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 fitted with the SICRAM automatic detection module: in addition to detection, the 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 which can be transferred from the instrument connected to a PC via the multi-standard RS232C serial port and USB 2.0. The storing interval, printing, and baud rate can be configured using the menu.
The HD2102.1 and HD2102.2 models are fitted 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* 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.


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	**IP67**

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

Time

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

*Measured values storage - model **HD2102.2***

Type	2000 pages containing 19 samples each
Quantity	Total of 38000 samples
Storage interval	1s…3600s (1hour)

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
Immediate print interval	1s…3600s (1hour)

*USB interface - model **HD2102.2***

Type	1.1 - 2.0 electrically isolated

Connections

Input module for the probes	8-pole male DIN45326 connector
Serial interface and USB	8-pole MiniDin connector
Mains adapter	2-pole connector (positive at centre)

Technical characteristics of photometric and radiometric probes complete with SICRAM module equipped with the instruments

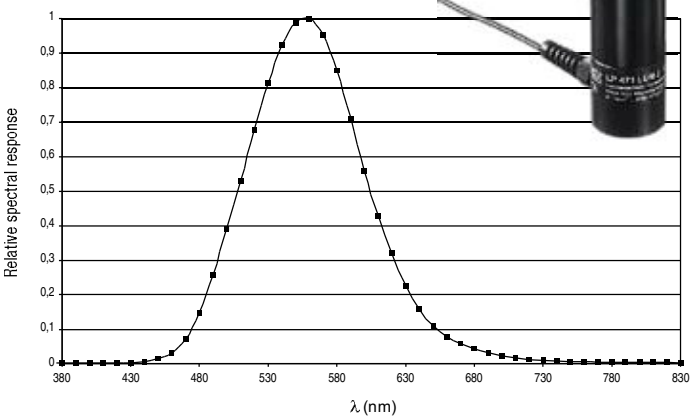
ILLUMINANCE measurement probe LP 471 PHOT				
Measurement range (lux):	0.01…199.99	…1999.9	…19999	…199.99·10³
Resolution (lux):	0.01	0.1	1	0.01·10³
Spectral range:	in agreement with standard photopic curve V(λ)			
Class	C (B on request)			
Calibration uncertainty:	<4%			
f'1 (in agreement with photopic response V(λ)):	<8%			
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%			
Functioning 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: 0.01 lux…200·10³ lux.
CIE69, UNI11142

LUMINANCE measurement probe LP 471 LUM 2				
Measurement range (cd/m²):	0.1…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%			
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%			
Functioning 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: 0.1 cd/m²…2000·10³ cd/m².

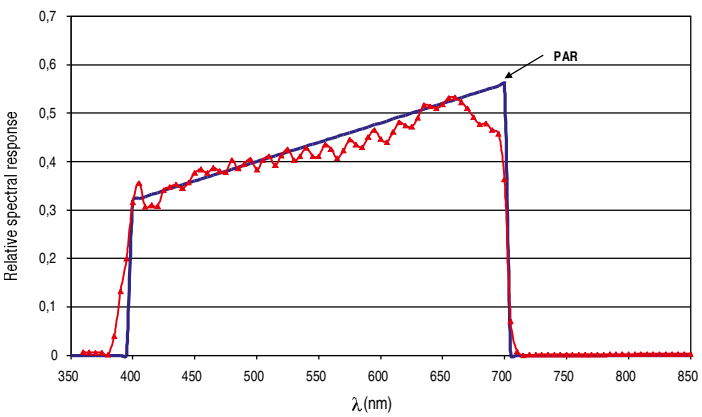
Typical response curve: LP 471 PHOT and LP 471 LUM2



Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range PAR LP 471 PAR			
Measurement range (μmol/m⁻²s⁻¹):	0.01… 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%		
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/m²s. Measurement range: 0.01μmol/m⁻²s⁻¹…10·10³μmol/m⁻²s⁻¹.

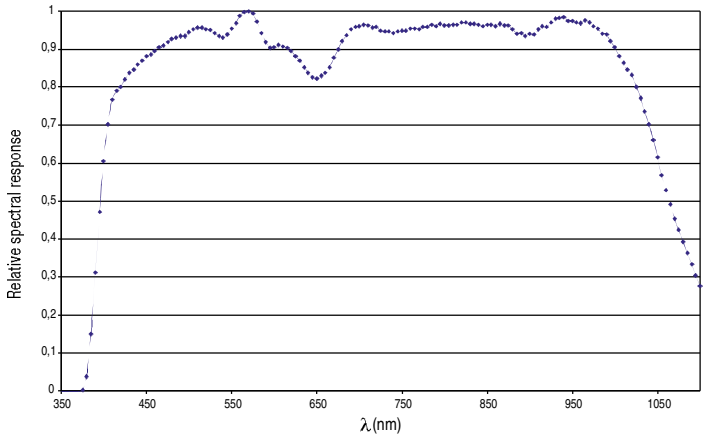
Typical response curve: LP 471 PAR



IRRADIANCE measurement probe LP 471 RAD				
Measurement range (W/m²):	0.1·10⁻³ … 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%			
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: 0.1·10⁻³W/m² …2000 W/m².

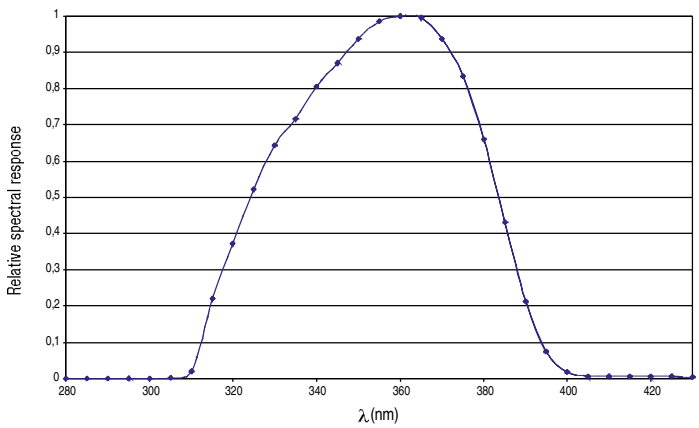
Typical response curve: LP 471 RAD



IRRADIANCE measurement probe LP 471 UVA				
Measurement range (W/m²):	0.1·10⁻³ … 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%			
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: 0.1·10⁻³W/m²…2000 W/m².

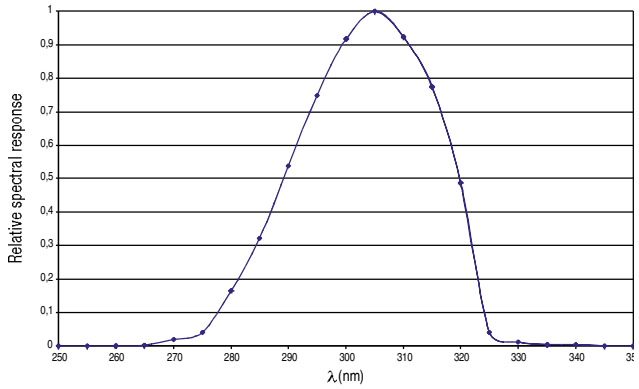
Typical response curve: LP 471 UVA



IRRADIANCE measurement probe LP 471 UVB				
Measurement range (W/m²):	0.1·10⁻³ … 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:	280nm…315nm (Peak 305nm)			
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, **UVB.** Measurement range: 0.1·10⁻³W/m²…2000 W/m².

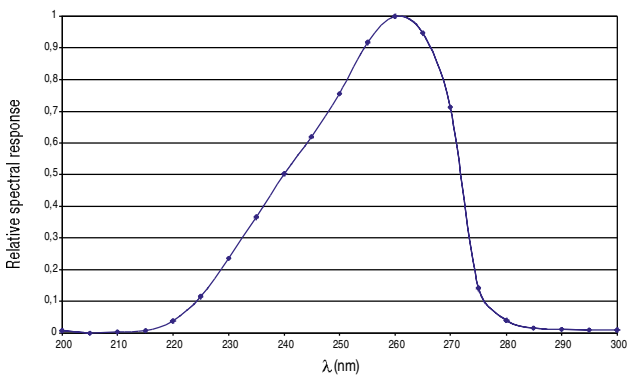
Typical response curve: LP 471 UVB



IRRADIANCE measurement probe LP 471 UVC				
Measurement range (W/m²):	0.1·10⁻³ … 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:	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: 0.1·10⁻³W/m²…2000 W/m².

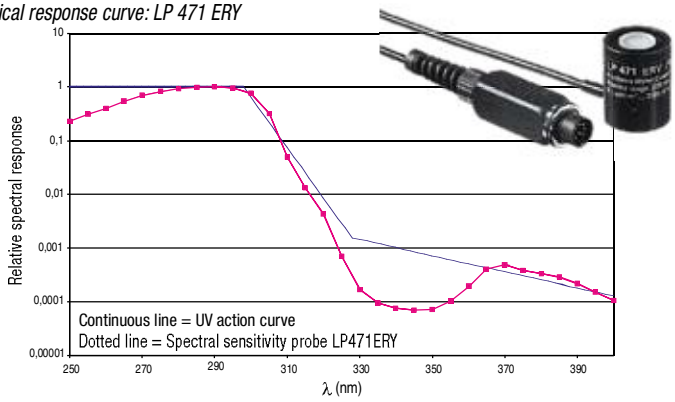
Typical response curve: LP 471 UVC



Measurement probe LP 471ERY of TOTAL EFFECTIVE IRRADIANCE (W/m²) according to the UV action curve UV (CEI EN 60335-2-27)				
Measurement range (W_{eff}/m²):	0.1·10⁻³ … 999.9·10⁻³	1.000 …19.999	20.00 …199.99	200.0 …1999.9
Resolution (W_{eff}/m²):	0.1·10⁻³	0.001	0.01	0.1
Spectral range:	UV action curve for erythema measurement (250nm…400nm)			
Calibration uncertainty:	<15%			
f_3 (linearity):	<3%			
f_4 (instrument reading error	±1digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year	<2%			
Working temperature:	0…50°C			
Reference standard	CEI EN 60335-2-27			

Radiometric probe for **EFFECTIVE TOTAL IRRADIANCE** (W_{eff}/m²) according to the UV action curve (CIE EN 60335-2-27). Spectral range: 250 nm…400 nm, Measurement range: 0.1·10⁻³W_{eff} /m² … 2000 W_{eff} /m²

Typical response curve: LP 471 ERY



The probe LP 471 ERY measures the effective total irradiance (W_{eff}/m²) according to the UV action curve (CEI EN 60335-2-27). A particular type of photodiode and a combination of special filters bring the spectral response closer to the UV action curve. CEI EN 60335-2-27 standards estabilish a maximum allowable dose of 100J/m² for first-time exposure and an annual dose of 15000J/m². The typical spectral response curve of LP 471 ERY is shown in the Figure together with the UV action curve. The good accordance between the two curves enables the instrument to take reliable measurements of different types of lamps (and filters) used at present for tonning machines.

PURCHASING 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.

HD2101/USB: Connection cable USB 2.0 connector type A - 8-pole MiniDin.

DeltaLog9: Software for download and management of the data on PC using Windows 98 to Vista operating systems.

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

HD40.1: On request, portable, serial input, 24 column thermal printer, 58mm paper width.

Probes complete with SICRAM module

LP 471 PHOT: Photometric probe for **ILLUMINANCE** measurement complete with SICRAM module, spectral response in agreement with standard photopic vision, diffuser for cosine correction. Measurement range: 0.01 lux…200·10³ lux.

LP 471 LUM 2: Photometric probe for **LUMINANCE** measurement complete with SICRAM module, spectral response in agreement with standard photopic vision, vision angle 2°. Measurement range: 0.1 cd/m²…2000·10³ 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 µmol/m⁻²s⁻¹, diffuser for cosine correction. Measurement range: 0.01µmol/m⁻²s⁻¹…10·10³µmol/m⁻²s⁻¹.

LP 471 RAD: Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module; in the 400nm…1050nm spectral range, diffuser for cosine correction. Measurement range: 0.1·10⁻³W/m² …2000 W/m².

LP 471 UVA: Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module; in the 315nm…400nm, peak 360nm, **UVA** spectral range, quartz diffuser for cosine correction. Measurement range: 0.1·10⁻³W/m²…2000 W/m².

LP 471 UVB: Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module, in the 280nm…315nm, peak 305nm, **UVB** spectral range, quartz diffuser for cosine correction. Measurement range: 0.1·10⁻³W/m²…2000 W/m².

LP 471 UVC: Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module, in the 220nm…280nm, peak 260nm, **UVC** spectral range, quartz diffuser for cosine correction. Measurement range: 0.1·10⁻³W/m²…2000 W/m².

LP 471 ERY: Radiometric probe for **EFFECTIVE TOTAL IRRADIANCE** (W_{eff}/m²) according to the UV action curve (CEI EN 60335-2-27) complete with SICRAM module. Spectral range: 250 nm…400 nm, quartz diffuser for cosine correction. Measurement range: 0.1·10⁻³W_{eff} /m² … 2000 W_{eff} /m².

LP BL: Base with levelling device (except LP 471 LUM 2).

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 instrument off	20µA

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

Connections

Input module for the probes	8-pole male DIN45326 connector

Technical characteristics of photometric and radiometric probes complete with SICRAM module equipped with the instruments

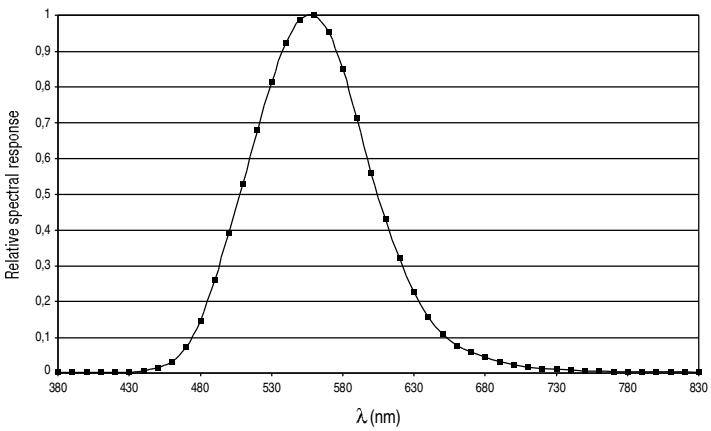
ILLUMINANCE measurement probe LP 471 PHOT				
Measurement range (lux):	0.01…199.99	…1999.9	…19999	…199.99·10³
Resolution (lux):	0.01	0.1	1	0.01·10³
Spectral range:	in agreement with standard photopic curve V(λ)			
Class	C			
Calibration uncertainty:	<4%			
f'1 (in agreement with photopic response V(λ)):	<8%			
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%			
Functioning 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: 0.01 lux…200·10³ lux.

LUMINANCE measurement probe LP 471 LUM 2				
Measurement range (cd/m²):	0.1…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%			
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%			
Functioning 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: 0.1 cd/m²…2000·10³ cd/m².

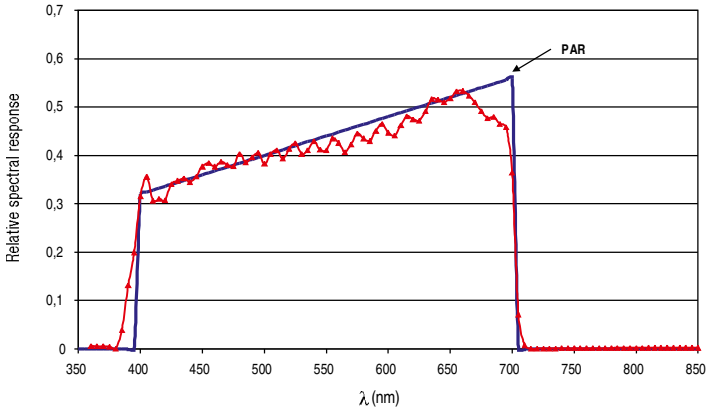
Typical response curve: probe LP 471 PHOT, LP 471 LUM2



Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range PAR LP 471 PAR			
Measurement range (µmol/m^{-2}s^{-1}):	0.01… 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_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^{-1}. Measurement range: 0.01µmol/m^{2}s^{-1}…10·10^{3}µmol/m^{2}s.

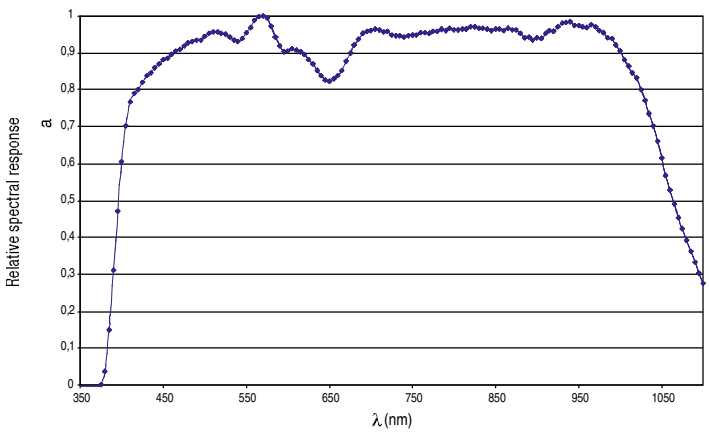
Typical response curve: probe LP 471 PAR



IRRADIANCE measurement probe LP 471 RAD				
Measurement range (W/m^2):	0.1·10^{-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_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: 0.1·10^{-3}W/m^2…2000 W/m^2.

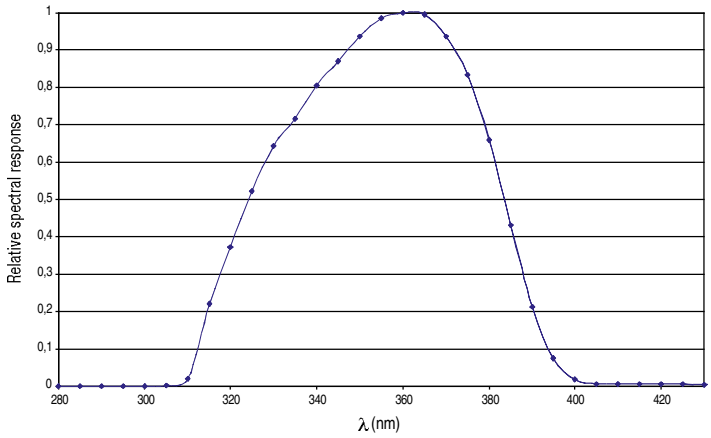
Typical response curve: probe LP 471 RAD



IRRADIANCE measurement probe LP 471 UVA				
Measurement range (W/m^2):	0.1·10^{-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: 0.1·10^{-3}W/m^2…2000 W/m^2.

