

## HD32.1



### HD 32.1 INSTRUMENT FOR STUDYING, MEASURING AND CONTROLLING THE MICROCLIMATE

The **Thermal Microclimate HD32.1** instrument is manufactured by **Delta OHM** and it allows studying, measuring and controlling the Microclimate in the workplace, in compliance with the following standards:

**ISO 7726:** Ergonomics of the thermal environment - Instruments for measuring physical quantities.

**ISO 7730:** Moderate Thermal Environments - Determination of the PMV and PPD indices and specification of the condition for thermal comfort.

**ISO 7243:** Hot environments. Estimation of the heat stress on working man, based on the WBGT Index (Wet bulb Globe temperature).

**ISO 7933:** Ergonomics of the thermal environment - Analytical determination and interpretation of heat stress using calculation of the predicted heat strain.

**ISO 11079:** Evaluation of cold environments - Determination of required clothing insulation (IREQ).

**ISO 8996:** Ergonomics of the thermal environment - Determination of metabolic rate.

Thanks to specific software: **Moderate environments (included), Hot environments, Cold environments and Discomfort (optional)**, as well as specific probes, the instrument can perform the following measurements:

- Globe temperature
- Natural wet bulb temperature
- Ambient temperature
- Atmospheric pressure
- Relative Humidity
- Air velocity
- Air temperature at the height of the head (1,7m subject standing; 1,1m subject sitting).
- Air temperature at the height of the abdomen (1,1 m subject standing; 0,6m subject sitting).
- Air temperature at the height of the ankles (0,1 m).
- Temperature at the floor level.
- Net radiation temperature.
- Net radiation.
- Radiant temperature asymmetry.
- Illuminance, luminance, PAR, irradiance, CO and CO<sub>2</sub>.

According to measurements performed, HD32.1, together with its specific software, calculates the following parameters:

- $t_r$  : Mean radiant temperature
- **PMV** : Predicted Mean Vote
- **PPD** : Predicted Percentage Dissatisfied
- **DR** : Draught Rating
- $t_o$  : Operative temperature

- **IS** : Scharlau Index
- **DI** : Thom Index
- **THI** : Thermohygrometric Index
- **RSI** : Relative Strain Index
- **SSI** : New Summer Simmer Index
- **HI** : Heat Index
- **H** : Humidex Index
- $T_{eq}$  : Equivalent Temperature Index

To compute the calculation of these indexes, temperature and relative humidity of the air have to be detected and the measured values to be inserted in the table "Discomfort indexes".

- **WBGT<sub>Indoor</sub>** : Wet bulb Globe temperature
- **WBGT<sub>Outdoor</sub>** : Wet bulb Globe temperature in the presence of radiation
- **SW<sub>e</sub>** : Sweat rate
- **E<sub>p</sub>** : Predicted evaporative heat flow
- **PHS** :  $T_{re} - \text{Water loss} - D_{lim tre} - D_{lim loss50} - D_{lim loss95}$
- **IREQ** : Required clothing insulation
- **DLE** : Duration Limit Exposure
- **RT** : Recovery time
- **WCI** : Wind chill index
- **PD<sub>v</sub>** : Percentage Dissatisfied due to vertical temperature difference (head-ankles)
- **PD<sub>f</sub>** : Percentage Dissatisfied due to floor temperature
- **PD<sub>a</sub>** : Percentage Dissatisfied due to radiant asymmetry
- **FLD** : Average Day Light Factor

The calculation of the FLD index requires light measurement (photometric probe LP471PHOT). Requires program "**HD32.1 prog. C**"

Three operating programs are already uploaded on the instrument and they can be used according to the analysis:

**HD32.1 A operating program:** Analysis of the Microclimate in moderate, hot and cold environments.

**HD32.1 B operating program:** Analysis of Discomfort in moderate environments.

**HD32.1 C operating program:** Measurement of Physical Quantities for general purposes. The HD32.1 together with C operating program turns into a multifunction datalogger instrument displaying maximum, minimum and average values. By connecting SICRAM probes, the instrument allows measuring temperature, temperature and relative humidity, air velocity, flow, light (with photometric/radiometric probes), CO and CO<sub>2</sub>.

