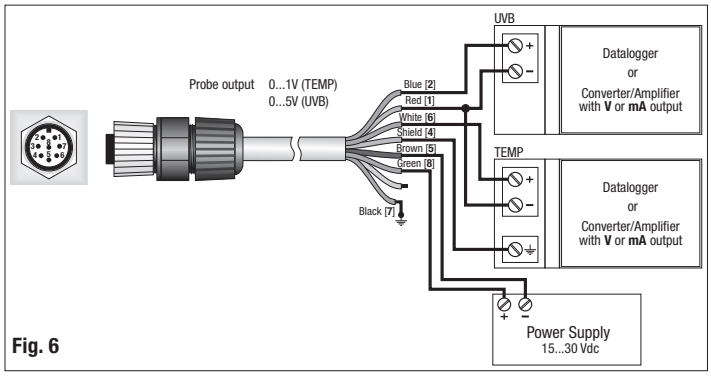


Fig. 6

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

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

Calibration and Measurements

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

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

where:

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

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

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

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

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

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

$$T=100 \cdot [VoutTemp+] - 40 \ °C$$

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

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

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

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

Technical characteristics

UV MEASUREMENT

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

TEMPERATURE MEASUREMENT

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

POWER SUPPLY

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

ORDERING CODES:

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

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

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

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

LP G: Packet with 5 silica gel spare cartridge.

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

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

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

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

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

HD 2021T…
TRANSMITTERS FOR ILLUMINANCE AND IRRADIANCE MEASUREMENTS.

The series of transmitters HD 2021T… allow to convert photometric and radiometric quantities, such as illuminance (Lux) and irradiance (W/m^2) in the UVA, UVB, UVC spectral regions and in the 400 ... 1050nm band, into a 0 ...10Vdc voltage signal. The 0 ... 10 V output voltage (0...1V, 0...5V, 4...20mA available upon request for orders of minimum 5 units) is factory calibrated according to the full scale range specified at the time of order. The wide range of applications of the HD2012T… transmitters include:

- Control of illuminance (HD 2021T…) in offices, manufacturing plants and production areas, commercial sites, theatres, museums, sports facilities, roadway lighting, tunnels and nursery-gardening systems.
- Control of solar radiation in the 400nm...1050nm spectral band (HD 2021T1).
- Control of the irradiance emitted by the tanning lamps in the UVA (HD 2021T2) and UVB (HD2021T3) spectral regions, as well as control of the efficiency of filters in devices using high pressure lamps.
- Control of the efficiency of the lamps used in sewage treatment plants, where UVC (HD2021T4) band irradiance has to be constantly monitored.

The series of transmitters HD2021T... is suitable to be installed either indoor and outdoor (Protection: IP66). In case of measurements of extremely intense light sources, the transmitter sensitivity can be reduced upon request. The HD 2021T… series use filters and photodiodes especially studied to adjust spectral response to a specific region of interest.

INSTALLATION OF THE TRANSMITTERS

Once identified the installation location, provide the electric connections inside the transmitter. Unscrew the four screws on the transmitter cover, lift the cover, the inside of the transmitter is as in Figure 1.
The terminal, easily identifiable, is equipped with three terminals with the following letters:
GND ➔ is the mass to which the power supply and the output signal are referred
+Vdc ➔ is the head connected to the positive pole (if a DC power supply is used)
Vlux (output) ➔ is the output of the system to be connected to the positive pole of a multimeter or to a data acquisition system.

The sample below shows the installation of illuminance HD2021T transmitter for monitoring lamps intensity. For this kind of applications, the HD2021T transmitters are generally installed on ceilings, close to the area where illuminance needs to be monitored (figure 2). By means of a reference Luxmeter (ex. HD2102.1 o HD2102.2 with the probe LP471PHOT) previously placed in the operating area, act on the HD2021T potentiometer up to obtain the reference value desired. The output of the HD2021T is suitable to control several adjustable power supply units at the same time.