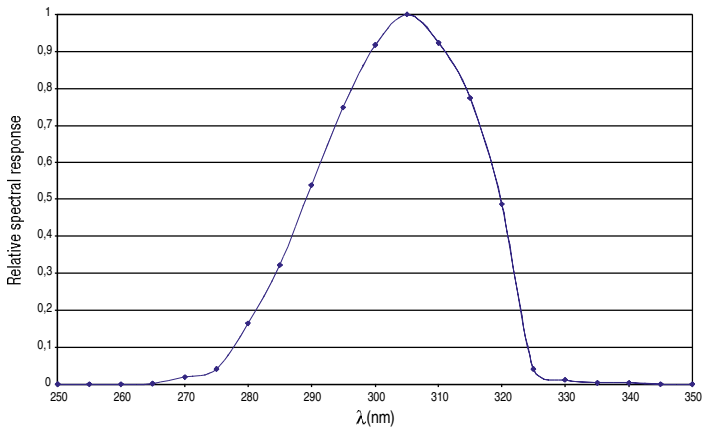
Typical response curve: probe LP 471 UVA



IRRADIANCE measurement probe LP 471 UVB				
Measurement range (W/m^2):	0.1·10^{-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)			
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, **UVB.** Measurement range: 0.1·10^{-3}W/m^2…2000 W/m^2.

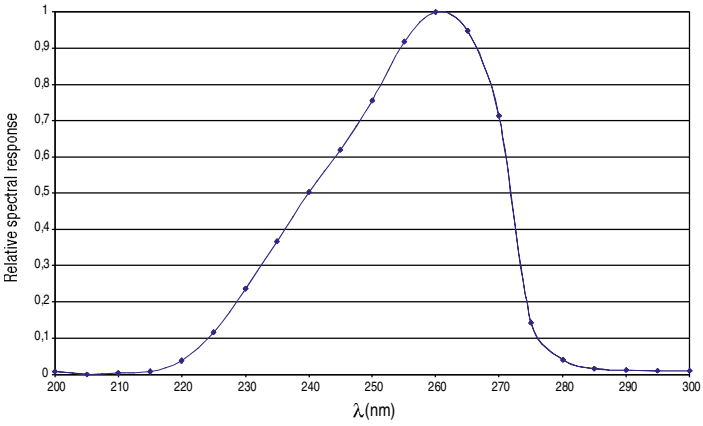
Typical response curve: probe LP 471 UVB



IRRADIANCE measurement probe LP 471 UVC				
Measurement range (W/m²):	$0.1 \cdot 10^{-3}$ … $999.9 \cdot 10^{-3}$	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: $0.1 \cdot 10^{-3}$W/m²…2000 W/m².

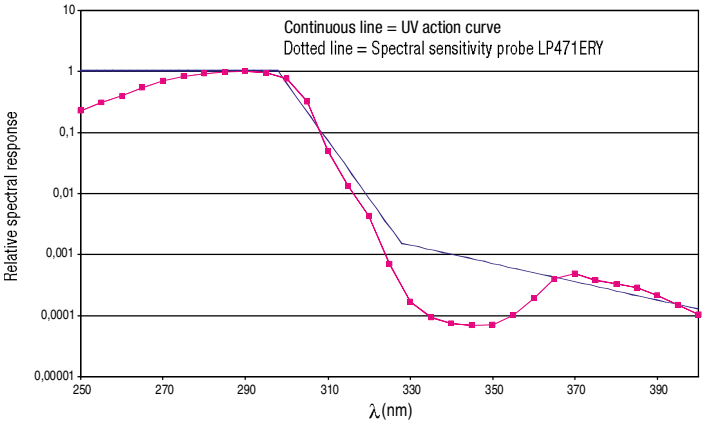
Typical response curve: probe LP 471 UVC



Measurement probe LP 471ERY of TOTAL EFFECTIVE IRRADIANCE (W/m²) according to the UV action curve UV (CEI EN 60335-2-27)				
Measurement range (W_{eff}/m²):	$0.1 \cdot 10^{-3}$ … $999.9 \cdot 10^{-3}$	1.000 …19.999	20.00 …199.99	200.0 …1999.9
Resolution (W_{eff}/m²):	$0.1 \cdot 10^{-3}$	0.001	0.01	0.1
Spectral range:	UV action curve for erythema measurement (250nm…400nm)			
Calibration uncertainty:	<15%			
f_3 (linearity):	<3%			
f_4 (instrument reading error	±1digit			
f_5 (fatigue):	<0.5%			
Drift after 1 year	<2%			
Working temperature:	0…50°C			
Reference standard	CEI EN 60335-2-27			

Radiometric probe for **EFFECTIVE TOTAL IRRADIANCE** (W_{eff}/m²) according to the UV action curve (CIE EN 60335-2-27). Spectral range: 250 nm…400 nm, Measurement range: $0.1 \cdot 10^{-3} W_{eff}$ /m² … 2000 W_{eff} /m²

Typical response curve:
TOTAL EFFECTIVE IRRADIANCE probe LP 471 ERY



The probe LP 471 ERY measures the total effective irradiance (W_{eff}/m²) according to the UV action curve (CEI EN 60335-2-27). A particular type of photodiode and a combination of special filters bring the spectral response closer to the UV action curve.
CEI EN 60335-2-27 standards estabilish a maximum allowable dose of 100J/m² for first-time exposure and an annual dose of 15000J/m².
The typical spectral response curve of LP 471 ERY is shown in the Figure together with the UV action curve.
The good accordance between the two curves enables the instrument to take reliable measurements of different types of lamps (and filters) used at present for tanning machines.
Calibration is performed at 290nm using a SIT calibrated photodiode as reference.

ORDER 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 equipped with SICRAM module

LP 471 PHOT: Photometric probe for **ILLUMINANCE** measurement complete with SICRAM module, spectral response in agreement with standard photopic vision, diffuser for cosine correction. Measurement range: 0.01 lux…$200 \cdot 10^3$ lux.

LP 471 LUM 2: Photometric probe for **LUMINANCE** measurement complete with SICRAM module, spectral response in agreement with standard photopic vision, vision angle 2°. Measurement range: 0.1 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 µmol/m⁻²s⁻¹, diffuser for cosine correction. Measurement range: 0.01µmol/m⁻²s⁻¹…$10 \cdot 10^3$µmol/m⁻²s⁻¹.

LP 471 RAD: Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module; in the 400nm…1050nm spectral range, diffuser for cosine correction. Measurement range: $0.1 \cdot 10^{-3}$W/m² …2000 W/m².

LP 471 UVA: Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module; in the 315nm…400nm, peak 360nm, **UVA** spectral range, quartz diffuser for cosine correction. Measurement range: $0.1 \cdot 10^{-3}$W/m²…2000 W/m².

LP 471 UVB: Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module, in the 280nm…315nm, peak 305nm, **UVB** spectral range, quartz diffuser for cosine correction. Measurement range: $0.1 \cdot 10^{-3}$W/m²…2000 W/m².

LP 471 UVC: Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module, in the 220nm…280nm, peak 260nm, **UVC** spectral range, quartz diffuser for cosine correction. Measurement range: $0.1 \cdot 10^{-3}$W/m²…2000 W/m².

LP 471 ERY: Radiometric probe for **TOTAL EFFECTIVE IRRADIANCE** (W_{eff}/m²) according to the UV action curve (CEI EN 60335-2-27) complete with SICRAM module. Spectral range: 250 nm…400 nm, quartz diffuser for cosine correction. Measurement range: $0.1 \cdot 10^{-3} W_{eff}$ /m² … 2000 W_{eff} /m².

LP BL: Base with levelling device for the probes (except LP 471 LUM 2).

PHOTOMETRIC AND RADIOMETRIC PROBES FOR PORTABLE INSTRUMENTS

Code	Description	
LP471PHOT	Photometric probe for **ILLUMINANCE** measurement, spectral response in agreement with standard photopic vision, diffuser for cosine correction. Measurement range: 0.01 lux…200·10^3 lux. CIE69, UNI11142	
LP471LUM2	Photometric probe for **LUMINANCE** measurement, spectral response in agreement with standard photopic vision, vision angle 2°. Measurement range: 0.1 cd/m^2…2000·10^3 cd/m^2.	
LP471PAR	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^{-1}. Measurement range: 0.01µmol/m^{-2}s^{-1}…10·10^{3}µmol/m^{-2}s^{-1}.	
LP471RAD	Radiometric probe for **IRRADIANCE** measurement in the spectral range 400nm…1050nm, diffuser for cosine correction. Measurement range: 0.1·10^{-3}W/m^2 …2000 W/m^2.	
LP471UVA	Radiometric probe for **IRRADIANCE** measurement, in the 315nm…400nm, peak 360nm, **UVA** spectral range. Measurement range: 0.1·10^{-3}W/m^2…2000 W/m^2.	
LP471UVB	Radiometric probe for **IRRADIANCE** measurement, in the spectral range 280nm…315nm, peak 305nm, **UVB.** Measurement range: 0.1·10^{-3}W/m^2…2000 W/m^2.	
LP471UVC	Radiometric probe for **IRRADIANCE** measurement, in the spectral range 220nm…280nm, peak 260nm, **UVC**. Measurement range: 0.1·10^{-3}W/m^2…2000 W/m^2.	
LP471ERY	Radiometric probe for **EFFECTIVE TOTAL IRRADIANCE** (W_{eff}/m^2) according to the UV action curve (CIE EN 60335-2-27). Spectral range: 250 nm…400 nm, Measurement range: 0.1·10^{-3}W_{eff} /m^2 … 2000 W_{eff} /m^2	
LP BL	Base with levelling device. On request for assembly with the probes at the time of order. (not for LUM probes)	

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** is able to take illuminance measurements in lux and in fcd (foot-candle), irradiance measurements in W/m^2, in µW/cm^2 e in µmol/m^{-2}s^{-1}, luminance measurements in cd/m^2 and temperature measurements in °C or °F. The function of the instrument data logger 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

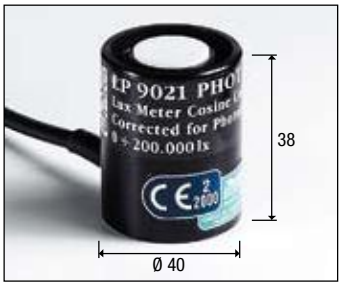
The instrument **DO 9721** has two circular DIN 45326 8-pole connectors (A and B) which allow the connection of Delta Ohm probes for measuring temperature, type TP 870, and probes for measuring the photometric and radiometric intensity, type LP 9021. The probe model should be chosen according to the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

INSTRUMENT TECHNICAL DATA

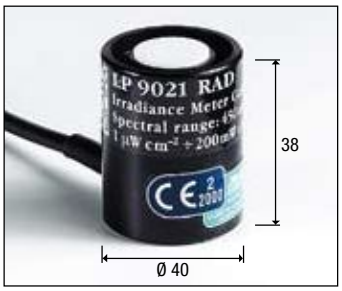
Inputs / type of measurement 2:	photometric / radiometric or temperature
Connector	DIN 45326 8-pole
Measuring range	
Photometric measurements	0...200.000 lux 0...20.000 fcd 0...2.000.000 cd/m^2
Radiometric measurements	0...2000 W/m^2 0...200.000 µW/cm^2 0...200.000 µmol/m^{-2}s^{-1}
Q energy	depends 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

ORDER CODES

DO 9721: Basic instrument kit, diplomatic carrying case, instrument, CP RS232C serial connecting cable, 9V battery. **The probes and cables must be ordered separately**.

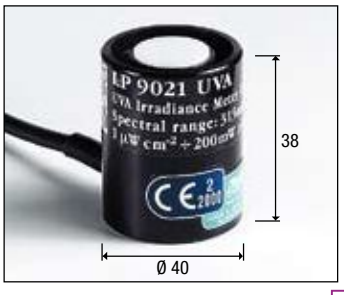


LP 9021 PHOT: Photometric probe for measuring light, **ILLUMINANCE**, photopic filter complying with CIE, diffuser for correction according to the cosine law.



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

LP 9021 PAR: Radiometric probe for measuring **IRRADIANCE** in the region of PAR radiations (Photosynthetically Active Radiation); it works in the field of the chlorophyll process following a special response curve.



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 LUM6: Probe for measuring **LUMINANCE**, measuring range from 1 to 1999 x 10^3 candles/ m^2. Measuring angle 2°. CIE filter for correction of the response according to the human eye, CIE n°69-UNI11142

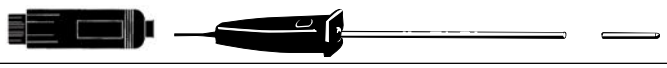
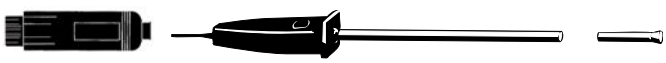
LP 9021 ERY: Radiometric probe for **TOTAL EFFECTIVE IRRADIANCE** (W_{eff}/m^2) according to the UV action curve (CEI EN 60335-2-27) complete with SICRAM module. Spectral range: 250 nm…400 nm, quartz diffuser for cosine correction. Measurement range: $0.1 \cdot 10^{-3} W_{eff}$ /m^2 … 2000 W_{eff} /m^2.

LP BL: Stand for supporting and levelling probes, eccept for LP 9021 LUM6.
TP 870: Immersion temperature probe, Pt100 sensor, diam. 3x230 mm, measuring range -50...+400°C.
TP 870/C: Contact temperature probe, Pt100 sensor, diam. 4x230 mm, measuring range -50...+400°C.
TP 870/P: Penetration temperature probe, Pt100 sensor, diam. 4x150 mm, measuring range -50...+400°C.
TP 870/A: Air temperature probe, Pt100 sensor, diam. 4x230 mm, measuring range -50...+250°C.

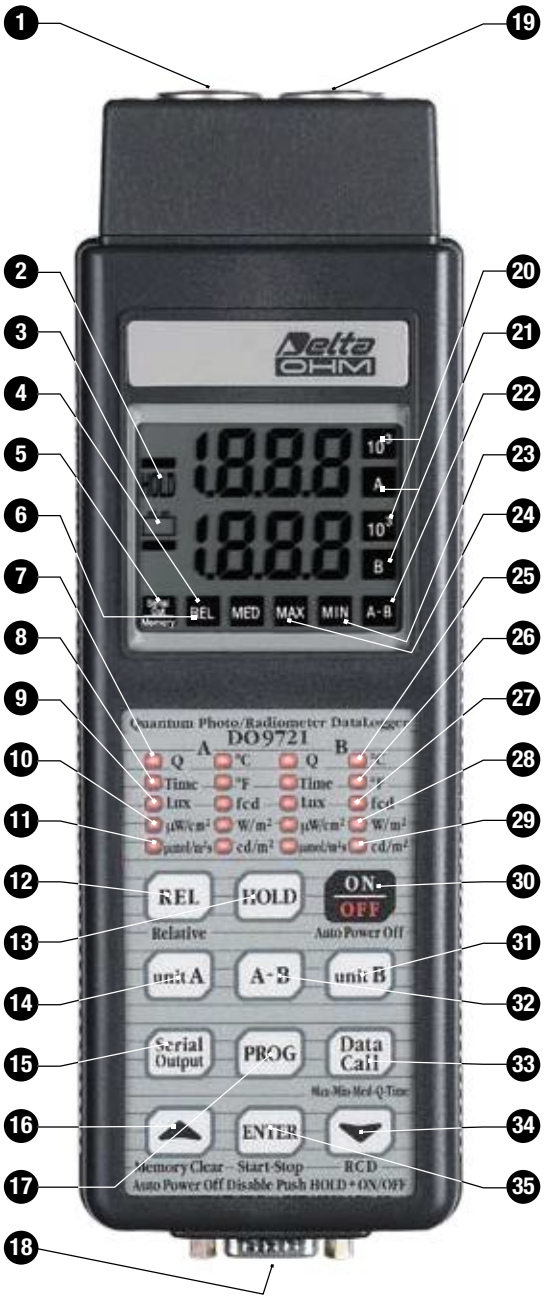
LP BL

Probe types	Measuring range	Spectral range	Calibration uncertainty
LP 9021 PHOT	0.1÷200000 LUX	CIE N°69 Classe C	<4%
LP 9021 RAD	1 mW/m^2÷2000 W/m^2	450÷950 nm	<5%
LP 9021 PAR	0.1 µmol $m^{-2}s^{-1}$÷20000 µmol $m^{-2}s^{-1}$	400÷700 nm	<5%
LP 9021 UVA	1 mW/m^2÷2000 W/m^2	315÷400 nm	<5%
LP 9021 UVB	1 mW/m^2÷2000 W/m^2	280÷315 nm	<5%
LP 9021 UVC	1 mW/m^2÷2000 W/m^2	200÷280 nm	<5%
LP 9021 LUM6	1÷2 x 10^6 cd/m^2	CIE N°69 Classe C	<5%
LP 9021 ERY	$0.1 \cdot 10^{-3}$ W_{eff}/m^2 2000 W_{eff}/m^2	250 mm÷400 mm	<15%

ACCURACY INSTRUMENT			
	at 25°C +/-	**from -5°C till 50°C +/-**	**Measuring range +/-**
Uncertainty of the instrument	0.1% + 1 digit	0.2% + 1 digit	
Temperature measurement instrument in line 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

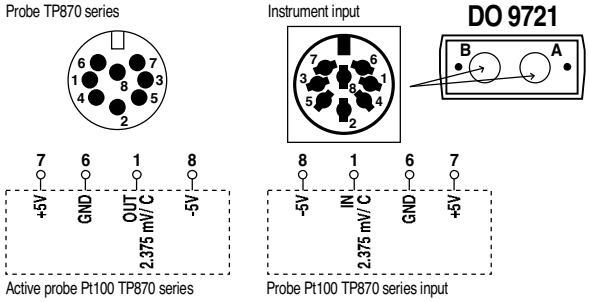
TEMPERATURE PROBES TP870				
CODE	Description	Drawing	τ Sec.	Temp/°C
TP 870	Immersion probe Ø 3 x 230 mm		3"A	-50/+400
TP 870/P	Penetration probe Ø 4 x 150 mm		3"A	-50/+400
TP 870/C	Contact probe Ø 4 x 230 mm		12"C	-50/+400
TP 870/A	Air probe Ø 4 x 230 mm		3"B	-50/+250

A) Time constant in water at 100°C / **B)** Time constant observed with metal surface at 200°C / **C)** Time constant in air at 100°C
Note: The time constant is the time needed to respond to 63% of the temperature changes.