#### TECHNICAL SPECIFICATIONS INSTRUMENT

##### Instrument

Dimensions (Length x Width x Height)	220x180x50 mm
Weight	1100 g (with batteries)
Materials	ABS, Polycarbonate and Aluminium
Display	Backlit, dot matrix



	128x64 dots, visible area 56x38mm
<b>Operative conditions</b>	
Operative temperature	-5 ... 50°C
Storage temperature	-25 ... 65°C
Operative Relative Humidity	0 ... 90% RH non condensing
<b>Protection class</b>	<b>IP64</b>
<b>Instrument uncertainty</b>	± 1 digit @ 20°C
<b>Power supply</b>	
Mains adapter (code SWD10)	12Vdc/1A
Batteries	Four 1.5V batteries size C-BABY
Autonomy	With temperature and RH probes: 200 hours with 7800mAh alkaline batteries With hotwire probe @ 5m/s: 100 hours with 7800mAh alkaline batteries
Power absorbed (instrument off)	< 45µA
<b>Security of stored data</b>	Unlimited
<b>Atmospheric pressure measurement with inbuilt sensor</b>	
Accuracy	±0.5hPa
Resolution	0.1hPa
Response time	1s
<b>Temperature measurement with instrument</b>	
Pt100 measuring range	-200...+650°C
Resolution	0.01°C in the range ±199.99°C, 0.1°C outside this range
Accuracy	±0.01°C in the range ±199.99°C, ± 0.1°C outside this range
Temperature drift @20°C	0.003%/°C
Drift after 1 year	0.1°C/year
<b>Instrument relative humidity measurement (capacitive sensor)</b>	
Measuring range	0...100%RH
Resolution	0.1%RH
Accuracy	±0.1%RH
Temperature drift @20°C	0.02%RH/°C
Drift after 1 year	0.1%RH/year
<b>Connections</b>	
Input for probes with SICRAM module	8 male 8-pole DIN 45326 connectors

<b>RS232C Serial interface</b>	
Type	Galvanically isolated RS232C
Baud rate	Configurable between 1200 and 38400 baud
Data Bit	8
Parity	None
Stop Bit	1
Flow control	Xon/Xoff
Serial cable length	Max 15m
<b>USB Interface</b>	
Type	1.1 - 2.0 galvanically isolated
<b>Memory</b>	divided in 64 blocks
<b>Storage capacity</b>	67600 storages of 8 inputs each
<b>Storage internal</b>	to select between: 15, 30 seconds, 1, 2, 5, 10, 15, 20, 30 minutes and 1 hour
<b>Printing internal</b>	to select between: 15, 30 seconds, 1, 2, 5, 10, 15, 20, 30 minutes and 1 hour



#### EXPLANATORY TABLES - HOW TO USE PROBES FOR MICROCLIMATIC MEASUREMENTS

DeltaLog10 Software	Operating program	Main calculated indices		Environments	Standard
DeltaLog10 BASIC	A Prog.	<b>t<sub>a</sub></b> : Air temperature <b>t<sub>r</sub></b> : Mean radiant temperature <b>PMV</b> : Predicted mean vote <b>PPD</b> : Predicted Percentage Dissatisfied <b>DR</b> : Draught rating <b>t<sub>o</sub></b> : Operative temperature	<b>IS</b> : Scharlau Index <b>DI</b> : Thom Index <b>THI</b> : Thermohygrometric Index <b>RSI</b> : Relative Strain Index <b>SSI</b> : New Summer Simmer Index <b>HI</b> : Heat Index <b>H</b> : Humidex Index <b>T<sub>eq</sub></b> : Equivalent Temperature Index To compute the calculation of these indexes, temperature and relative humidity of the air have to be detected and the measured values to be inserted in the table "Discomfort indexes".	Moderate	ISO 7730
DeltaLog10 Hot environments	A Prog.	<b>WBGT</b> : Wet bulb globe temperature <b>SW<sub>p</sub></b> : Sweat rate <b>E<sub>p</sub></b> : Predicted evaporative heat flow <b>PHS</b> : Predicted Heat Strain Model		Severe hot	ISO 7243 ISO 7933
DeltaLog10 Cold Environments	A Prog.	<b>IREQ</b> : Required clothing insulation <b>DLE</b> : Duration limit exposure <b>RT</b> : Recovery time <b>WCI</b> : Wind chill index		Severe cold	ISO 11079
DeltaLog10 Analysis of Discomfort	B Prog.	<b>PD<sub>v</sub></b> : Percentage Dissatisfied due to vertical temperature difference (head-ankles). <b>PD<sub>f</sub></b> : Percentage Dissatisfied due to floor temperature <b>PD<sub>Δ</sub></b> : Percentage Dissatisfied due to radiant asymmetry		Moderate	ISO 7730
DeltaLog10 BASIC	C Prog.	<b>t<sub>a</sub></b> : Air temperature <b>RH-t</b> : Humidity-temperature <b>V<sub>a</sub>-t</b> : Air velocity, temperature and flow <b>Lux</b> : Illuminance <b>cd/m<sup>2</sup></b> : Luminance <b>µW/cm<sup>2</sup></b> : Irradiance <b>W/m<sup>2</sup></b> : Irradiance <b>µmol/m<sup>2</sup>s</b> : PAR <b>ppm</b> : CO and CO <sub>2</sub>	<b>FLD</b> : Average Day Light Factor The calculation of the FLD index requires light measurement (photometric probe LP471PHOT). Requires program "HD32.1 prog. C"	General purposes	

**EMC standards**

Safety	EN61010-1 level 3
Electrostatic discharge	EN61000-4-2 level 3
Electrical Fast Transients	EN61000-4-4 level 3, EN61000-4-5 level 3
	EN61000-4-11
Voltage variations	
Electromagnetic interference susceptibility	EN61000-4-3 level 3
Electromagnetic interference emission	EN55022 class B

The following table explains how to use the operating programs and the different software applications available.