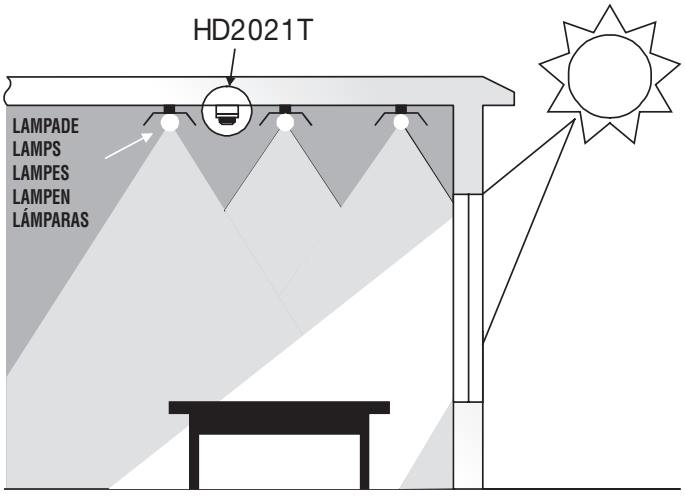


fig. 2

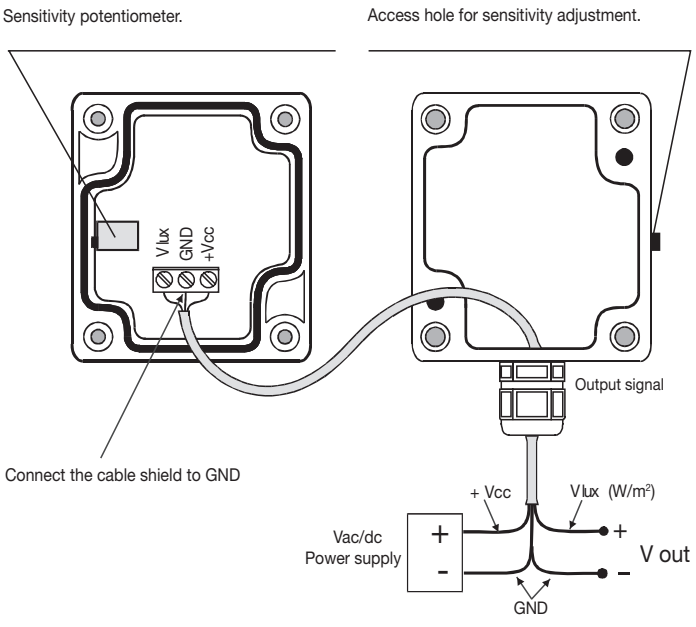
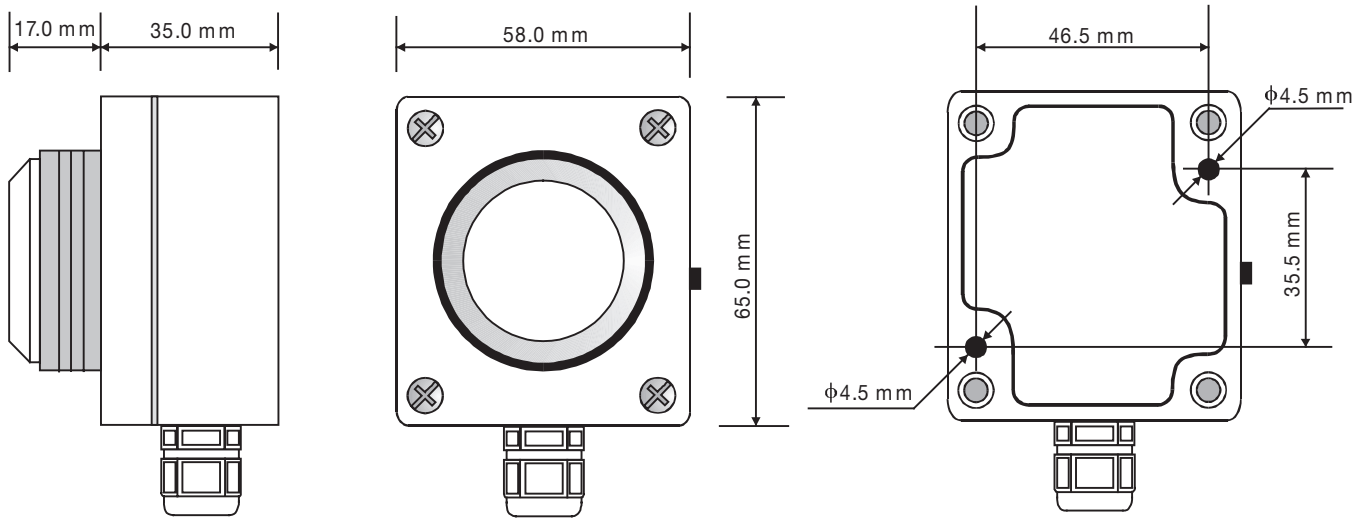


fig. 1

DIMENSIONS:
HD2021T, HD2021T1, HD2021T2, HD2021T3, HD2021T4



TECHNICAL SPECIFICATIONS

	HD2021T	HD2021T1	HD2021T2	HD2021T3	HD2021T4
Sensor	Photodiode Si	Photodiode Si	Photodiode GaP	Photodiode SiC	Photodiode SiC
Spectral range	Curve V(λ)	450 ... 1050 nm	UVA	UVB	UVC
Measure	Photometric	Radiometric			
Viewing angle	Corrected in accordance with the Cosine law				
Measurement range	see table **A - B - C**				
	mV/lux	mV/(mW/m²)	mV/(mW/m²) peak 360 nm	mV/(mW/m²) peak 305 nm	mV/(mW/m²) peak 260 nm
Output signal	0 ... 10 V (0 ... 1 V, 0 ... 5 V minimum order 5 pcs) 4 ... 20mA				
Power supply	16 ... 40 Vdc or 24 Vac, for 0 ... 10 V output 10 ... 40 Vdc or 24 Vac for 0 ... 1 V, 0 ... 5 V output - 10 ... 40 Vdc for 4 ... 20 mA output				
Power consumption	10 mA				
Working temperature	-20 ... +60 °C				
Electrical protection	Protected against polarity inversions				
Maximum dimensions	58 mm x 65 mm x 52 mm				
Degree of protection	IP 66				
Maximum cable length	150 m with output 4...20mA – 10m with the voltage outputs				

ORDERING CODES

* The full scale value has to be selected in the fields A, B, C

MODEL	A	B	C	X
HD 2021T	0.02...2 klux	0.2...20 klux	2...200klux	**Other ranges available upon request for at least 5 pcs per order**
HD 2021 T1	0.2...20 W/m²	2...200 W/m²	20...2000 W/m²	
HD 2021 T2	0.2...20 W/m²	2...200 W/m²	20...2000 W/m²	
HD 2021 T3	2...200 W/m²	20...2000 W/m²		
HD 2021 T4	2... 200 W/m²	20...2000 W/m²		