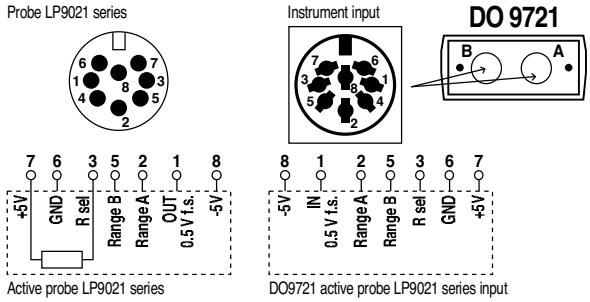


1 Input A, DIN 45326 8-pole connector.
2 HOLD symbol, the measurement refers to the moment in which the HOLD key was pressed.
3 Battery symbol: flashes during RECORD function, permanently lit if the battery is running low.
4 REL symbol, indicates that the instrument is making a relative measurement.
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 µW/cm^2: the led indicates that the measurement is in µW/cm^2.
11 µmol/m^{-2}s^{-1}: the led indicates that the measurement is in µmol 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

The LP…01 series allows measurement of Photometric and Radiometric quantities such as illuminance (lux), irradiance (W/m^2) across VIS-NIR, UVA, UVB, UVC spectral regions, as well as the number of photons received per unit time on a unit area, in the Photosynthetical Active Radiation (PAR) wavelength range from 400nm - 700nm.
In LP….01 probes, 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 applications in-door** 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 you have chosen where to install the probe, you must provide the connections between the probe and the voltmeter; the volmeter must 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:

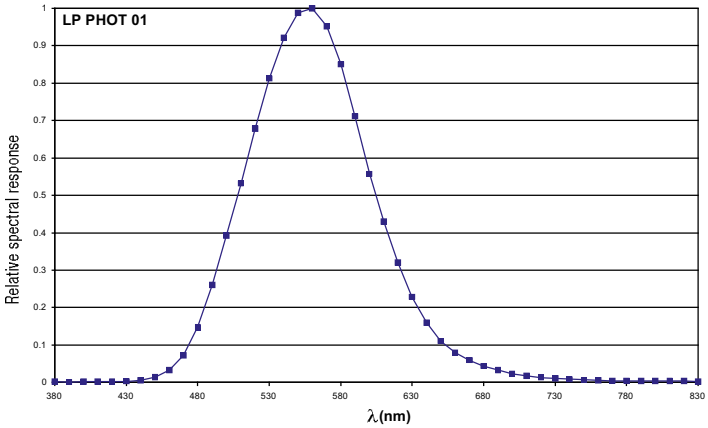
LP PHOT 01 probe measures illuminance (lux) defined as the ratio between the luminous flux (lumen) passing through a surface and the surface area (m^2).
The spectral response curve of a photometric probe is similar to the human eye curve, known as standard photopic curve V(λ). The difference in spectral response between LP PHOT 01 and the standard photopic curve V(λ) is calculated by means of the error f_1'. Calibration is carried out by comparison with a luxmeter, calibrated by a Primary Metrological Institute. Calibration procedures follow CIE publication No 69 (1987) "Method of Characterizing Illuminance Meters and Luminance Meteres". **The measurement 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):	<8%
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:

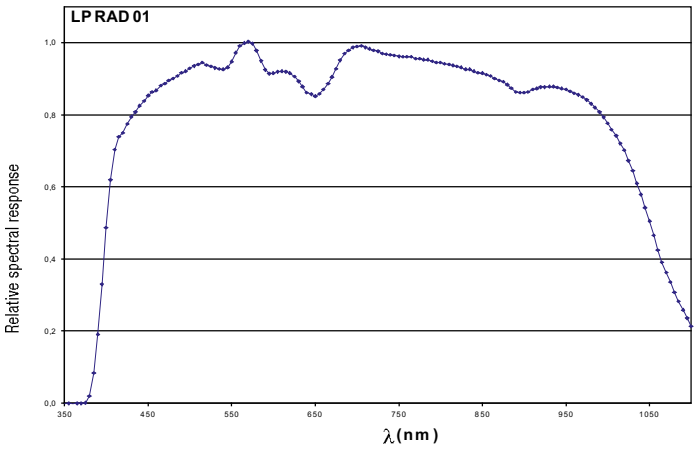


LP RAD 01 probe measures irradiance (W/m^2) defined as the ratio between the radiant flux (W) passing through a surface and the surface area (m^2) in the VIS-NIR (400nm-1050nm) spectral range. These particular features apply to an instrument suitable for measurements in visible and near infrared fields. **Probe calibration is carried out by using 577/579 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):	<7%
Operating temperature:	0-50°C
Output impedance:	1 kΩ

Typical spectral response LP RAD 01



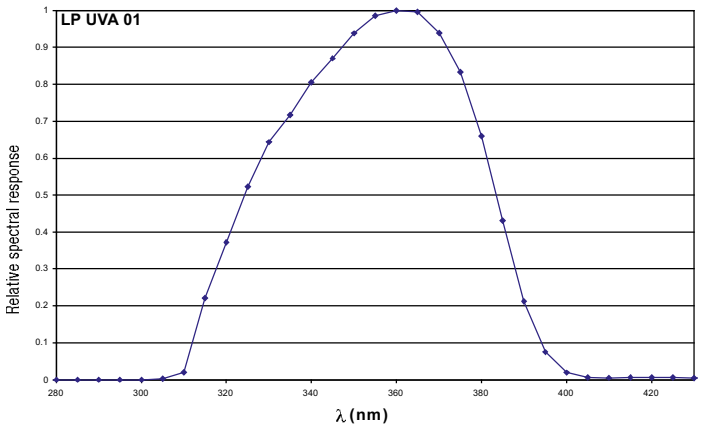
LP UVA 01:

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

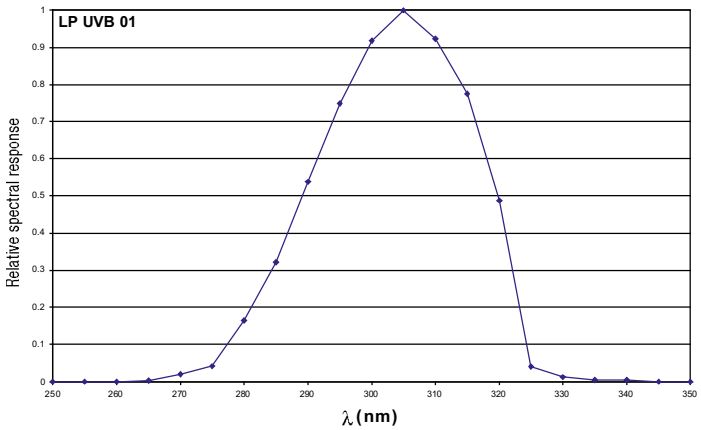


LP UVB 01:
LP UVB 01 probe measures irradiance (W/m²) defined as the ratio between the radiant flux (W) passing through a surface and the surface area (m²) in the UVB (280 nm –315 nm) spectral range. Thanks to a new type of photodiode, LP UVB 01 is blind to visible and infrared light.
Probe calibration 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

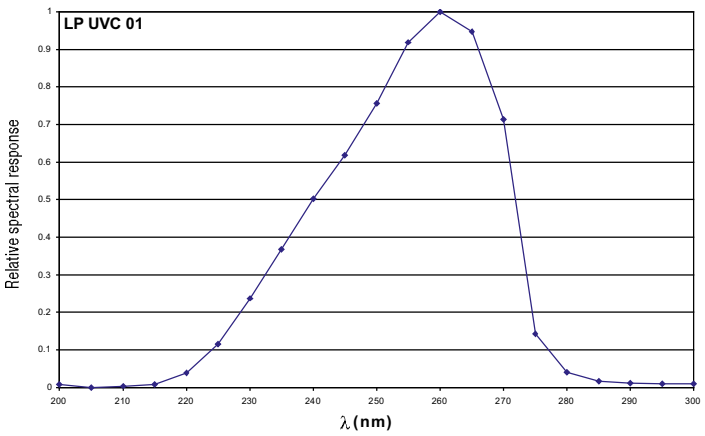


LP UVC 01:
LP UVC 01 probe measures irradiance (W/m²) defined as the ratio between the radiant flux (W) passing through a surface and the surface area (m²) in the UVC (200nm ÷280nm) spectral range. Thanks to a new type of photodiode, LP UVC 01 is blind to visible and infrared light. **The probe calibration 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

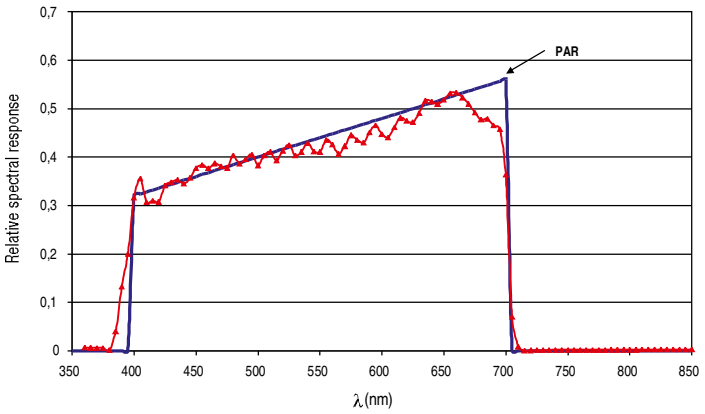


LP PAR 01:
LP PAR 01 probe measures the ratio between the number of photons that strike a surface in one second, in the 400nm - 700nm spectral range and the surface area (m²). This quantity is defined as PAR: Photosynthetically Active Radiation.
The probe calibration is carried out by using an alogen 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):	<7%
Operating temperature:	0-50°C
Output impedance:	1 kΩ

Typical spectral response LP PAR 01



Purchasing codes:
LP PHOT 01: Photometric probe for measuring ILLUMINANCE, CIE photopic filter, diffuser for correction according to the cosine law. mV per klux output, 5 m cable.
LP RAD 01: Radiometric probe for measuring IRRADIANCE, diffuser for correction according to the cosine law. mV per klux output, 5 m cable.
LP PAR 01: Radiometric probe for measuring PHOTONS FLUX in the range of PAR (Photosynthetically Active Radiation). Cosine correction. mV/micromol/m⁻²s⁻¹, 5 m cable.
LP UVA 01: Radiometric probe for measuring IRRADIANCE in the UVA (315…400nm). µV/µWcm² output, 5m cable
LP UVB 01: Radiometric probe for measuring IRRADIANCE in the UVB (280…315nm). µV/µWcm² output, 5m cable.
LP UVC 01: Radiometric probe for measuring IRRADIANCE in the UVC (200…280nm). µV/µWcm² output, 5m cable
LP BL: Base with levelling device. On request for assebly 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÷10 (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÷10 (10÷0Vdc) output. Input measuring range –10..+60mV. Default setting 0÷20mV. Minimum measuring range 2mV.

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

PHOTOMETRIC AND RADIOMETRIC PROBES WITH OUTPUT SIGNAL IN mV OR NORMALIZED 4÷20mA OR 0÷10Vdc 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 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.
The heating option allows you to operate at low temperatures with good results.
M12 male 4-pole connector, heated version 8-poles.
Cables with female connectors and with 2, 5 or 10m length available on request.
On request female connector cable 2, 5 or 10 m long.

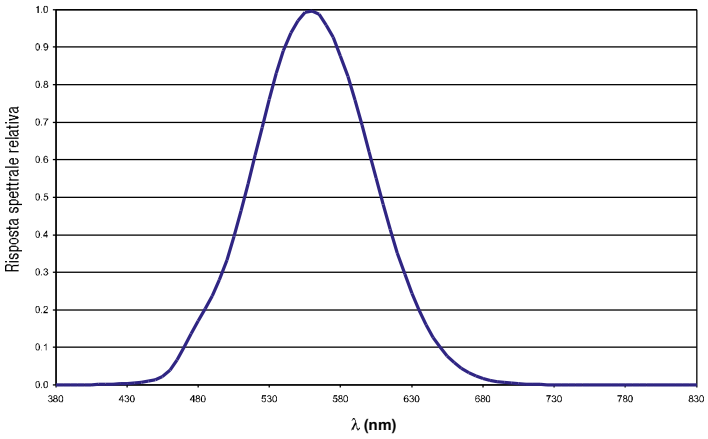
LP PHOT 03

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 f1.
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.
The heating option allows you to operate at low temperatures with good results.
Output, according to the chosen configuration, mV or normalized output 4÷20mA or 0÷10Vdc.

TECHNICAL SPECIFICATIONS:

Typical sensitivity:	0.5 ÷ 1.5 mV/(klux)
Spectral range:	V(λ) (see figure)
Calibration uncertainty:	< 4%
f'_1 (agreement with the standard curve V(λ)):	<6%
f_2 (Cosine response)	<3%
f_3 (linearity)	<1%
Measuring range:	0-200 klux
Viewing angle:	2π sr
Operating temperature:	-40°C ÷ +60°C heated version -20°C ÷ +60°C standard version
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:**



PURCHASING CODE

LP PHOT 03: Photometric probe for the measurement of illuminance, complete with K5 dome, silica gel cartridge, flying female 4-pole or 8-pole connector (depending on the version), calibration report. **Cable with female connector has to be ordered separately.** Cables: **CPM12 AA** …with cable length 2, 5 or 10 meters.

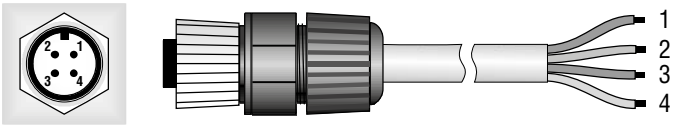
LP PHOT ☐ ☐
- **R** = heating option
- **Blank** = not heated

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

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

- **4** = 4-pole cable for non-heated versions
- **8** = 8-pole cable for heated versions, **option R**

WIRING DIAGRAM
4-pole wire CPM12AA4…



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

LPPHOT 03, LP PHOT 03BL

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

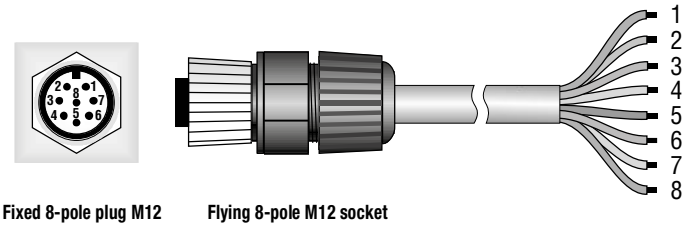
LP PHOT 03BLAV

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

8-pole wire CPM12AA8…



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

LP PHOT 03R, LP PHOT 03BLR

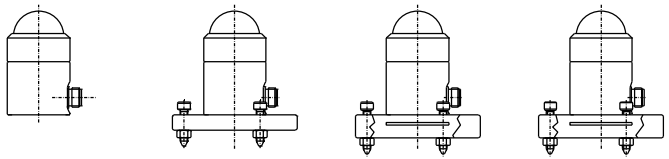
Connector	Function	Color
1	Positive signal (+)	Red
2	Negative signal (-)	Blue
3	Not connected	
4	Shield	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green

LP PHOT 03BLAVR

Connector	Function	Color
1	(-) V out and (-) Vdc	Red
2	(+) V out	Blue
3	Not connected	
4	(+) Vdc	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green

LP PHOT 03BLACR

Connector	Function	Color
1	Positive signal (+), (+) Vdc	Red
2	Negative signal (-), (-)Vdc	Blue
3	Not connected	
4	Shield	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green



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

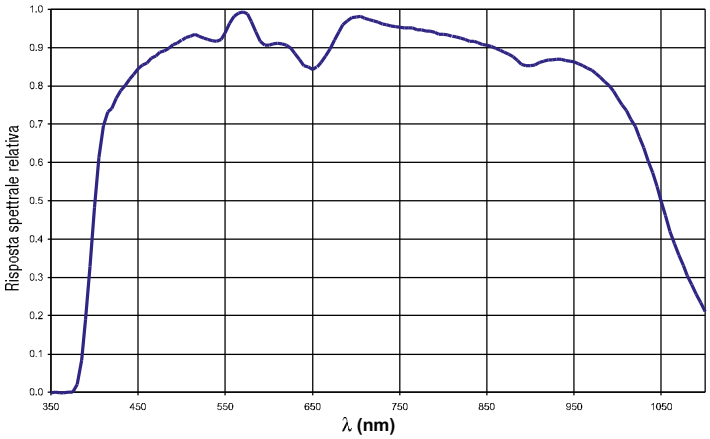
LP RAD 03

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.
The heating option allows you to operate at low temperatures with good results.
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:	-40°C ÷ +60°C heated version -20°C ÷ +60°C standard version
Impedance:	0.5 ÷ 1.0 KΩ non-normalized version
Version with normalized output 4÷20mA: Version with normalized output 0÷10Vdc	4mA = 0 W/m², 20mA = 2000 W/m² 0V = 0 W/m², 10V = 2000 W/m²
Output impedance:	0.5 ÷ 1.0 KΩ non-normalized version
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**



PURCHASING CODE

LP RAD 03: Radiometric probe for the measurement of irradiance, complete with K5 dome, silica gel cartridge, flying 4-pole or 8-pol connector (depending on the version). Cable with female connector has to be ordered separately Cables: **CPM12 AA** …with cable length 2, 5 or 10 meters.