** For voltage output 0...10V, please indicate: V
For current output 4...20mA, please indicate: A
i.e. HD2021TBA: Transmitter for illuminance range 0,2...20klux, Output 4...20mA

HD 2021T7
HD 2021T6

HD 2021T7, HD 2021T6
DEBILITATING LUMINANCE PROBE, LUMINANCE PROBE

HD2021T7

The HD2021T7 probe allows converting the photometric quantity "debilitating luminance" into a current (4...20 mA) or a voltage (0...10 V) signal according to the version chosen. If the acquisition station is far from the probe (>50m), it is necessary to use the current output version.
The HD2021T7 transmitter has IP67 protection. In order to grant high accuracy, it is important to keep the surface of the outer lens clean. It is possible to wash them by using only water and standard papers for lens. The transmitter full scale can be chosen (when ordering) between two different values: 2000cd/m^2 or 20000cd/m^2. For orders of at least 5 pieces, it is possible to calibrate the scale to a value chosen by the customer.
The probe is used for the control of street lighting, in particular, the measurement of debilitating luminance is essential to determine the *threshold luminance* at the entrance of the tunnels (UNI 11095:2011).

The measurement of debilitating luminance (L_v) consists of three components:
$L_v = L_{seq}+L_{alm}+L_{par}$
where.
L_{seq} is the equivalent veiling luminance;
L_{alm} is the atmospheric luminance;
L_{par} is the luminance of the windshield.

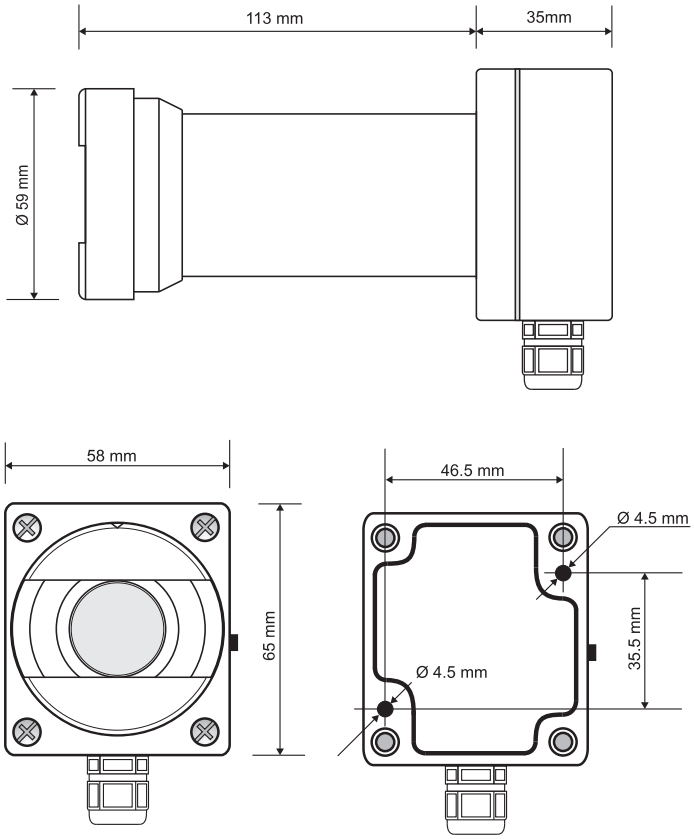
The **equivalent veiling luminance (L_{seq})** is measured according to standard UNI11095: 2005 with the probe HD2021T7 as reported in the test report I.N.Ri.M. 08-1199-01. This quantity is measured and defined starting from the subtended angles greater than 1°.

The **atmospheric luminance (L_{atm})** is evaluated with the HD2021T7 probe by measuring the luminance for subtended angles less than 1° (2° total opening) as reported in Tables B and C of the test report.
The contribution of the **luminance of the windshield (L_{par})** is measured directly by inserting the HD2021T7 probe in a protective case. The dialog interface that separates the probe from the external environment simulates the behaviour of the windshield, so the value read by the probe in the container already includes this contribution.

INSTRUMENT TECHNICAL SPECIFICATIONS

Dimensions
(Length x Width x Height) 147mm x 58 mm x 65mm

Figure 1 Dimensions of the HD2021T7 probe



SPECTRAL RESPONSE

The probe uses a silicon photodiode and a set of filters to correct the spectral response curve to make it equal to that of the human eye (photopic response). Figure 2 shows the trend of the relative spectral response according to the wavelength.
f'$_1$ <9% according to the standard photopic curve V(λ).

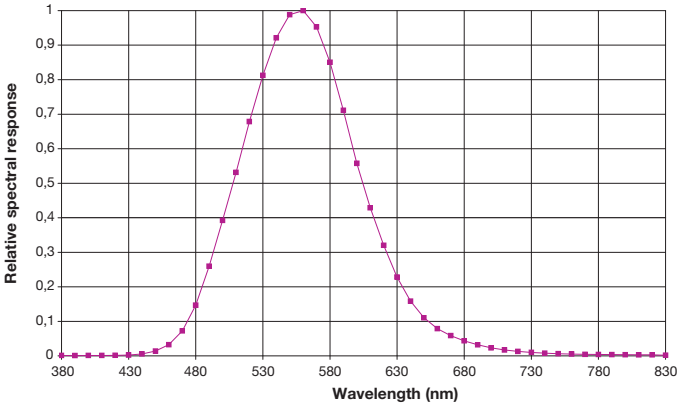


Figure 2. HD2021T7 Relative spectral response

ANGULAR RESPONSE:

The equivalent veiling luminance (L_v) is estimated starting from the following formula:

$$L_v = 10 \sum_{\beta=1°}^{\beta=90°} \frac{L(\beta)\cdot\cos(\beta)}{\beta\cdot(\beta+1.5)}\cdot\Omega \qquad \textbf{A}$$

where:

L(β) is the luminance of a source of disturbance measured at an angle β,

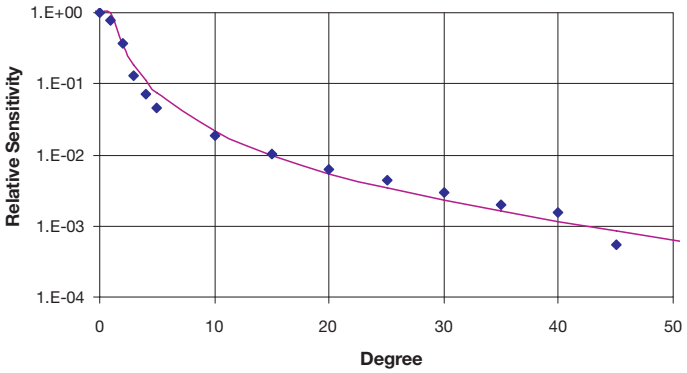
β is the angle between the pointing direction of the object to be watched and the source of interference,

Ω is the solid angle

Figure 3 shows the sensitivity as a function of the angle of the probe.

In the standard CIE88:2004 the equivalent veiling luminance is calculated by considering the contributions up to angles of 28.4°. By using DeltaOhm probe HD 2021T7 it is possible to evaluate contributions to greater angles (up to 40°).

Figure 3. HD2021T7 Relative angular response



For angles less than 1° as shown in fig.3 the probe measures the luminance necessary for the proper calculation of the contributions of the atmospheric luminance and the luminance of windshield.

WORKING TEMPERATURE

The probe can work in a temperature range from -20° to +60° C. If the probe is placed in watertight containers, take care that there is no fogging or condensation on the window towards which the probe is overlooking. In this case the reading of the equivalent veiling luminance would be altered by systematic errors.

CALIBRATION

The calibration of the probe HD2021T7 is carried out by measuring the luminance on the output port of an integrating sphere with a known luminance. If requested, the uncertainty of the calibration of the probe with fixed full scale is 10% (confidence level of 95%).

TRANSMITTER INSTALLATION

The installation of the probe for the evaluation of the *threshold luminance* at the entrance of tunnels should be performed in compliance with the standard UNI 11095.

In order to connect the transmitter, it is necessary to lift the lid (by unscrewing the four locking screws). For the 4...20mA version, please refer to Figure 5, while the version 0...10 V is referred to Figure 4.

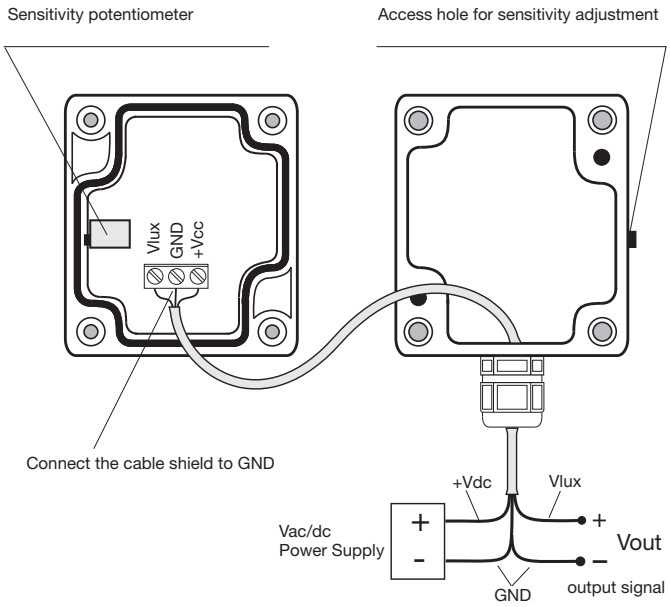


Figure 4. Connection diagram for HD2021T… with voltage output

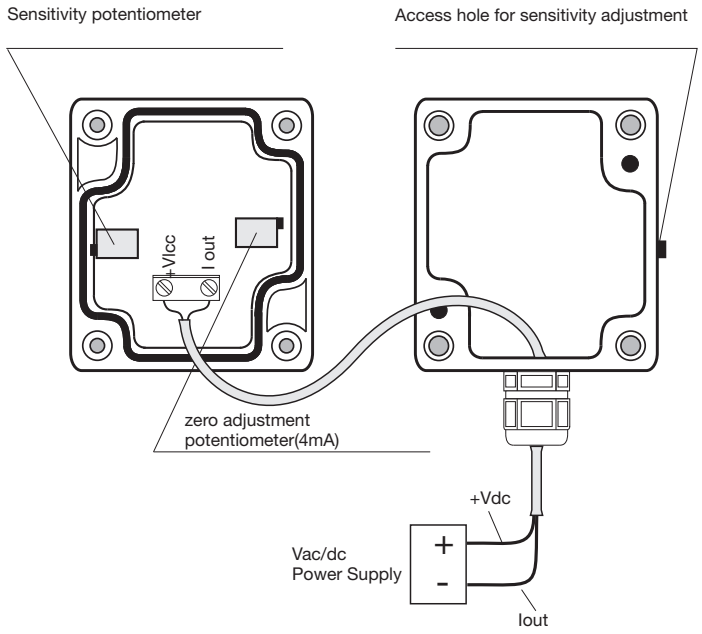


Figure 5. Connection diagram for HD2021T… with current output

ORDERING CODES:

	Output	Measurement range	Power supply	Spectral response
HD2021T7A.V	0...10 V	0...2000 cd/m²	16...40 Vac/dc	V(λ)
HD2021T7B.V		0...20 kcd/m²		
HD2021T7X.V		Upon request *		
HD2021T7A.A	4...20 mA	0...2000 cd/m²		
HD2021T7B.A		0...20 kcd/m²		
HD2021T7X.A		Upon request *		

*minimum order 5 pcs

HD2021T6

The probe HD 2021T6 allows converting a photometric quantity Luminance (cd/m^2) into a current (4...20 mA) or voltage (0...10 V) signal according to the version chosen. If the acquisition station is far from the probe (>50m), the current version is required.

The protection degree of the transmitter HD2021T6 is IP67. In order to ensure correct measurements, the outer surface of the lens must be kept clean. If necessary, clean the lens with water and lens cleaning paper.

At the order time, it is possible to choose the transmitter sensitivity among three previously set values: 2 kcd/m^2, 20 kcd/m^2 or 200 kcd/m^2. For orders of quantities over 5 pieces, the full scale can be customized.

The probe is used for road lighting control. In particular, the measurement of luminance at a **20° angle (L_{20})** is necessary to estimate *threshold luminance* at tunnel entrances (CIE standard 88:2004. This standard foresees the measurement of debilitating luminance in future).

Moreover, the probe can be used for calculating vertical illuminance (E_v) as prescribed in the above-mentioned standard.

Finally, the probe can be used for any application where the measurement of luminance is required, for example projector screens, diaphanoscopes etc.

Instrument technical specifications

Dimensions

(Length x Width x Height) 145mm x 58 mm x 65mm

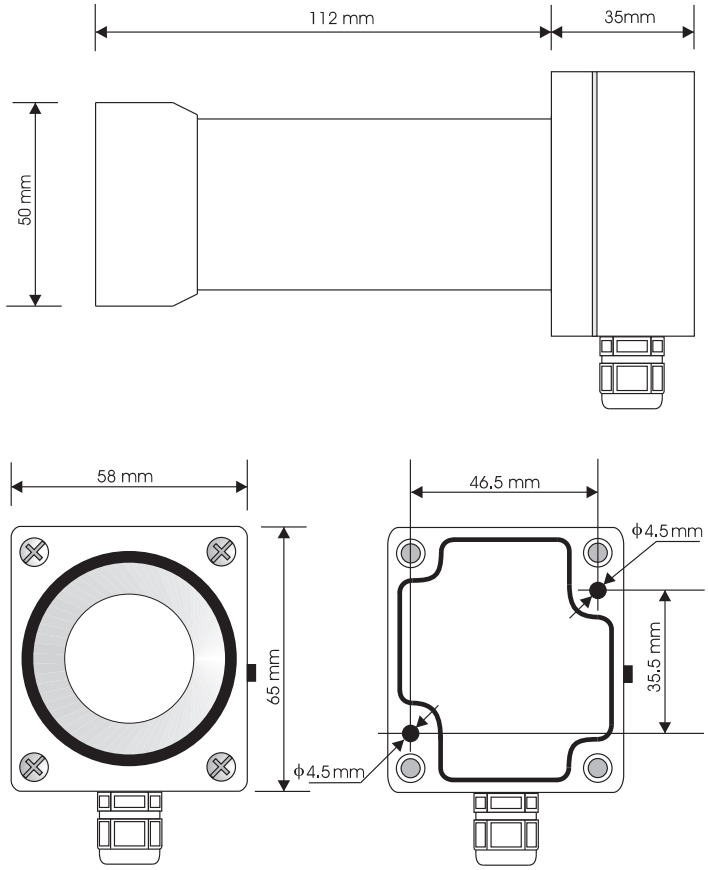


Figure 1. HD2021T6 probe dimensions

Spectral Response

The probe is equipped with a silicon photodiode and a series of filters to correct the spectral response curve and make it equal to that of the human eye (photopic response). Figure 2 shows the trend of the relative spectral response depending on the wavelength.

f'$_1$ <9% according to the standard photopic curve V(λ).

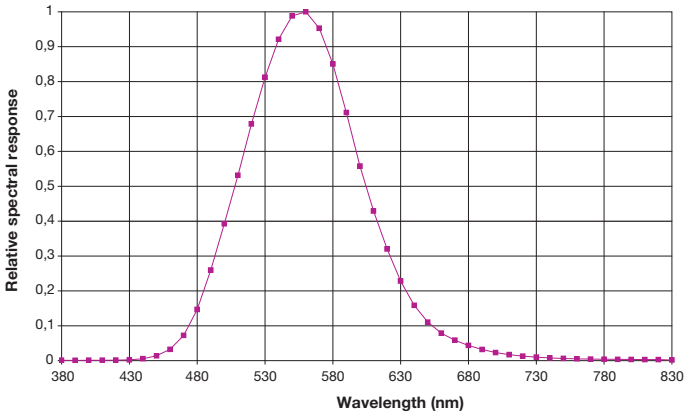


Figure 2. HD2021T6 probe relative spectral response

FIELD OF VIEW

The total field of view of HD2021T6 probe is 20°.

WORKING TEMPERATURE

The probe can work in a temperature range from -20° to +60° C. If the probe is placed in watertight containers, take care that there is no fogging or condensation on the window towards which the probe is overlooking. In this case the reading of the equivalent veiling luminance would be altered by systematic errors.

CALIBRATION

The calibration of the probe HD2021T6 is carried out by measuring the luminance on the output port of an integrating sphere with a known luminance. If requested, the uncertainty of the calibration of the probe with fixed full scale is 5% (confidence level of 95%).

TRANSMITTER INSTALLATION

The installation of the probe for the evaluation of the *threshold luminance* at the entrance to the galleries has to be performed according to standard CIE 88:2004.

In order to connect the transmitter, it is necessary to lift the lid (by unscrewing the four locking screws). For the 4...20mA version refer to Figure 5, while for the version 0...10 V refer to Figure 4 of HD2021T7.

ORDERING CODES:

Model	Output	Measurement range	Power supply	Spectral Response
HD2021T6A.V	0...10 V	0...2000 cd/m^2	16...40 Vac/dc	V(λ)
HD2021T6B.V		0...20 kcd/m^2		
HD2021T6C.V		0...200 kcd/m^2		
HD2021T6X.V		Upon request *		
HD2021T6A.A	4...20 mA	0...2000 cd/m^2		
HD2021T6B.A		0...20 kcd/m^2		
HD2021T6C.A		0...200 kcd/m^2		
HD2021T6X.A		Upon request *		

*minimum order 5 pieces

HD2402
INCOHERENT OPTICAL RADIATION MONITORING

The **HD2402** is a portable photo-radiometer data logger for the measurement of **non-coherent optical radiation in compliance with the European Directive 2006/25/EC and the legislative decree n. 81 of April 9th 2008**.
The instrument is equipped with a series of sensors to cover different spectral portions and a small laser suitable to indicate the analyzed source.
The various sensors work in the following spectral ranges:

- Photometric sensor for measuring illuminance (lux meter) in the spectral range 380...780 nm.
- Radiometric sensor for the UV band (220...400 nm) with spectral weighting factor S(λ).
- Radiometric sensor for UVA band (315...400 nm).
- Radiometric sensor for the band 400...700 nm (blue) with spectral weighting factor B (λ).
- Radiometric sensor for the IR band (700...1300 nm) with spectral weighting factor R(λ).
- Thermopile sensor for the measurement of irradiance in the infrared spectral range 400...2800 nm.

The **HD2402** can be power supplied either by the connection to a PC, receiving power supply directly from the USB port of the PC, or by an external power supply with USB output (code **SWD05**). The connection cable **CP24** is equipped with an M12 connector on the instrument side and a USB type connector for the PC side or to the power supply SWD05 side.
By using the **software DeltaLog13 from the version 1.0.1.0** and a PC, the **HD2402** can be configured (calendar, date, time, starting time and duration of the logging) as well as performing the download and the analysis of the data stored and the acquisition of data in real time. Once configured, the data logger can be disconnected from the PC and connected to its external power supply for the acquisition and storage of data according to the programmed settings.

Instrument specifications

Instrument	
Dimensions	
(Length x Width x Height)	69x69x155 mm 74x74x155 mm with protective shell
Weight	500 g
Materials	Aluminium alloy
Protective shell	Rubber
Operating conditions	
Working temperature	-5 … 50°C
Storage temperature	-25 … 65°C
Working relative humidity	0 … 85% RH no condensation
Protection degree	IP 64
Power supply	
Power adapter (cod. SWD05)	5Vdc/1A
Stored data security	unlimited
Serial interface:	output for connection to the PC by using the USB cable CP24
Storage capacity:	96,000 recordings, corresponding to approximately 26 hours of continuous data acquisition.
Storage interval:	fixed at 1 second.

Measuring ranges

Measurement of the illuminance in the spectral range 380...780 nm
1.0 ... 399.9 lux
$0.010 \cdot 10^3$ ... $3.999 \cdot 10^3$ lux
$0.10 \cdot 10^3$ ... $39.99 \cdot 10^3$ lux
$1.0 \cdot 10^3$ ... $399.9 \cdot 10^3$ lux

Measurement of the UV radiation in the spectral range 220...400 nm with spectral weighting factor S(λ)
$0.10 \cdot 10^{-3}$ ... $39.99 \cdot 10^{-3}$ W/m²
$1.0 \cdot 10^{-3}$ ... $399.9 \cdot 10^{-3}$ W/m²
0.010 ... 3.999 W/m²
0.10 ... 39.99 W/m²

Measurement of the ultraviolet radiation in the spectral UVA range (315...400 nm)
0.010 ... 3.999 W/m²
0.10 ... 39.99 W/m²
1.0 ... 399.9 W/m²
$0.010 \cdot 10^3$ ... $3.999 \cdot 10^3$ W/m²

Measurement of the radiation in the spectral range 400...700 nm (blue) with spectral weighting factor B(λ)
$1.0 \cdot 10^{-3}$ ... $399.9 \cdot 10^{-3}$ W/m²
0.010 ... 3.999 W/m²
0.10 ... 39.99 W/m²
1.0 ... 399.9 W/m²