LP RAD ☐☐
- **R** = heating option
- **Blank** = not heated

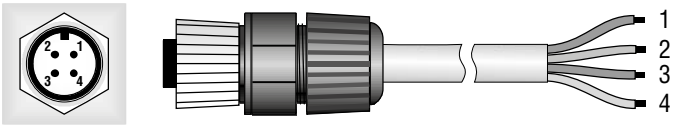
- **03** = µV per µW/cm²
- **03BL** = µV/(µW/cm²), base with levelling device
- **03BLAC** = µV/(µW/cm²), base with levelling device output 4÷20 mA
- **03BLAV** = µV/(µW/cm²), base with levelling device output 0÷10 mA

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

- **4** = 4-pole cable for non-heated versions
- **8** = 8-pole cable for heated versions, **option R**

WIRING DIAGRAM

4-pole wire CPM12AA4…



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

LP RAD 03, LP RAD 03BL

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

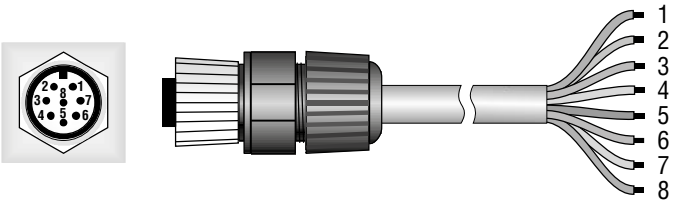
LP RAD 03BLAV

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

8-pole wire CPM12AA8…



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

LP RAD 03R, LP RAD 03BLR

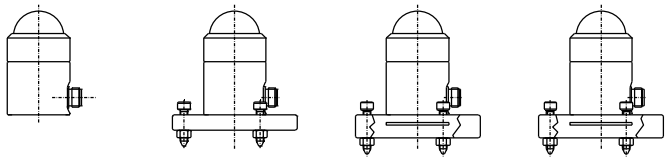
Connector	Function	Color
1	Positive signal (+)	Red
2	Negative signal (-)	Blue
3	Not connected	
4	Shield	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green

LP RAD 03BLAVR

Connector	Function	Color
1	(-) V out and (-) Vdc	Red
2	(+) V out	Blue
3	Not connected	
4	(+) Vdc	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green

LP RAD 03BLACR

Connector	Function	Color
1	Positive signal (+), (+) Vdc	Red
2	Negative signal (-), (-)Vdc	Blue
3	Not connected	
4	Shield	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green



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

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 (m^2). 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.

The heating option allows you to operate at low temperatures with good results.

Output, according to the chosen configuration, in µV per µmol $m^{-2}s^{-1}$ or normalized outputs 4÷20mA or 0÷10Vdc.

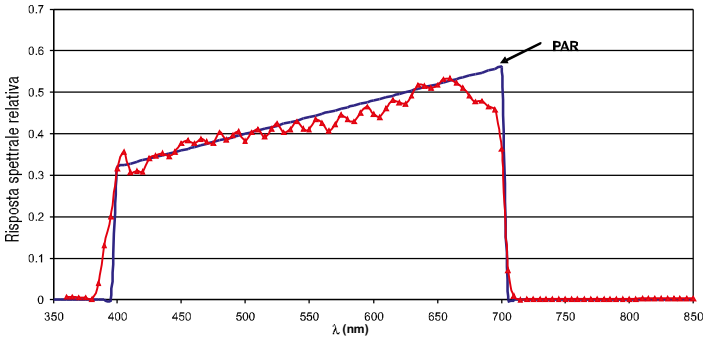
TECHNICAL SPECIFICATIONS

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:	-40°C ÷ +60°C heated version
	-20°C ÷ +60°C standard version
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

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



PURCHASING 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, flying 4-pole or 8-pole connector (depending on the version). **Cable with female connector has to be ordered separately**. Cables: **CPM12 AA** …with cable length 2, 5 or 10 meters.

LP PAR [ ][ ]

- **R** = heating option
- **Blank** = not heated

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

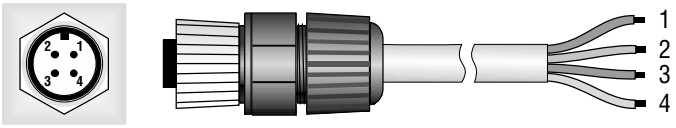
CABLE:

CPM12 AA [ ][ ]

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

- **4** = 4-pole cable for non-heated versions
- **8** = 8-pole cable for heated versions, **option R**

WIRING DIAGRAM
4-pole wire CPM12AA4…



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

LP PAR 03, LP PAR 03BL

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

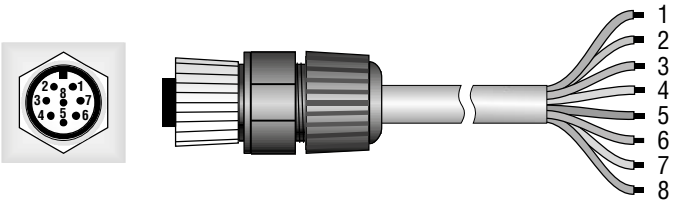
LP PAR 03BLAV

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

8-pole wire CPM12AA8…



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

LP PAR 03R, LP PAR 03BLR

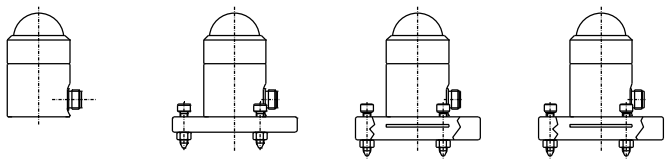
Connector	Function	Color
1	Positive signal (+)	Red
2	Negative signal (-)	Blue
3	Not connected	
4	Shield	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green

LP PAR 03BLAVR

Connector	Function	Color
1	(-) V out and (-) Vdc	Red
2	(+) V out	Blue
3	Not connected	
4	(+) Vdc	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green

LP PAR 03BLACR

Connector	Function	Color
1	Positive signal (+), (+) Vdc	Red
2	Negative signal (-), (-)Vdc	Blue
3	Not connected	
4	Shield	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green



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.

The heating option allows you to operate at low temperatures with good results.

Output, according to the chosen configuration, in µV per µW/cm² or 4÷20mA or 0÷10Vdc normalized output.

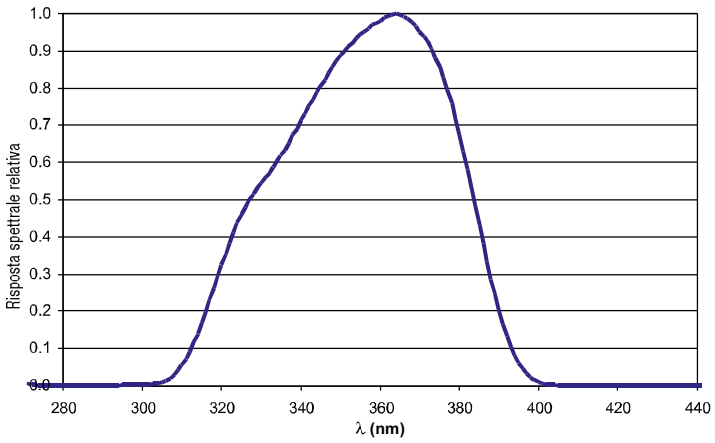
TECHNICAL SPECIFICATIONS

Typical sensitivity:	70÷200 µV/(W/cm²)
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:	-40°C ÷ +60°C heated version -20°C ÷ +60°C standard version
Impedance:	0.5 ÷ 1.0 KΩ non-normalized version

Version with normalized output 4÷20mA: 4mA = 0 W/m² 20mA = 200W/m²
Version with standard output 0÷10Vdc : 0V = 0 W/m10V = 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:**



PURCHASING CODE

LP UVA 03: Radiometric probe for the measurement of the UVA irradiance, complete with with K5 dome, silica gel cartridge, flying 4-pole or 8-pole connector (depending on the version). **Cable with female connector has to be ordered separately**. Cables: **CPM12 AA** …with cable length 2, 5 or 10 meters.

LP UVA [ ][ ]
- **R** = heating option
- **Blank** = not heated

[ ][ ]
- **03** = µV per µW/cm²
- **03BL** = µV per µW/cm², base with levelling device
- **03BLAC** = µV per µW/cm², base with levelling device output 4÷20 mA
- **03BLAV** = µV per µW/cm², base with levelling device output 0÷10 mA

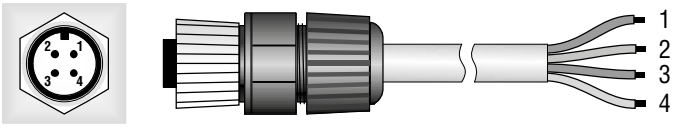
CABLE:

CPM12 AA [ ][ ]
- **2** = length 2m
- **5** = length 5m
- **10** = length 10m

[ ]
- **4** = 4-pole cable for non-heated versions
- **8** = 8-pole cable for heated versions, **option R**

WIRING DIAGRAM

4-pole wire CPM12AA4…



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

LP UVA 03, LP UVA 03BL

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

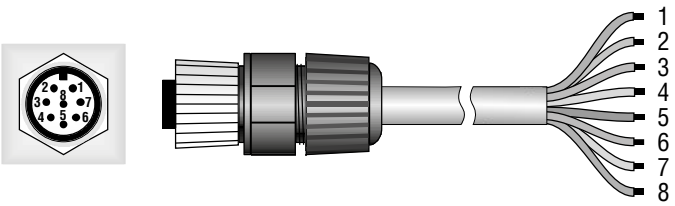
LP UVA 03BLAV

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

8-pole wire CPM12AA8…



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

LP UVA 03R, LP UVA 03BLR

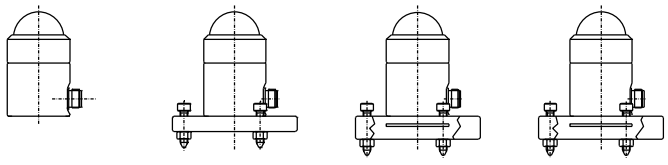
Connector	Function	Color
1	Positive signal (+)	Red
2	Negative signal (-)	Blue
3	Not connected	
4	Shield	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green

LP UVA 03BLAVR

Connector	Function	Color
1	(-) V out and (-) Vdc	Red
2	(+) V out	Blue
3	Not connected	
4	(+) Vdc	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green

LP UVA 03BLACR

Connector	Function	Color
1	Positive signal (+), (+) Vdc	Red
2	Negative signal (-), (-)Vdc	Blue
3	Not connected	
4	Shield	Braid
5	NTC (10K)	Brown
6		White
7	Heater	Black
8		Green



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

LP UVB 03BLAVR:

The LP UVB 03BLAVR probe measures global 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 UVB (280 nm ÷315 nm) spectral region. In particular, the spectral sensitivity is focused at 365nm, 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.

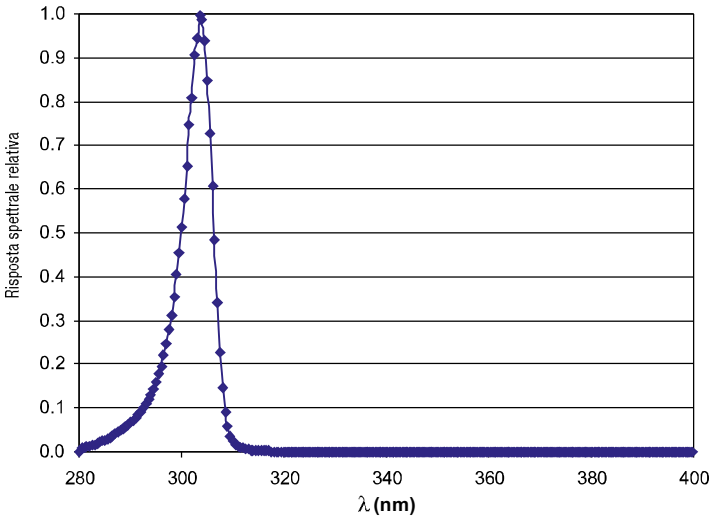
The heating option allows you to operate at low temperatures with good results.

Standard output 0÷5Vdc.

TECHNICAL SPECIFICATIONS

Typical sensitivity:	≈6V/(W/m^2)
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%

Typical spectral response curve **LP 03BLAVR**



PURCHASING CODE

LP UVB 03BLAVR: Radiometric probe for the measurement of the UVB irradiance, complete with Quartz dome, 3 silica gel cartridges, flying 8-pole 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 ☐ — **03BLAVR** = 0÷5 V, complete with levelling device and heater

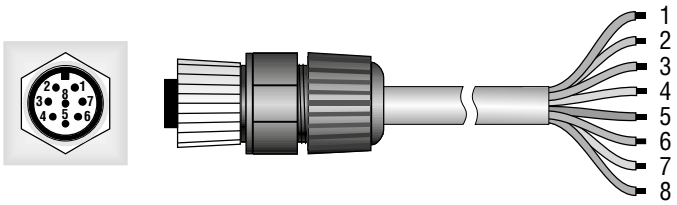
CABLE:

CPM12 AA ☐☐

- **2** = length 2m
- **5** = length 5m
- **10** = length 10m
- **8** = 8-pole cable for heated versions, **option R**

WIRING DIAGRAM

8-pole wire CPM12AA8…

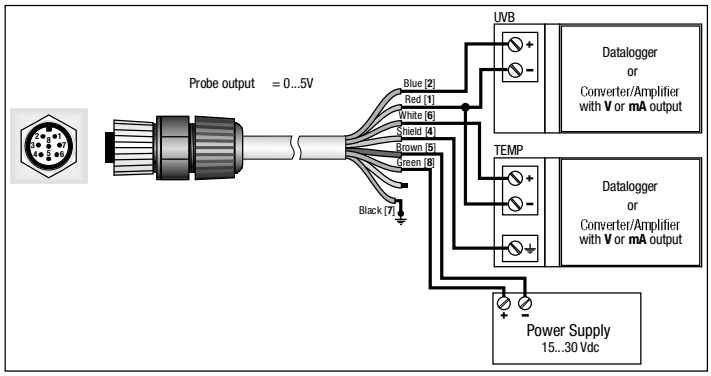


Fixed 8-pole plug M12 **Flying 8-pole M12 socket**

LP UVB 03BLAVR, LP UVB 03BLAVR

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 CONNECTION DIAGRAMS



ACCESSORIES

Heating option R

LP G: Packet with 5 silica gel spare cartridge

CPM12 AA4.2: 4-pole cable for not heated versions. Length 2 m. Connector M12 8-pole on one side, open wires on the other sid

CPM12 AA4.5: 4-pole cable for not heated versions. Length 5 m. Connector M12 8-pole on one side, open wires on the other side.

CPM12 AA4.10: 4-pole cable for not heated versions. Length 10 m. Connector M12 8-pole on one side, open wires on the other side.

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

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

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

Configurable amplifiers and converters

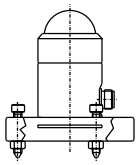
HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Two DIN module (35mm) for rail attachment. Minimum measuring range 2mV. **Configurable with HD 778 TCAL.**

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

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

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

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



LP UVB 03BLAVR

LP RAD 03 BLAC

LP RAD 03 BL

LP RAD 03

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

The LP PHOT 02, LP PHOT 02AC, and LP PHOT 03AV probes measure illuminance (lux), defined as the ratio between the luminous flux (lumen) passing through a surface and the surface area (m^2).
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 02 and the standard photopic curve V(λ) is calculated by means of the error f_1'.
LP PHOT 02 is designed for outdoor installation for long period.
The photometric measurement for external use is used for measurement of daylight in meteorology and climatology.

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

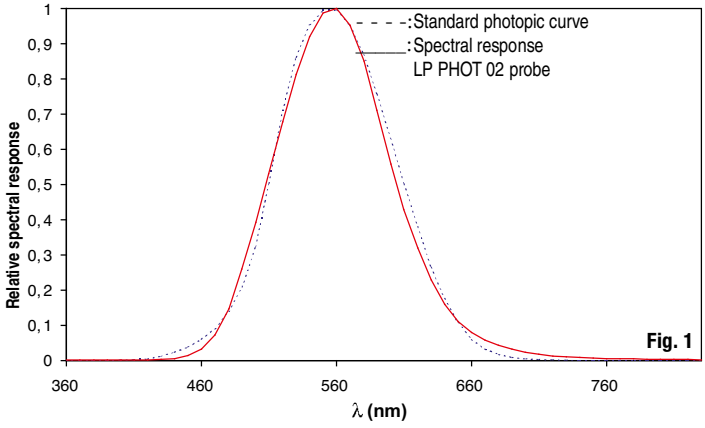


Fig. 1

LP PHOT 02 is equipped 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 installing the probe, 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 probe is ready for use