Measurement of infrared radiation in the spectral field 700...1300 nm, with spectral weighting factor R(λ)
0.010 ... 3.999 W/m²
0.10 ... 39.99 W/m²
1.0 ... 399.9 W/m²
$0.010 \cdot 10^3$ ... $3.999 \cdot 10^3$ W/m²

Measurement of infrared radiation, spectral range 400...2800 nm
$0.010 \cdot 10^3$ ... $3.999 \cdot 10^3$ W/m²

ORDERING CODES

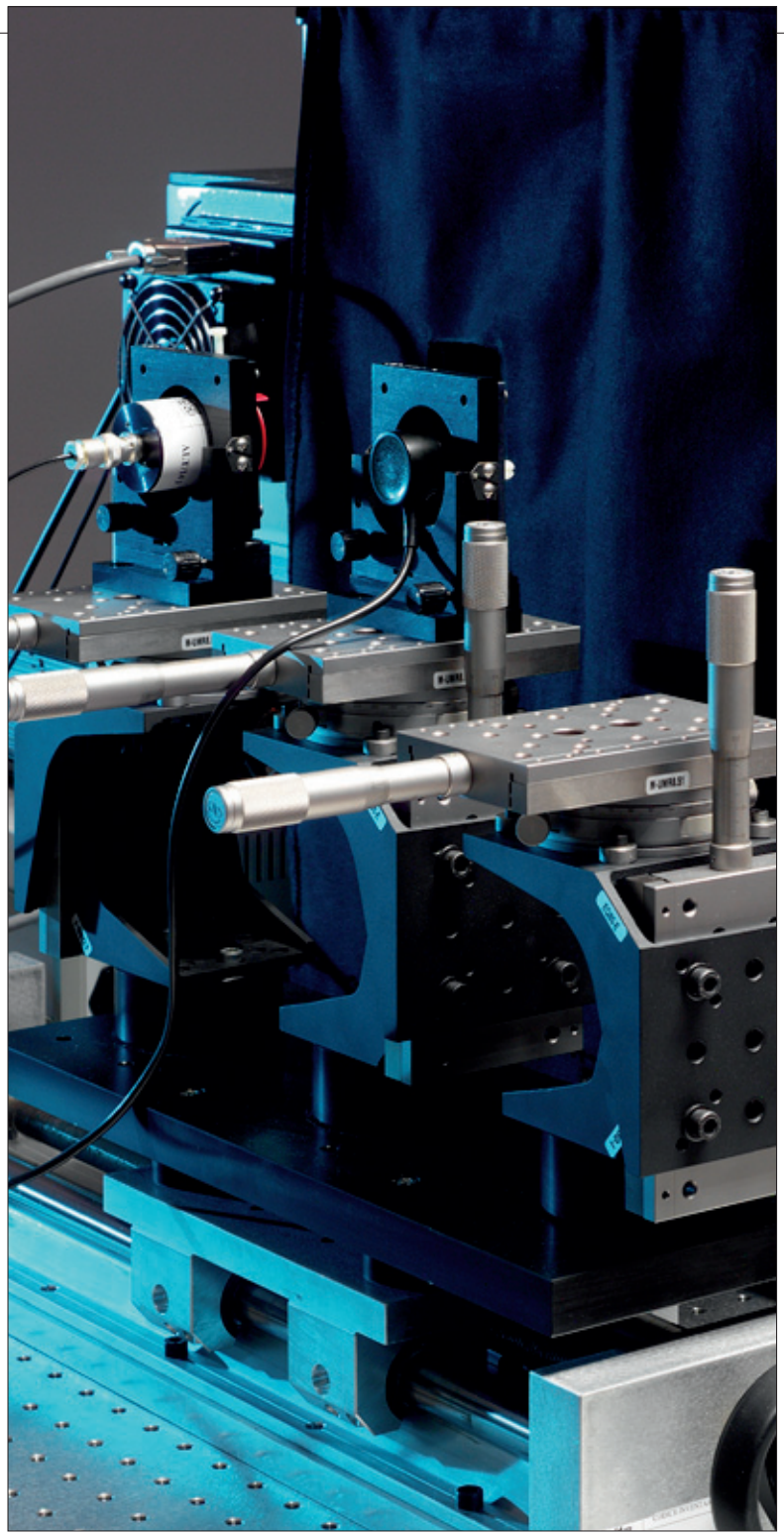
HD2402: Multi-sensor instrument, data logger, for measuring noncoherent optical radiation. Equipped with: **DeltaLog13 software (version 1.0.1.0)** to download, monitor and process the data on a personal computer, hardware key **CH20-ROA** to enable the software, **CP24 connection** cable, **SWD05** external power supply, **VTRAP20** tripod, manual, carrying case.

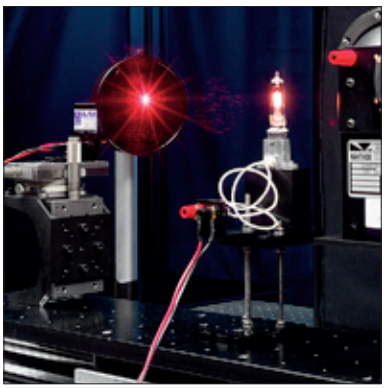
Accessories:

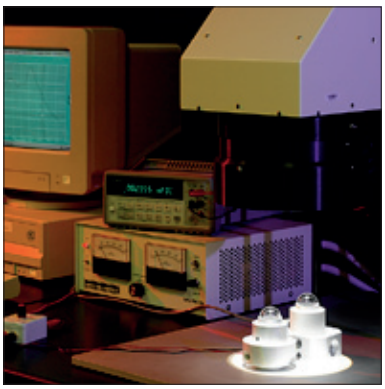
CH20-ROA: Hardware key for PC with Windows® operating systems. Inserted into a USB port enables the use of PC software DeltaLog13 with the instrument HD2402.
DeltaLog13: Additional copy of the software for the configuration of the instrument and the data download by the PC connection. Suitable for Windows® operating systems.
CP24: Connection cable to a PC or to the external power supply. M12 connector on the instrument side and USB type A- connector on the PC / Power Supply side.
SWD05: Stabilized external power supply 100...240Vac/5Vdc-1A. Output with USB connector type A.
VTRAP20: Tripod to fix the instrument, maximum height 270 mm.

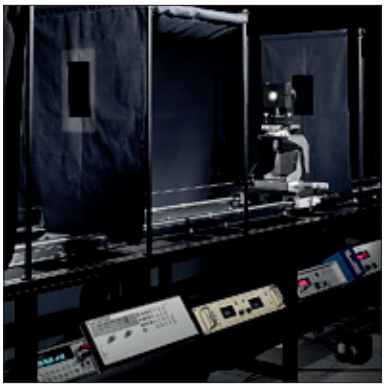
ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

ACCREDIA LAT N° 124 laboratory
photometry/radiometry measurements









ACCREDIA
L'ENTE ITALIANO DI ACCREDITAMENTO

Laboratory LAT N° 124

DELTA OHM s.r.l.
Via G. Marconi, 5
35030 CASELLE DI SELVAZZANO (PD) - ITALIA

Tel.: +39 049 89 77 150 - fax: +39 049 63 55 96
E-mail: info@deltaohm.com
URL http://www.deltaohm.com

Permanent Laboratory

ACCREDITATION TABLE

Quantity	Instruments to be calibrated	Measuring range	Measuring conditions	Uncertainty
Illuminance	Luxmeters	2,5 ÷ 4000 lux		2 %
Luminous Intensity	Incandescence lamps	1 ÷ 3000 cd		2,7 %
Luminance	Luminance meters	1 ÷10000 cd m^{-2}		3,2 %
Correlated temperature colour	Incandescence lamps	2200 a 3300 K		50 K
Spectral Radiance	Source	$(4 \cdot 10^{-5} \div 3 \cdot 10^{0})$ $W \cdot m^{-2} \cdot sr^{-1} \cdot nm^{-1}$ $(4 \cdot 10^{-5} \div 3 \cdot 10^{0})$ $W \cdot m^{-2} \cdot sr^{-1} \cdot nm^{-1}$	da 300 a 400nm da 400 a 800nm	5 % 4,4 %
Spectral Irradiance	Source	$(1 \cdot 10^{-5} \div 1 \cdot 10^{0})$ $W \cdot m^{-2} \cdot nm^{-1}$ $(1 \cdot 10^{-5} \div 1 \cdot 10^{0})$ $W \cdot m^{-2} \cdot nm^{-1}$ $(1 \cdot 10^{-5} \div 1 \cdot 10^{0})$ $W \cdot m^{-2} \cdot nm^{-1}$ $(1 \cdot 10^{-5} \div 1 \cdot 10^{0})$ $W \cdot m^{-2} \cdot nm^{-1}$ $(1 \cdot 10^{-5} \div 1 \cdot 10^{0})$ $W \cdot m^{-2} \cdot nm^{-1}$ $(1 \cdot 10^{-5} \div 1 \cdot 10^{0})$ $W \cdot m^{-2} \cdot nm^{-1}$	(200 ÷ 250) nm (250 ÷ 300) nm (300 ÷ 350) nm (350 ÷ 400) nm (400 ÷ 700) nm (700 ÷ 800) nm	10% 7,0% 4,4% 3,8% 3,2% 3,6%
	UV-A Radiometers UV-B Radiometers UV-C Radiometers	1 ÷ 25 $W \cdot m^{-2}$ 1,2W/m² 1,5W/m²	(365) nm (311) nm (254) nm	5,0% 6,6% 7,2%
Spectral Sensitivity	Detectors	$(1 \cdot 10^{-2} \div 1 \cdot 10^{1})$ $A \cdot W^{-1}$ $(1 \cdot 10^{-3} \div 1 \cdot 10^{1})$ $A \cdot W^{-1}$ $(1 \cdot 10^{-4} \div 1 \cdot 10^{1})$ $A \cdot W^{-1}$ $(1 \cdot 10^{-4} \div 1 \cdot 10^{1})$ $A \cdot W^{-1}$ $(1 \cdot 10^{-4} \div 1 \cdot 10^{1})$ $A \cdot W^{-1}$ $(1 \cdot 10^{-4} \div 1 \cdot 10^{1})$ $A \cdot W^{-1}$ $(1 \cdot 10^{-4} \div 1 \cdot 10^{1})$ $A \cdot W^{-1}$	(200 ÷ 240) nm (240 ÷ 375) nm (375 ÷ 920) nm (920 ÷ 1000) nm (1000 ÷ 1100) nm (1100 ÷ 1550) nm (1550 ÷ 1650) nm	6,6% 3,7% 1,9% 2,0% 2,2% 2,0% 2,6%

(*)The uncertainty of measurement is stated as expanded uncertainty corresponding to a confidence level of 95% and is obtained by multiplying the uncertainty by the coverage factor k specified.