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

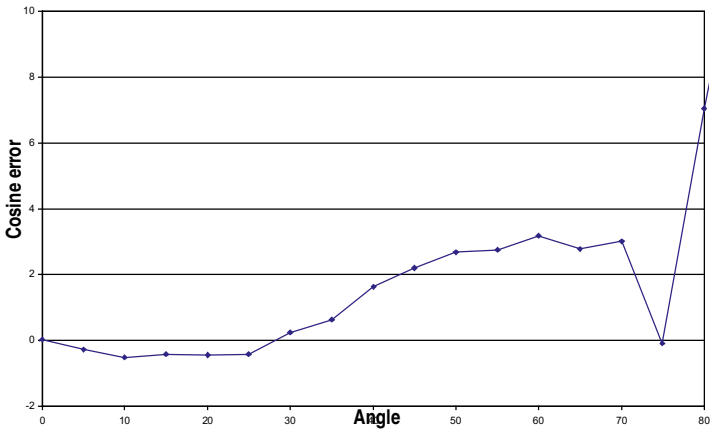


Fig. 2

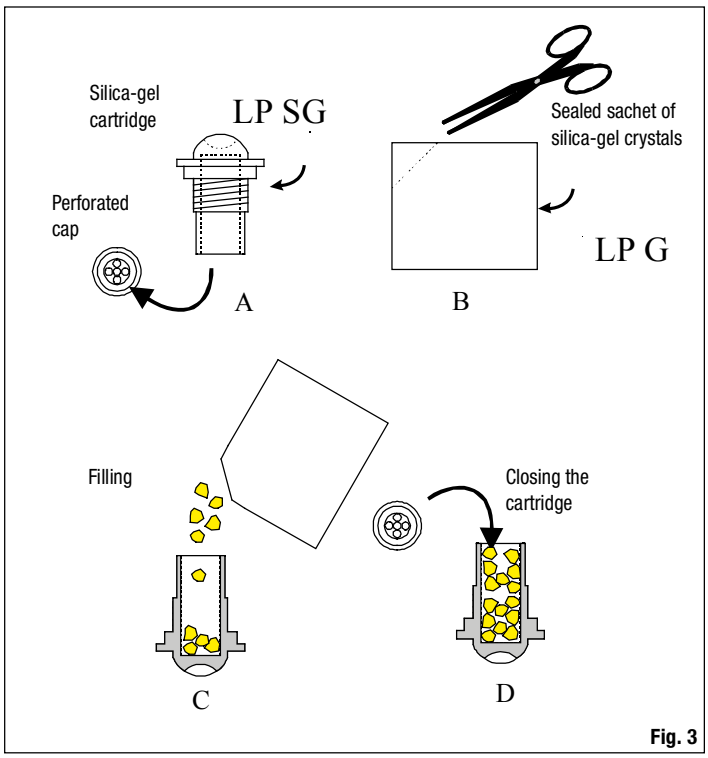


Fig. 3

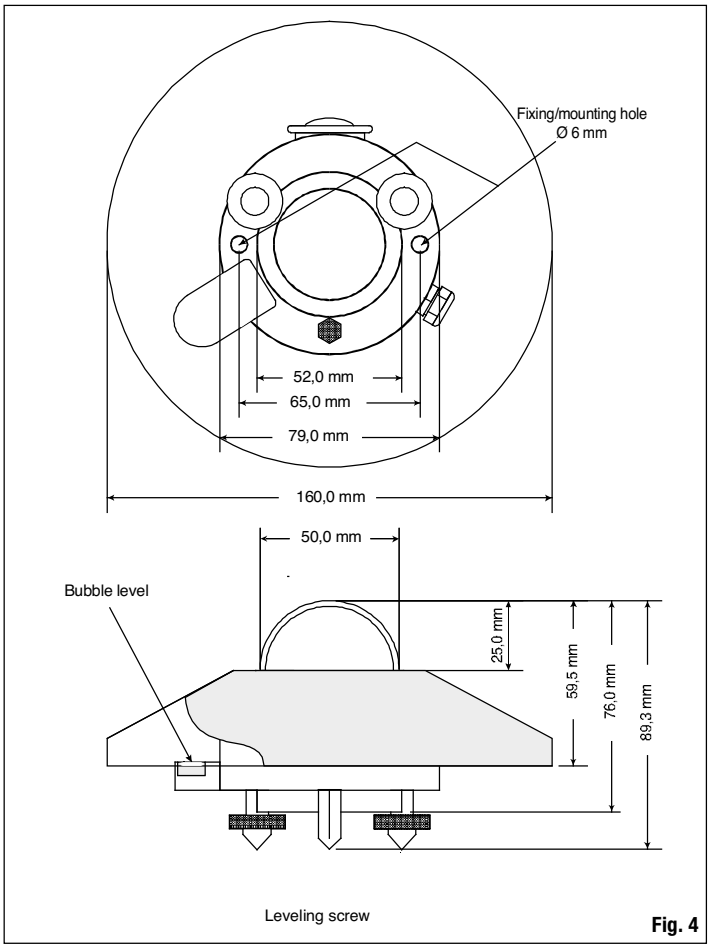
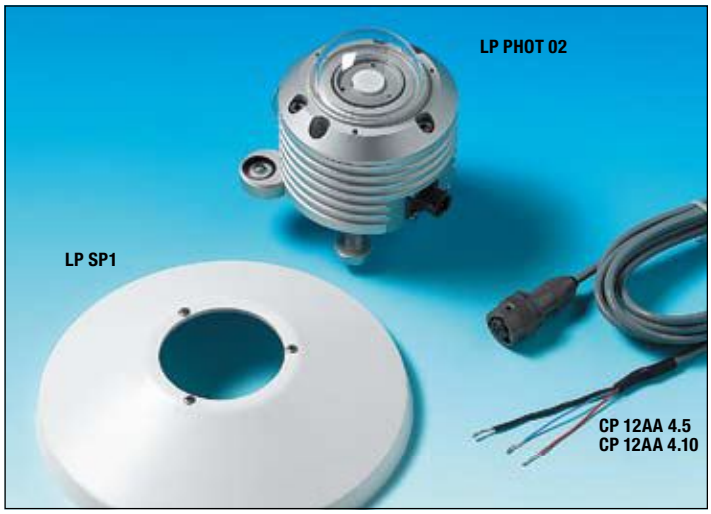


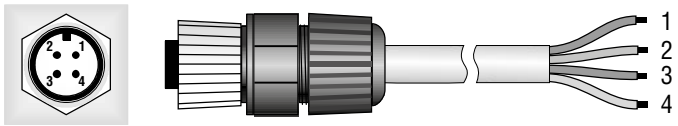
Fig. 4



the adjustment is by means of the two screws with adjusting nut for adjusting the tilt. The fixation on a plane can be performed using the two holes of 6mm diameter and spacing of 65 mm. To access holes to remove the screen and reposition it after mounting, see Figure 4.

- The support LP S1, available on request as an accessory, allows easy installation of the probe on a support pole. The maximum diameter of the pole to which the media can be set is 50 mm. The installer must take care that the height of the mast does not exceed the level of the probe, not to introduce measurement errors caused by reflections and shadows caused by the pole. To secure the probe to the support bracket remove the screen by removing the three screws, attach the probe and once the installation is complete, refit the white screen.
- It is better to insulate the probe from its support.
- Ensure good electrical contact to earth.

WIRING DIAGRAM LP PHOT 02



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

P PHOT 02

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

LP PHOT 02 AC

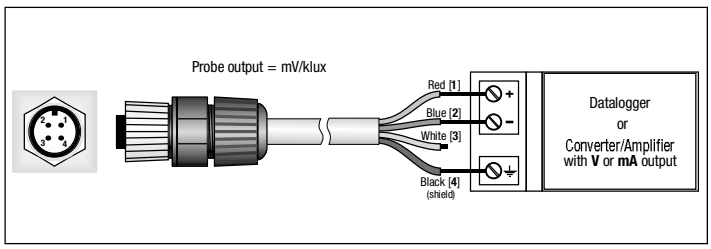
Connector	Function	Color
1	Positivo (+), +Vdc	Red
2	Negativo (-), -Vdc	Blue
3	Not connected	White
4	Shield (⏚)	Black

LP PHOT 02 AV

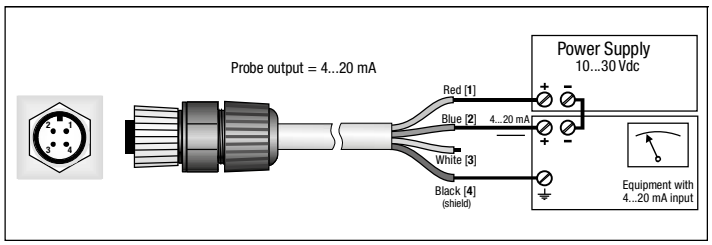
Connector	Function	Color
1	(+) Vout	Red
2	(-) Vout e (-) Vdc	Blue
3	(+) Vdc	White
4	Shield (⏚)	Black

- The LP PHOT 02 is installed in a location easily accessible for periodic cleaning of the outer dome and maintenance. At the same time you should avoid buildings, trees or obstacles of any kind exceeds the horizontal plane on which lies the probe. In case this is not possible it is advisable to choose a location where obstacles on the path of the sun from sunrise to sunset is less than 5°.
- The probe should be placed away from any obstacle that might reflect the sun (or shadow) on the probe itself.
- For accurate horizontal positioning, the probe LP PHOT 02 is equipped with bubble level,

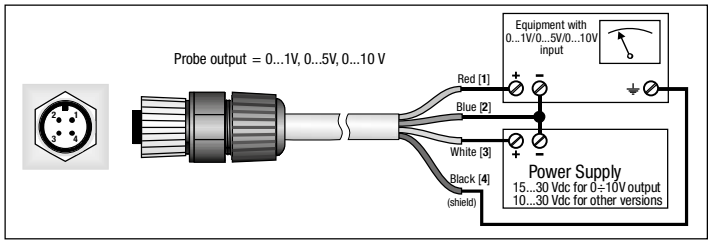
LP PHOT 02 CONNECTION DIAGRAMS



LP PHOT 02 AC



LP PHOT 02 AV



LP PHOT 02 Electrical Connections and requirements for electronic readout devices

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

Maintenance:

To ensure a high measurement accuracy is necessary for the outer dome to be always kept clean, so the higher the frequency of cleaning of the dome greater the precision of the measurements. Cleaning can be done with normal maps for the cleaning of lens paper and water, otherwise just use pure ethyl alcohol. After cleaning with alcohol, it is necessary to clean the dome again with just water.

Due to the high temperature changes between day and night it is possible the presence of condense on the dome of the probe, in this case the reading performed is strongly overestimated. To minimize condensation inside the light meter there is a proper cartridge inside with absorbent material: Silica gel. The efficiency of silica-gel crystals decreases over time with the absorption of moisture. When crystals of silica gel are efficient their color is **yellow**, while gradually losing efficiency the color turns to **white**, see the instructions for replacing.

Typically the duration of silica gel ranges from 4 to 6 months depending on environmental conditions in which it operates the probe.

Calibration and measurements:

The photometric probe 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 photomatric probe is individually factory calibrated and is distinguished by its calibration factor. Calibration is carried out by using a standard **illuminant A**, as indicated in CIE publication N° 69 "Methods of characterizing illuminance meters and luminance meters: Performance, characteristics and specifications, 1987". Calibration is carried out by comparison with a reference luxmeter, assigned to Delta Ohm Metrological Laboratory.

To get the best performances from LP PHOT 02, we strongly recommend to check calibration annually.

Technical specifications:

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

PURCHASING CODES

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

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

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

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

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

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

LP G: Packet with 5 silica gel spare cartridge.

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

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

Configurable amplifiers and converters

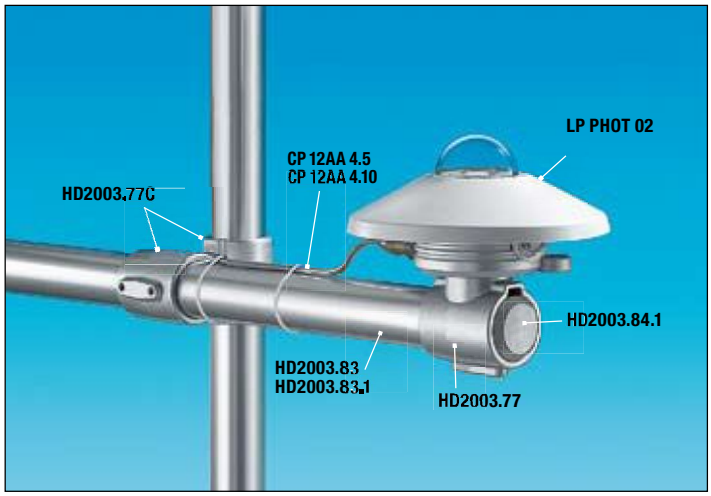
HD978TR3: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Two DIN module (35mm) for rail attachment. Minimum measuring range 2mV. **Configurable with HD 778 TCAL.**

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

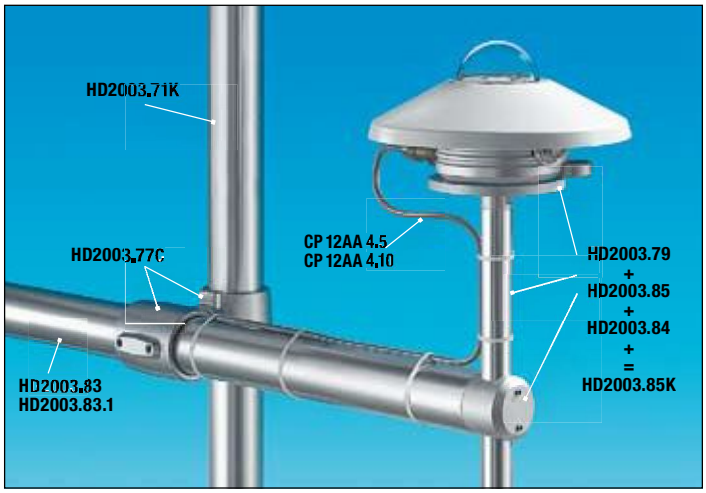
HD978TR5: Configurable signal converter amplifier with 4÷20mA (20÷4mA) output. Input measuring range –10..+60mV. **Default setting 0÷20mV.** Minimum measuring range 2mV. **Configurable with HD 778 TCAL. For wall mounting.**

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

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



LP PHOT 02



LP PHOT 02

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

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

Working Principle
LP UVA 02 radiometer is based on a solid state sensor, whose spectral response sensor has been adapted to that desired by using appropriate filters. The relative spectral response is reported on figure 4.
In order to protect the diffuser from the dust, LP UVA 02 is equipped with a 50mm glass dome.
The cosine low response is obtained with a particular shaped PTFE diffuser. In figure 5 the cosine error versus angle of incident is reported.
The excellent cosine law response of LP UVA 02 allow to use the radiometer at any sun's zenith angle. (The diffused component of the UVA increases as the sun moves away from the zenith, so the error on direct component due to imperfect response according to the cosine becomes negligible on the measurement of global irradiance).

Installation and Mounting of the Radiometer for the Measurement of Global Radiation:
Before installing the radiometer, 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 is installed in a location easily accessible for periodic cleaning of the outer dome and maintenance. At the same time you should avoid buildings, trees or obstacles of any kind exceeds the horizontal plane on which lies the radiometer. In case this is not possible, it is advisable to choose a location where obstacles on the path of the sun from sunrise to sunset is less than 5 °.
- The radiometer should be placed away from any obstacle that might reflect the sun (or shadow) on the same radiometer.
- For accurate horizontal positioning, the LP UVA 02 radiometer has a bubble level, the adjustment is by means of two screws with adjusting nut for adjusting the angle of the radiometer. The fixation on a plane can be performed using the two holes of 6mm diameter and spacing of 65 mm. To access holes to remove the screen and reposition it after mounting, see Figure 2.
- The support LP S1, supplied on request as an accessory, allows easy installation of the radiometer on a mast. The maximum diameter of the pole to which the media can be set is 50 mm. The installer must take care that the height of the mast does not exceed the level of the radiometer, not to introduce measurement errors caused by reflections and shadows caused by the pole. To secure the probe to the support bracket remove the screen by removing the three screws, attach the probe and once the installation is complete, refit the white screen.
- It is better to insulate the radiometer from its support, while ensuring that there is a good electrical contact to earth.

Electrical Connection and Requirements for Electronic Readout Devices:

- LP UVA 02 radiometer does not require any power supply.
- LP UVA 02 is supplied with a flying 4-pole M12 connector
- UV-proof PTFE cables are **available on request**, cable colors and connector poles of the screened 2-wire cable are matched as follows:
  Black → shield braid
  Red → (+) signal generated by the detector
  Blue → (-) negative signal generated by the detector (connected to the housing)
- LP UVA 02 is to be connected either to a millivoltmeter or data acquisition unit which input load resistance must be > 5MΩ. Typically, the radiometer output signal does not exceed 20mV. In order to better exploit the radiometer features, the readout instrument should have a 1µV resolution.

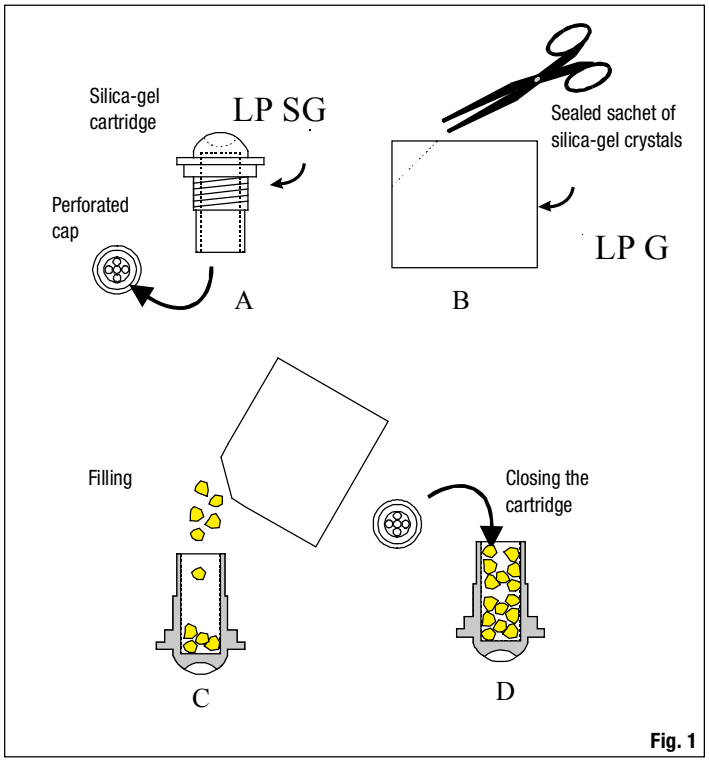


Fig. 1

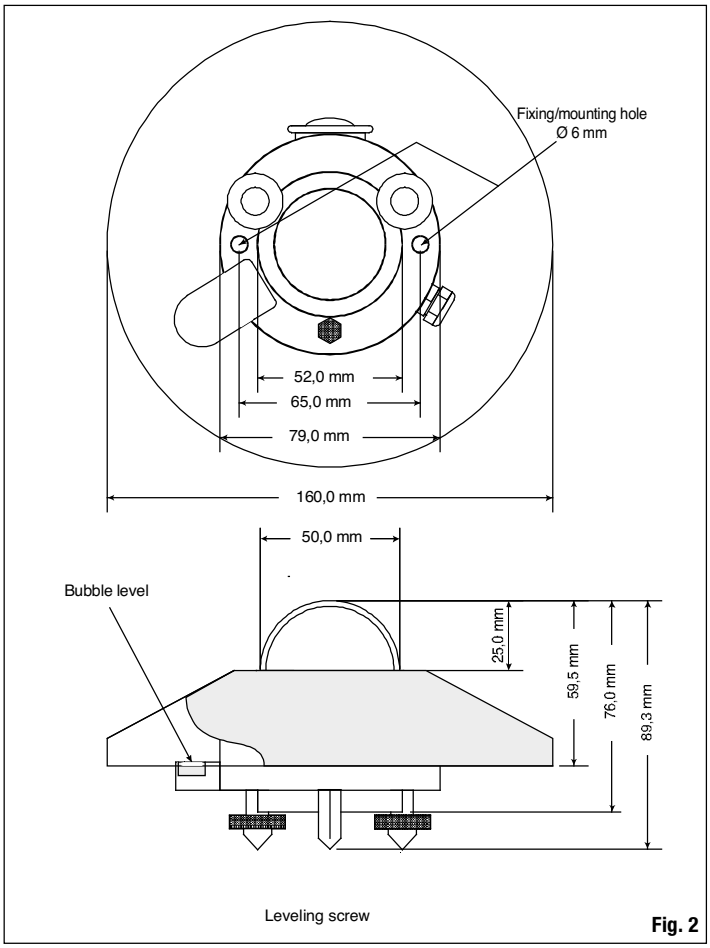
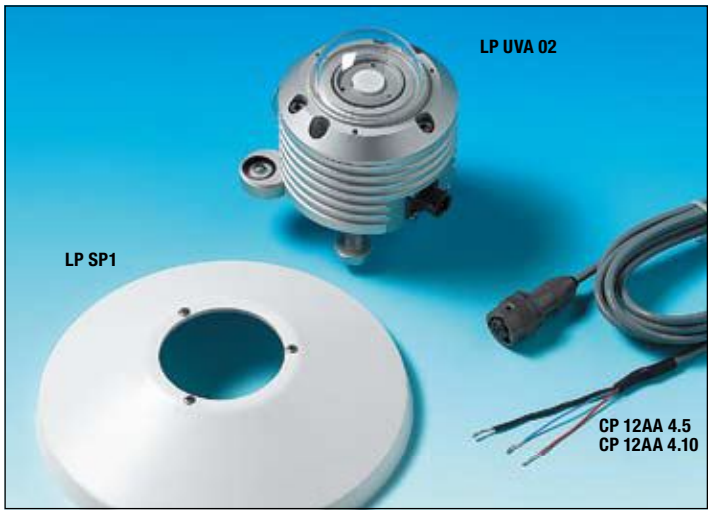


Fig. 2



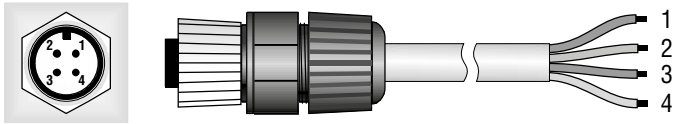
mated. To minimize condensation inside the light meter there is a proper cartridge inside with absorbent material: Silica gel. The efficiency of silica-gel crystals decreases over time with the absorption of moisture. When crystals of silica gel are efficient their color is **yellow**, while gradually losing efficiency the color turns to **white**, see the instructions for replacing.
Typically the duration of silica gel ranges from 4 to 6 months depending on environmental conditions in which it operates the probe.

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

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

$$E_e = DDP/S$$

WIRING DIAGRAM LP PHOT 02



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

LP UVA 02

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

LP UVA 02 AC

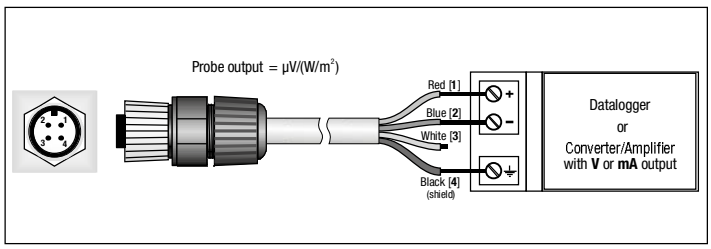
Connector	Function	Color
1	Positivo (+), +Vdc	Red
2	Negativo (-), -Vdc	Blue
3	Not connected	White
4	Shield (⏚)	Black

LP UVA 02 AV

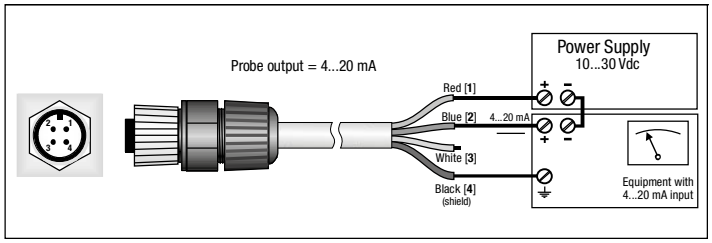
Connector	Function	Color
1	(+) Vout	Red
2	(-) Vout e (-) Vdc	Blue
3	(+) Vdc	White
4	Shield (⏚)	Black

Maintenance:
To ensure a high measurement accuracy is necessary for the outer dome to be always kept clean, so the higher the frequency of cleaning of the dome greater the precision of the measurements. Cleaning can be done with normal maps for the cleaning of lens paper and water, otherwise just use pure ethyl alcohol. After cleaning with alcohol, it is necessary to clean the dome again with just water.
Due to the high temperature changes between day and night it is possible the presence of condense on the dome of the probe, in this case the reading performed is strongly overesti-

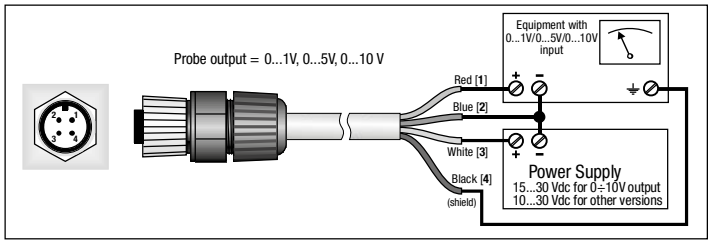
LP UVA 02 CONNECTION DIAGRAMS



LP UVA 02 AC



LP UVA 02 AV



Where:
E_e: is the Irradiance expressed in W/m²,
DDP: is the difference of potential expressed in µV and measured by the multimeter,
S: is the calibration factor in µV/(W/m²) shown on the radiometer label (and mentioned in the calibration report) .

Each radiometer is individually calibrated at factory and is distinguished by its calibration factor.
The calibration is carried out following procedure N° DHLF-E-59. This procedure is used in the SIT calibration center N° 124 for the calibration of UVA radiometer.
The calibration was performed by reference to Delta Ohm srl primary standard with monochromatic light at 365 nm obtained separating the emission line of a Xe-Hg lamp with an inferential filter. To get best performances from your LP UVA 02 it is strongly recommended that the calibration be checked annually.
N.B. At the moment no international agreement exists for the calibration of this kind of radiometer, so the calibration coefficient is dependent from the calibration procedure like reported in the following article:
"*Source of Error in UV Radiation Measurements*", T. C. Larason, C. L. Cromer on "*Journal of Research of the National Institute of Standards and Technology*" Vol. 106, Num. 4, 2001. (The article is free on the NIST's WEB site at the following address : http://www.nist.gov/jers)

Technical Specifications:

Typical sensitivity:	150 ÷ 350µV/(W/m²)
Response time:	<0.5 sec (95%)
Impedance:	5 ÷ 7.5 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

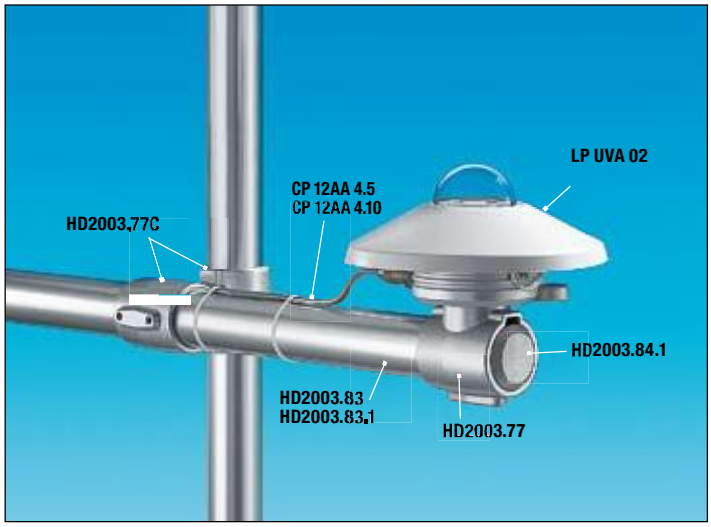
PURCHASING CODES

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

LP UVA 02AC: Amplified radiometric probe for the outdoor measurement of UVA irradiance (315…400nm), **4÷20mA output (0…150W/m²)**, integrated transmitter amplifier, **power supply 10…30Vdc**. Complete with flying M12 4-pole connector and Calibration Report. **Cable has to be ordered separately.**

LP UVA 02AV: Amplified radiometric probe for the outdoor measurement of UVA irradiance (315…400nm), **0÷1Vdc, 0÷5Vdc, 0÷10Vdc output (0…150W/m²)**, integrated transmitter amplifier, **power supply 10…30Vdc. (15..30Vdc for 0…10Vdc output).** Complete with flying M12 4-pole connector and Calibration Report. **Cable has to be ordered separately.**

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



LP UVA 02

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

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

LP G: Packet with 5 silica gel spare cartridge.

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

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

Configurable amplifiers and converters

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

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

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

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

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

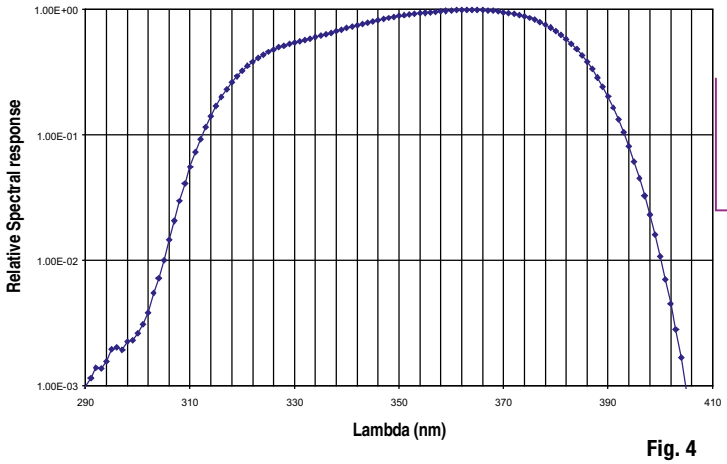


Fig. 4

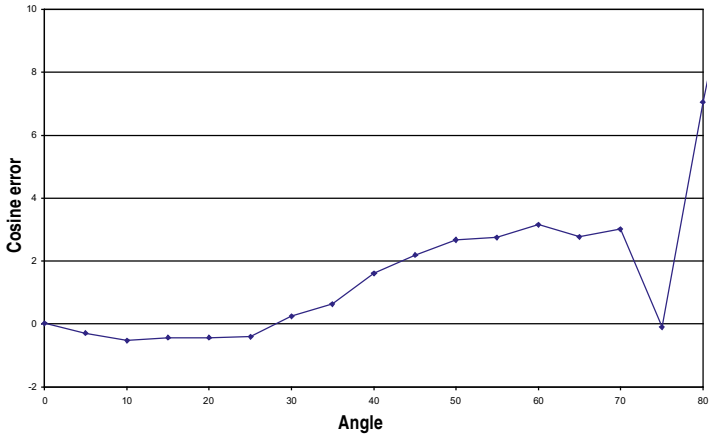


Fig. 5

LP UVB 02
RADIOMETRIC PROBE FOR ENVIRONMENTAL USE

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

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

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

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

LP UVB 02 is robust and was manufactured to operate for long periods without maintenance (if powered correctly). This characteristic makes it suitable for location in meteorological stations.

A platinum-resistance thermometer (Pt100) is inserted inside the LP UVB 02 in order to control its temperature. Internal temperature must remain within its functioning range, otherwise measurements could be affected by higher systematic errors than those asserted in the manual. Exposure to temperature higher than +60°C can alter the interferential-filters spectral characteristics.

WORKING PRINCIPLE

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

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

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

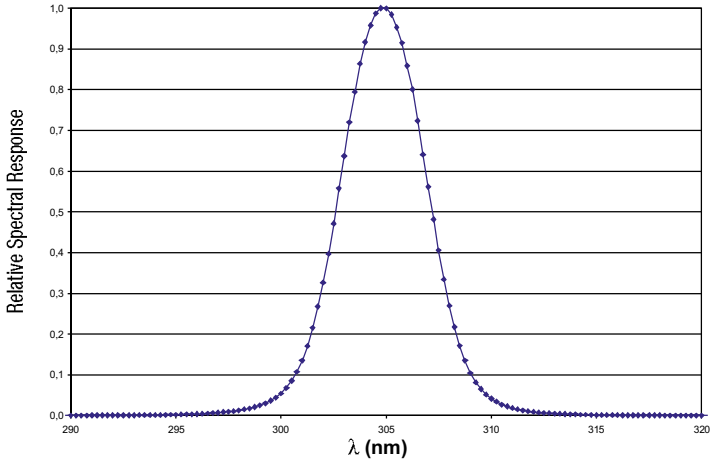


Fig. 1A

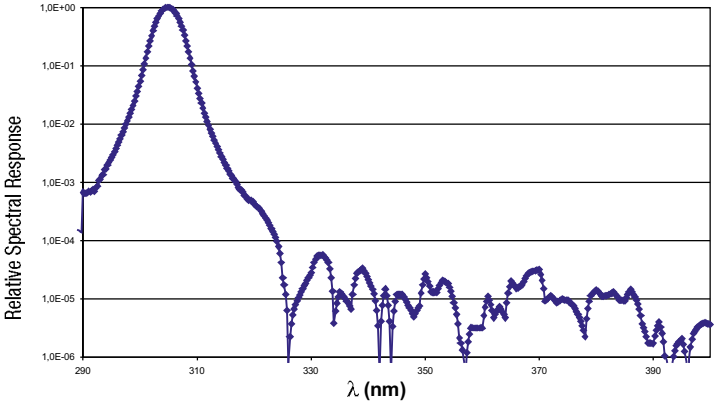


Fig. 1B

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

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

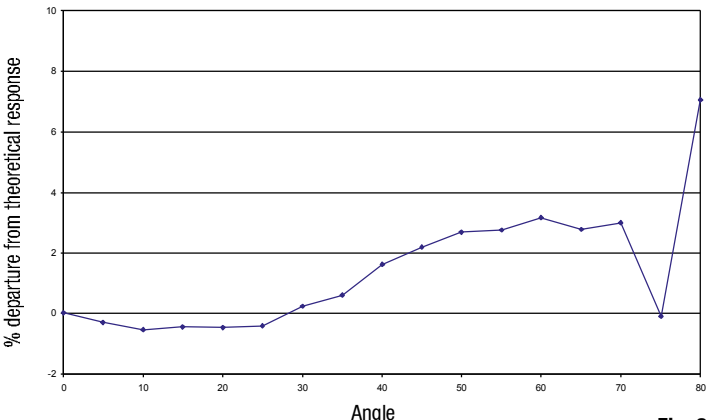


Fig. 2

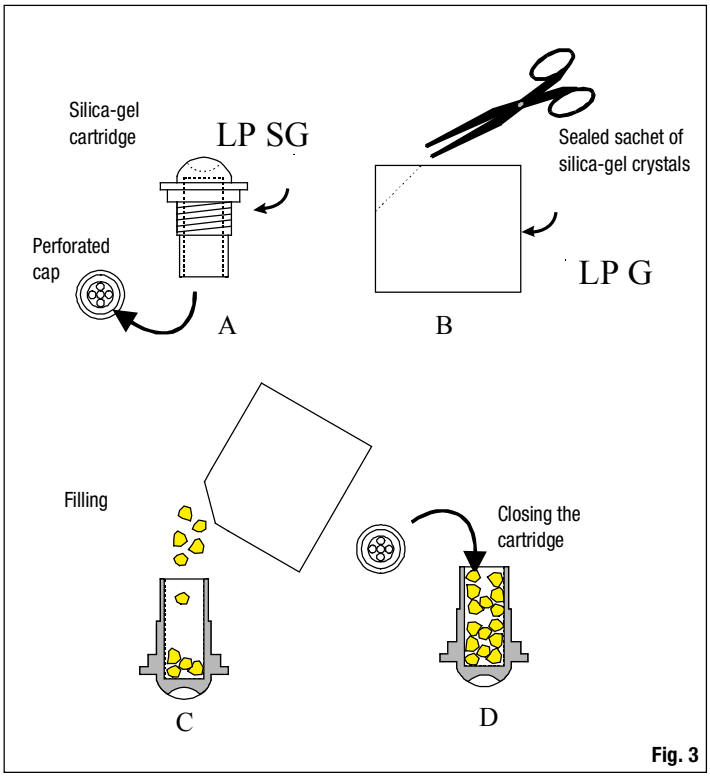


Fig. 3

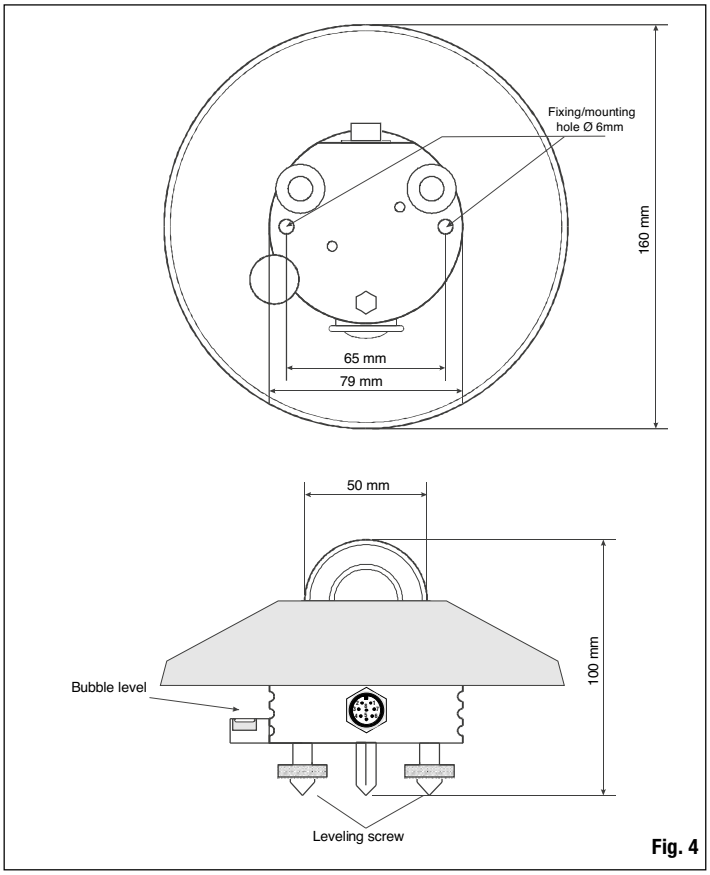


Fig. 4

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

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

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

- The LP UVA 02 radiometer is installed in a location easily accessible for periodic cleaning of the outer dome and maintenance. At the same time you should avoid buildings, trees or obstacles of any kind exceeds the horizontal plane on which lies the radiometer. In case this is not possible, it is advisable to choose a location where obstacles on the path of the sun from sunrise to sunset is less than 5 °.
- The radiometer should be placed away from any obstacle that might reflect the sun (or shadow) on the same radiometer.
- For accurate horizontal positioning, the LP UVA 02 radiometer has a bubble level, the adjustment is by means of two screws with adjusting nut for adjusting the angle of the radiometer. The fixation on a plane can be performed using the two holes of 6mm diameter and spacing of 65 mm. To access holes to remove the screen and reposition it after mounting, see figure 4.
- The support LP S1 (figure 5), supplied on request as an accessory, allows easy installation of the radiometer on a mast. The maximum diameter of the pole to which the media can be set is 50 mm. The installer must take care that the height of the mast does not exceed the level of the radiometer, not to introduce measurement errors caused by reflections and shadows caused by the pole. To secure the probe to the support bracket remove the screen by removing the three screws, attach the probe and once the installation is complete, refit the white screen.
- It is better to insulate the radiometer from its support, while ensuring that there is a good electrical contact to earth.

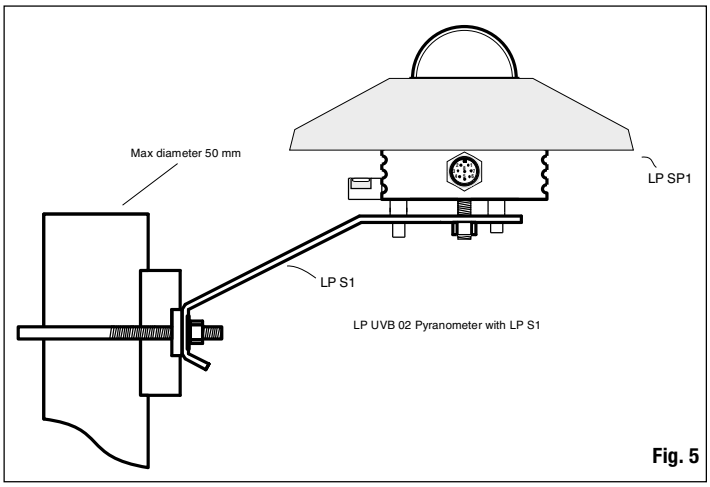


Fig. 5

Electrical Connections and Requirements for Electronic Readout Devices

The connections on the output connector are indicated below:

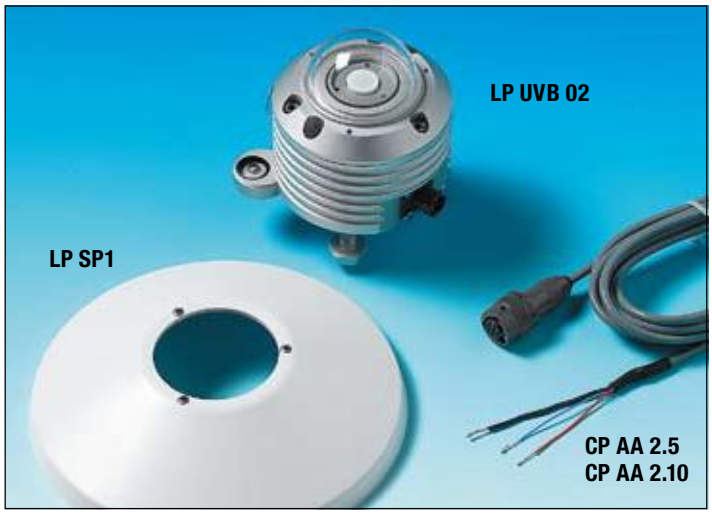
Pin8: V+, positive supply voltage for LP UVB 02 internal electronics. 7Vdc < V+ <30Vdc
Pin6: VoutTemp+, output signal for temperature measurement. 0V (-40°C) < Vout Temp+ < 1V (+60°C)
Pin2: Vout+, output signal for irradiance measurement in the UVB band. 0V < VoutUV+ < 4V.
Pin1: Ground of the two output signals, VoutTemp+, VoutUV+
Pin7: Housing.
Pin5: Power supply grounding.

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

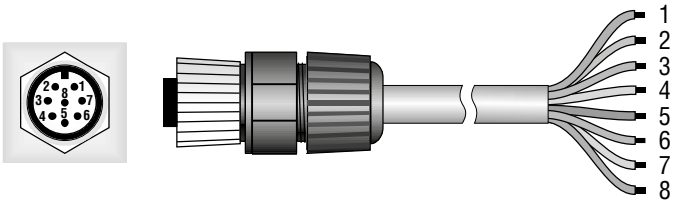
N.B. The input load resistance of the data acquisition system must be greater than 10KΩ. The connection scheme is shown in figure 6.

The cable supplied with the UV-resistant output connector has 5 wires plus the braid (screen); the colour code is shown in fig. 6.

Maintenance
To ensure a high measurement accuracy is necessary for the outer dome of the radiometer is always kept clean, so the higher the frequency of cleaning of the dome will be the best measurement accuracy. Cleaning can be done with normal maps for the cleaning of lens paper and water, if not just use pure ethyl alcohol. After cleaning with alcohol is necessary to clean the dome again with just water.
Due to the high temperature changes between day and night it is possible the presence of



WIRING DIAGRAM LP UVB 02

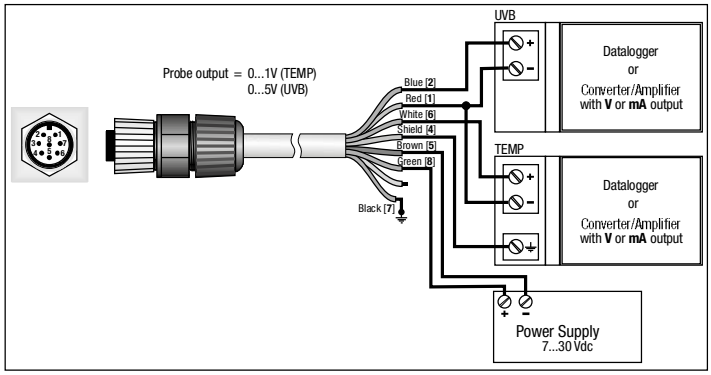


Fixed 8-pole plug M12 **Flying 8-pole M12 socket**

LP UVB 02

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

LP UVA 02 CONNECTION DIAGRAMS



condense on the dome of the probe, in this case the reading performed is strongly overestimated. To minimize condensation inside the radiometer there is a proper cartridge inside with absorbent material: Silica gel. The efficiency of silica-gel crystals decreases over time with the absorption of moisture. When crystals of silica gel are efficient their color is **yellow**, while gradually losing efficiency the color turns to **white**, to replace the instructions to see Figure 3. Typically the duration of silica gel ranges from 4 to 6 months depending on environmental conditions within which the radiometer.

The instrument calibration is recommended annually. The calibration can be performed at the Metrology Laboratory Delta Ohm, or alongside the same instrument calibrated with reference to a Primary Metrological Institute with 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:

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

Each radiometer is individually calibrated at factory and is distinguished by its calibration factor. 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:	0-8 W/m^2
Viewing range:	2π sr
Spectral range:	305nm Peak 302.5nm ÷ 307.5 nm (1/2) 304nm ÷ 309 nm (1/10) 297.5nm ÷ 311.75nm (1/100) 292.5nm ÷ 316.255nm (1/1000)
Working temperature:	-40 °C ÷ +60 °C
Response according to the cosine law:	< 8 % (between 0° and 80°)
Long-term instability(1 year):	<|±3| %
Non linearity:	<1 %
Response according to temperature:	< 0.01%/°C

TEMPERATURE MEASUREMENT

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

POWER SUPPLY

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

PUCHASING CODES:

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

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

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

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

LP G: Packet with 5 silica gel spare cartridge.

CPM12 AA2.5: 8-pole UV resistant cable L=5 m.

CPM12 AA2.10: 8-pole UV resistant cable L=10 m.

HD 2021T…
TRANSMITTERS FOR ILLUMINANCE AND IRRADIANCE MEASUREMENTS.

GENERAL DESCRIPTION

The HD 2021T series allows conversion of photometric and radiometric quantities as illuminance (Lux) and irradiance (W/m²) - across, UVA, UVB, UVC spectral regions and 400 ÷ 1000nm band - into a 0 ÷10 voltage signal. The voltage output 0 ÷ 10 V (0 ÷ 1 V, 0 ÷ 5V, 4 ÷ 20mA on request for substantial orders) comes factory set calibrated to the full scale range specified at the time of order.

HD 2012T transmitters wide range of applications include:

• Measurement of illumimance (HD 2021T) in offices and laboratories, manufacturing plants and production areas, commercial sites, theatres, museums, sports lighting, roadway lighting, tunnels and nursery-gardening systems.

• Measurement of solar irradiance, within 400nm ÷ 1000nm spectral band (HD 2021T.1).

• Monitoring tanning lamps irradiance within UVA (HD 2021T.2) and UVB (HD2021T.3) spectral regions, as well as efficiency control in filters for high pressure UV lamps.

• Efficiency control in UV lamps used in water purification plants, where UVC (HD2021T.4) band irradiance needs to be constantly monitored.

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

INSTALLATION OF TRANSMITTERS

After choosing the right position where to install HD2021T, you need to provide the electric connections inside the transmitter. Loosen the four screws on the lid in order to lift it; the inside of the transmitter will look as in figure n.1. On the terminal board we will locate three terminals with the following tags:

GND ➔ meaning the ground referred to power supply and output signal

+Vdc ➔ where the positive pole of the power supply has to be connected (in case of continuous power being employed)

Vlux (output) ➔ system output to be connected to the positive pole of a Multimeter or Data Logger

The sample below shows the installation of HD2021T illuminance transmitter monitoring lamps intensity. For this kind of application, HD2021T transmitters are generally installed on ceilings, close to the area where illuminance needs to be monitored (figure 2). Through a reference Luxmeter (ex. HD2102.1(2) with probe LP471 PHOT) previously placed in the operating area, we work on HD2021T potentiometer until we get to the desired reference value. HD2021T output is able to control several adjustable feeders at the same time.

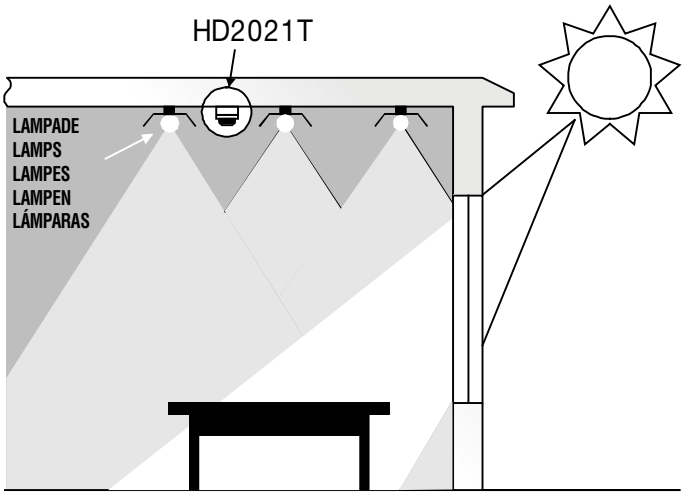


fig. 2

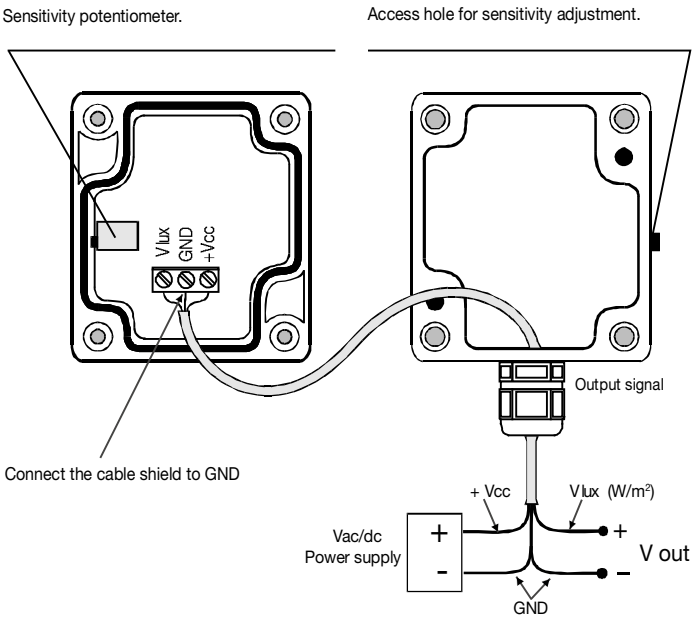
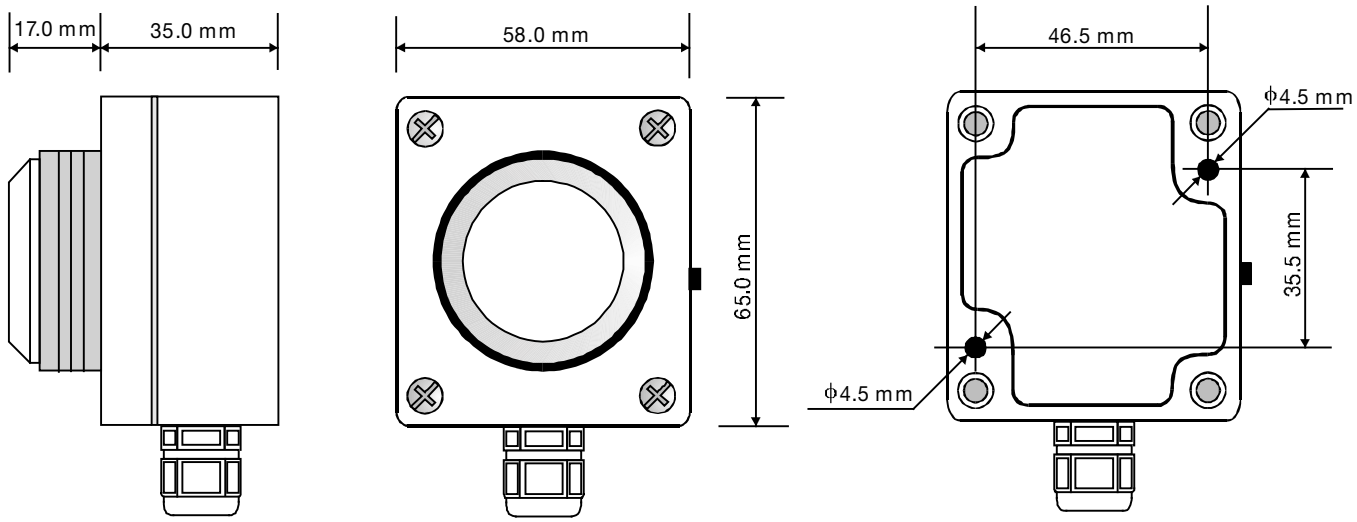


fig. 1

DIMENSIONS:
HD2021T, HD2021T.1, HD2021T.2, HD2021T.3, HD2021T.4



TECHNICAL SPECIFICATIONS

	HD2021T	HD2021T.1	HD2021T.2	HD2021T.3	HD2021T.4
Sensor	Photodiode Si	Photodiode Si	Photodiode GaP	Photodiode SiC	Photodiode SiC
Spectral range	Curva V(l)	450 ÷ 1100 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				

PURCHASING 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 on 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
EQUIVALENT VEILING LUMINANCE PROBE, LUMINANCE PROBE

The HD2021T7 probe allows converting a photometric quantity such as the "equivalent veiling luminance" (cd/m²) into a current (4-20 mA) or a voltage signal (0-10 V) according to the version that you choose.
If the acquisition station is far from the probe (>50m), the current output version is required.
The HD2021T7 probe has IP67 protection. In order to grant high accuracy, it is important to keep the outer lens clean. You can wash them using only water and standard papers for lens. The transmitter full scale can be chosen (when ordering) between two different values: 2000cd/m² or 20000cd/m². The full scale can be customized for orders greater than 5 pcs.
The field of application of the transmitter includes road lighting. In particular the equivalent veiling luminance is necessary to calculate the threshold luminance at tunnel entrances (UNI 11095).

INSTRUMENT TECHNICAL SPECIFICATIONS
Dimensions
(Length x Width x Height) 147mm x 58 mm x 65mm)

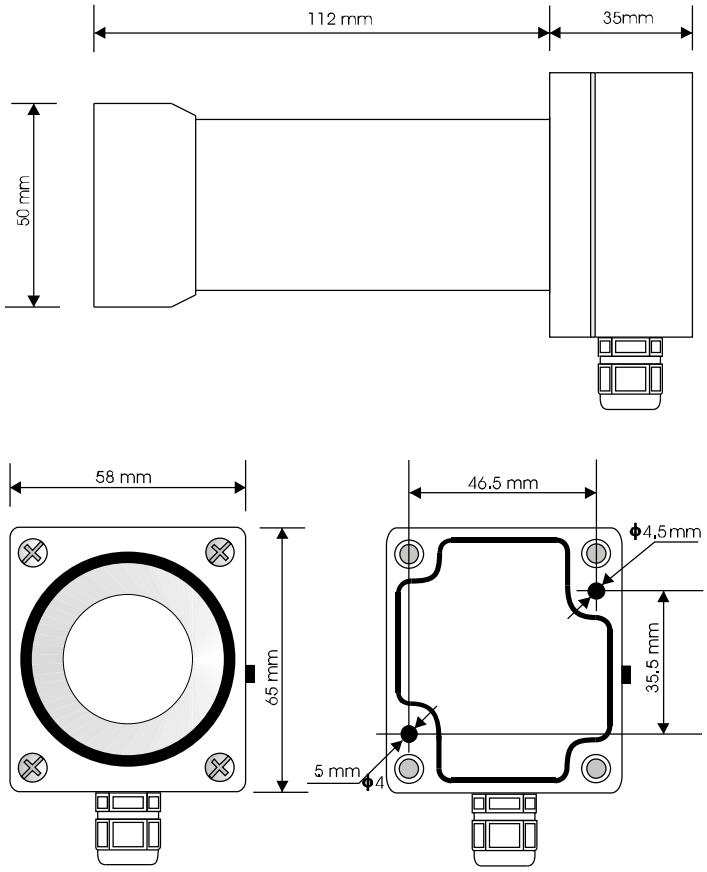


Figure 1 Dimensions of the HD2021T7 probe

SPECTRAL RESPONSE
The probe is fitted with a silicon photodiode and a set of filters in order to match the spectral response curve to that of the human eye (photopic vision).
Figure 2 shows relative spectral response versus wavelength .
f'1 <9% in accordance with the photopic curve to V(λ).

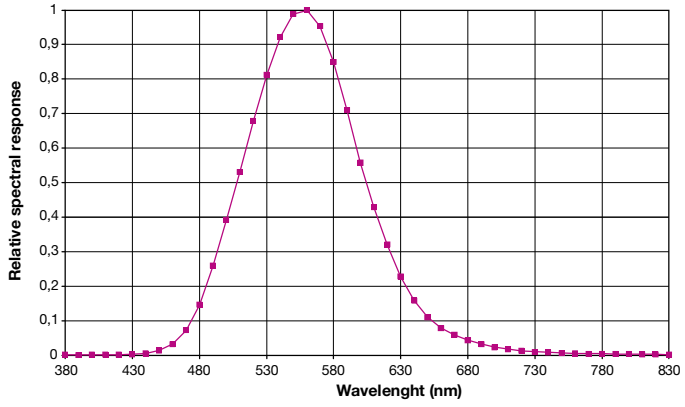


Figure 2. HD2021T7 Relative spectral response

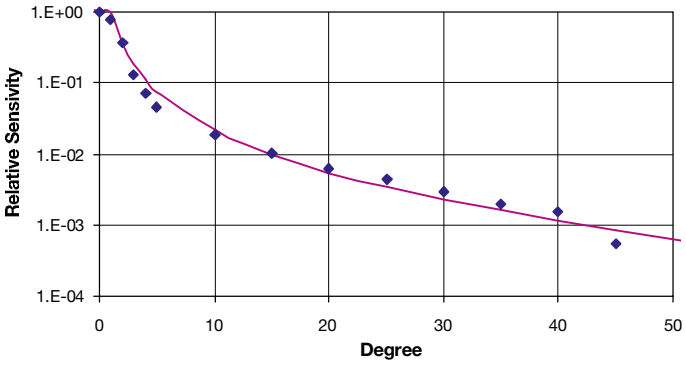
ANGULAR RESPONSE
The equivalent veiling luminance (L_v) is estimated by the following formula:

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

where:
L(β) is the luminance of the disturbing source at angle β,
β is the angle between the disturbing source and the observing direction,
Ω is the solid angle

Figure 3 shows the relative sensitivity versus angle.
In the CIE88:2004 standard the equivalent veiling luminance is calculated considering contributions up to 28.4° angles. Therefore the DeltaOhm HD 2021T7 probe allows estimating contributions also to greater angles (up to 40°).

Figure 3. HD2021T7 Relative angular response



WORKING TEMPERATURE

The probe can operate in a temperature range from -20 ° to +60° C. If the probe is placed in watertight containers, you should prevent the exit window from misting up or being covered with condensation. In this case the reading would be altered.

CALIBRATION

The calibration of the HD2021T7 probe is carried out by measuring the luminance on the output port of an integrating sphere with a known luminance. The equivalent veiling luminance veil is calculated by the formula **A** with a total field of view for the HD2021T7 probe of ±40°. The probe calibration uncertainty, with fixed full scale is 10% (at a 95% level of confidence).

TRANSMITTER INSTALLATION

To calculate the *threshold luminance* at the tunnel entrance the probe must be installed in compliance with UNI 11095.
To connect the transmitter, unscrew the lid which covers the terminal board. Figure 4 refers to the 4-20mA version, while figure 5 relates to the 0-10 V version.

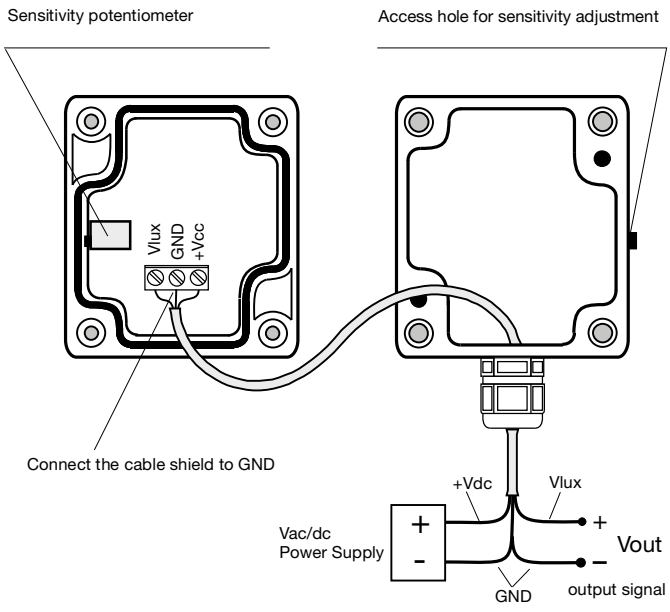


Figure 4. Connection diagram for HD2021T… with current output

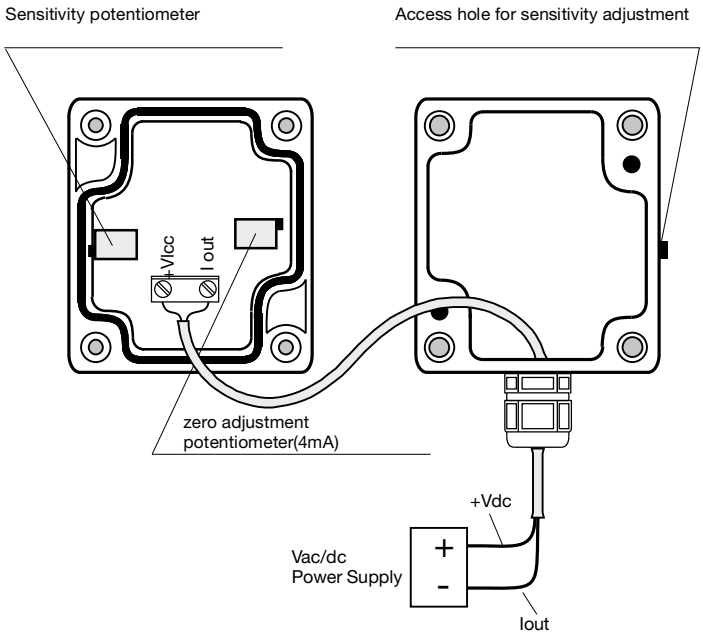


Figure 5. Connection diagram for HD2021T… with voltage output

PURCHASING 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		On request *		
HD2021T7A.A	4-20 mA	0-2000 cd/m²		
HD2021T7B.A		0-20 kcd/m²		
HD2021T7X.V		On request *		

*minimum order 5 pcs

HD2021T6

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

The protection class of the HD2021T6 transmitter is IP67. 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.

The transmitter sensitivity can be chosen from three previously set values when placing the order: 2 kcd/m^2 , 20 kcd/m^2 or 200 kcd/m^2. For orders of more than 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 degree angle (L_{20}) is necessary to estimate *threshold luminance* at a tunnel entrance (CIE standard 88:2004. This standard foresees the measurement of equivalent veiling luminance in future).

Besides, 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

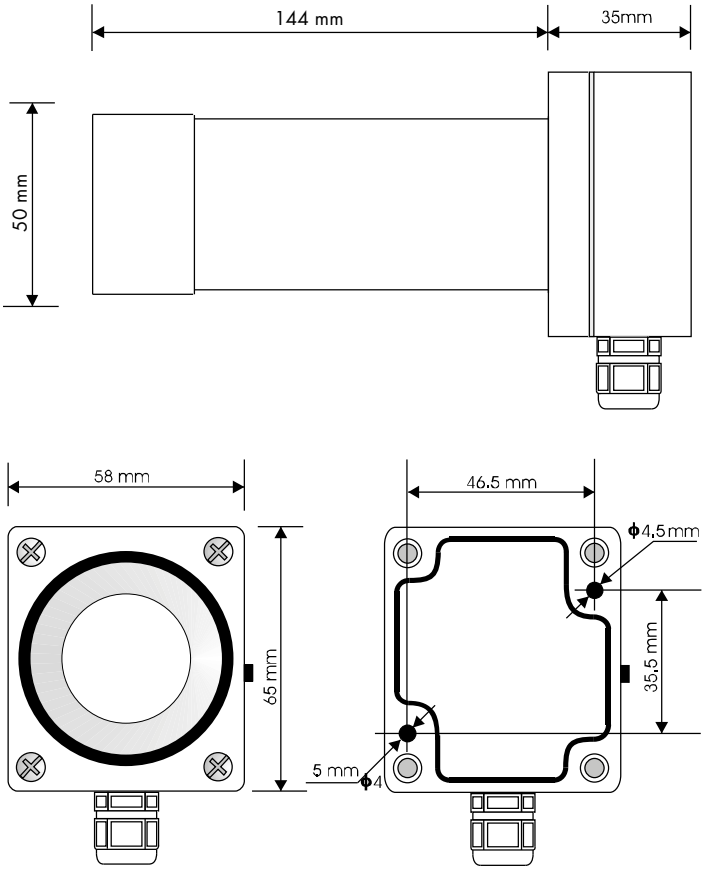


Figure 1. HD2021T6 probe dimensions

SPECTRAL RESPONSE

The probe is fitted with a silicon photodiode and a set of filters to match the spectral response curve to that of the human eye (photopic response). Figure 2 shows the relative spectral response depending on wavelength.

f'1 <9% in accordance with the standard photopic curve V(λ).

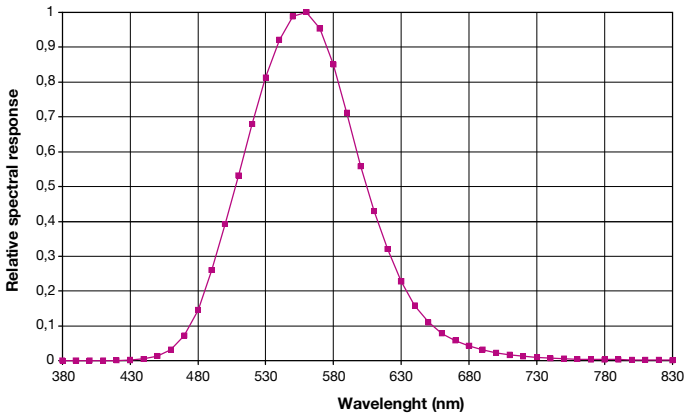


Figure 2. HD2021T6 probe relative spectral response

FIELD OF VIEW

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

WORKING TEMPERATURE

The probe can work in the temperature range -20° to +60° C.

If the probe is placed inside watertight containers, you should prevent the window from misting up or being covered with condensation. In this case, the equivalent veiling luminance reading would be altered.

CALIBRATION

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

TRANSMITTER INSTALLATION

To measure Threshold luminance at a tunnel entrance, the probe must be installed in compliance with CIE standard 88:2004.

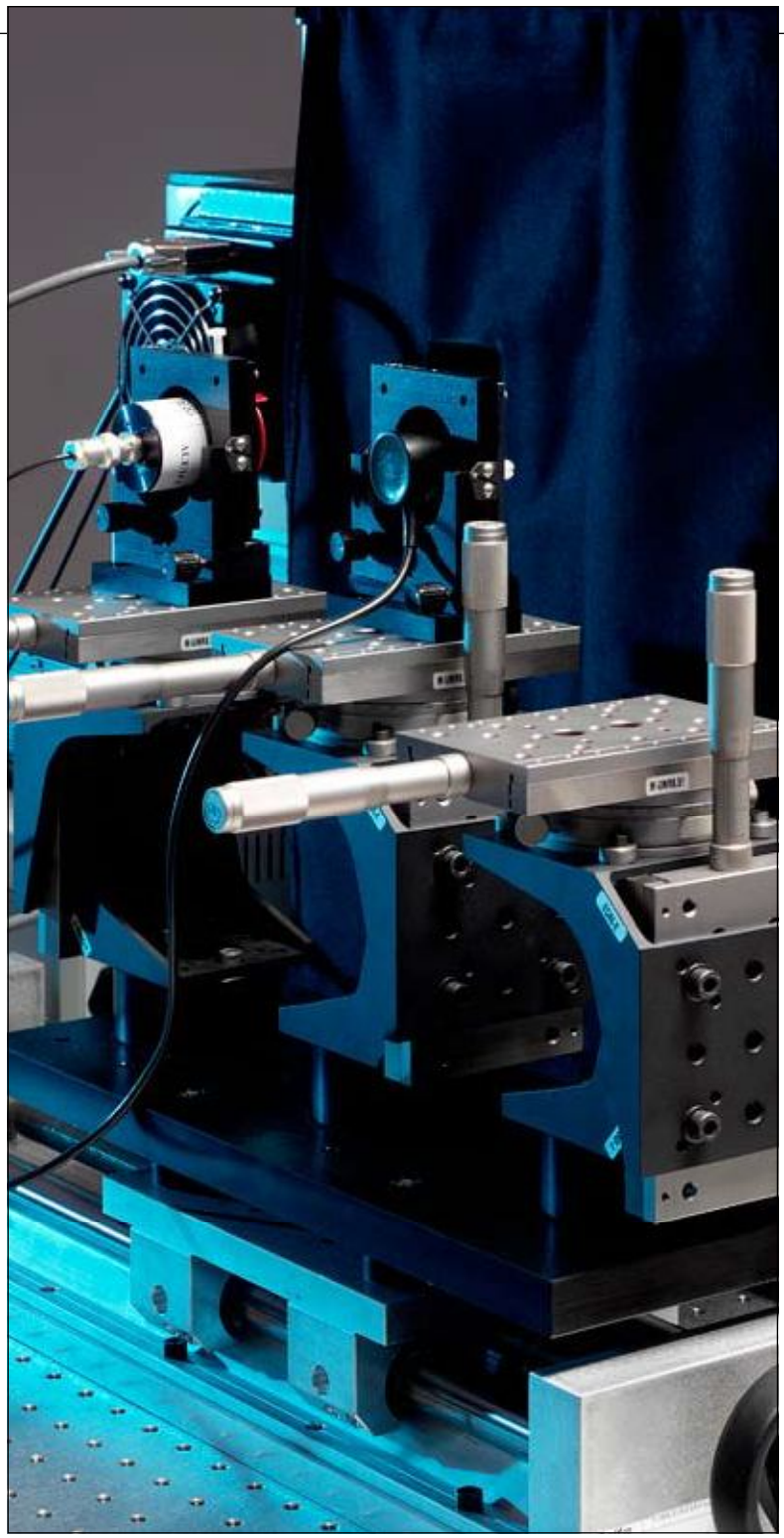
To connect the transmitter, unscrew the lid which covers the terminal board. Figure 4 refers to the 4-20mA version, while figure 5 of HD2021T7, page 188 relates to the 0-1V version.

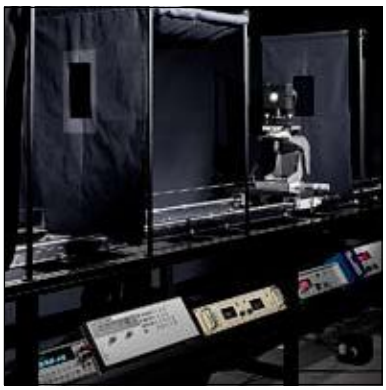
PURCHASING CODES:

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		On 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		On request *		

*minimum order 5 pieces

SIT N° 124 Laboratory - photometry radiometry measurements





Italian calibration service

SIT centre n° 124:
DELTA OHM s.r.l.
Via G. Marconi, 5
35030 CASELLE DI SELVAZZANO (PD) - ITALIA
Telefono: +39 049 89 77 150
Telefax: +39 049 63 55 96
E-mail: deltaohm@tin.it
URL http://www.deltaohm.com

Permanent Laboratory **SIT ACCREDITATION TABLE**

Measure	Instrument to calibrate	Measuring range	Measuring conditions	Uncertainty (*)
Illuminance	Luxmeters	from 2,5 lux to 4000 lux		2 %
Luminous Intensity	Incandescence lamps	from 1 cd to 3000 cd		2,7 %
Luminance	Luminance meters	from 1 cd m^{-2} to 10000 cd m^{-2}		3,2 %
Correlated colour temperature	Incandescence lamps	from 2200 K to 3300 K		50 K
Spectral Radiance	Source	$(4 \cdot 10^{-5} \div 3 \cdot 100)$ W·m^{-2}·sr^{-1}·nm^{-1} $(4 \cdot 10^{-5} \div 3 \cdot 100)$ W·m^{-2}·sr^{-1}·nm^{-1}	from 300 nm to 400 nm from 400 nm to 800 nm	5 % 4,4 %
Spectral Irradiance	Source	$(1 \cdot 10^{-5} \div 1 \cdot 100)$ W·m^{-2}·nm^{-1} $(1 \cdot 10^{-5} \div 1 \cdot 100)$ W·m^{-2}·nm^{-1} $(1 \cdot 10^{-5} \div 1 \cdot 100)$ W·m^{-2}·nm^{-1} $(1 \cdot 10^{-5} \div 1 \cdot 100)$ W·m^{-2}·nm^{-1} $(1 \cdot 10^{-5} \div 1 \cdot 100)$ W·m^{-2}·nm^{-1} $(1 \cdot 10^{-5} \div 1 \cdot 100)$ W·m^{-2}·nm^{-1}	from 200 nm to 250 nm from 250 nm to 300 nm from 300 nm to 350 nm from 350 nm to 400 nm from 400 nm to 700 nm from 700 nm to 800 nm	10 % 7,0 % 4,4 % 3,8 % 3,2 % 3,6 %
	UV-A Radiometers UV-B Radiometers UV-C Radiometers	from 1 W/m^2 to 50 W/m^2 1,2 W/m^2 1,5 W/m^2	(365) nm (311) nm (254) nm	5,0 % 6,6 % 7,2 %
Spectral Sensitivity	Detectors	from $1 \cdot 10^{-2}$ A·W^{-1} to $1 \cdot 10^{1}$ A·W^{-1} from $1 \cdot 10^{-3}$ A·W^{-1} to $1 \cdot 10^{1}$ A·W^{-1} from $1 \cdot 10^{-4}$ A·W^{-1} to $1 \cdot 10^{1}$ A·W^{-1} from $1 \cdot 10^{-4}$ A·W^{-1} to $1 \cdot 10^{1}$ A·W^{-1} from $1 \cdot 10^{-4}$ A·W^{-1} to $1 \cdot 10^{1}$ A·W^{-1} from $1 \cdot 10^{-4}$ A·W^{-1} to $1 \cdot 10^{1}$ A·W^{-1} from $1 \cdot 10^{-4}$ A·W^{-1} to $1 \cdot 10^{1}$ A·W^{-1}	from 200 nm to 240 nm from 240 nm to 375 nm from 375 nm to 920 nm from 920 nm to 1000 nm from 1000 nm to 1100 nm from 1100 nm to 1550 nm from 1550 nm to 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 standard uncertainty by the coverage factor k specified.