A series of probes specially designed for different applications completes the instrument. **Delta OHM is ACCREDIA LAT Calibration Centre no. 124. Therefore, it can calibrate the probes employed and issue their ISO17025 certificates.**

**Table of probes for HD32.1 A operating program: Microclimatic Analysis**

<b>TP3207</b>	Dry bulb temperature probe.
<b>TP3275</b>	Globe temperature probe Ø 150mm (alternatively TP3276).
<b>TP3276</b>	Globe temperature probe Ø 50mm (alternatively TP3275).
<b>HP3217DM</b>	Two-sensor probe for measuring natural wet bulb temperature and dry bulb temperature (alternatively: HP3201 and TP3207).
<b>AP3203</b>	Omnidirectional hotwire probe (0°C...80°C)
<b>AP3203-F</b>	Omnidirectional hotwire probe (-30°C...+30°C)
<b>HP3201</b>	Natural wet bulb temperature probe.
<b>TP3204S</b>	Natural wet bulb temperature probe for long-lasting measurement
<b>HP3217R</b>	Combined temperature and relative humidity probe.

The following table lists all the necessary probes for determining the microclimatic indices.

The following indices are obtained by using the **DeltaLog10 BASIC** software:

**Each line shows the combination of probes to use for calculating the indices**

	TP3207	TP3275	TP3276	AP3203 AP3203-F (3)	HP3201 TP3204S	HP3217R	HP3217DM
<b>t<sub>a</sub></b> : Air temperature.	•						•
<b>t<sub>r</sub></b> : Mean radiant temperature.	•	•		•			•
<b>PMV</b> : Predicted mean vote. <b>PPD</b> : Predicted Percentage Dissatisfied	•	•	•	•	•	•	•
<b>DR</b> : Draught rating.	•			•			•
<b>t<sub>o</sub></b> : Operative temperature.	•	•		•			•
<b>T<sub>eq</sub></b> : Equivalent temperature. (necessary for measuring: <b>atmospheric pressure</b> )	•			•			•
<b>IS</b> : Scharlau Index							•
<b>DI</b> : Thom Index							•
<b>THI</b> : Thermohygroscopic Index							•
<b>RSI</b> : Relative Strain Index							•
<b>SSI</b> : New Summer Simmer Index							•
<b>HI</b> : Heat Index							•
<b>H</b> : Humidex Index							•
<b>T<sub>eq</sub></b> : Equivalent Temperature Index							•
To compute the calculation of these indexes, temperature and relative humidity of the air have to be detected and the measured values to be inserted in the table "Discomfort indexes"							

The following indices are obtained by using the **DeltaLog10 Hot environments** software:

**Each line shows the combination of probes to use for calculating the indices**

	TP3207	TP3275	TP3276	AP3203	HP3201 TP3204S	HP3217R	HP3217DM
<b>WBGT Indoor</b> : Wet bulb globe temperature		•			•		
<b>WBGT Outdoor</b> : Wet bulb globe temperature in the presence of radiation	•	•			•		
<b>SW<sub>p</sub></b> : Sweat rate <b>E<sub>p</sub></b> : Predicted evaporative heat flow	•	•		•	•	•	•
<b>PHS</b> (1)	•	•		•	•	•	•
<b>T<sub>re</sub></b> : Predicted rectal temperature	•			•	•	•	•
<b>Water Loss</b> : Loss of water	•			•	•	•	•
<b>D<sub>lim tre</sub></b> : Maximum allowable exposure duration for heat storage	•			•	•	•	•
<b>D<sub>lim loss50</sub></b> : Maximum allowable exposure duration for water loss, standard subject	•			•	•	•	•
<b>D<sub>lim loss95</sub></b> : Maximum allowable exposure duration for water loss, 95% of the working population	•			•	•	•	•

(1) **T<sub>re</sub>**: Predicted rectal temperature

**Water Loss**: Loss of water

**D<sub>lim tre</sub>**: Maximum allowable exposure duration for heat storage

**D<sub>lim loss50</sub>**: Maximum allowable exposure duration for water loss, standard subject

**D<sub>lim loss95</sub>**: Maximum allowable exposure duration for water loss, 95% of the working population

The following indices are obtained by using the **DeltaLog10 Cold environments** software:

**Each line shows the combination of probes to use for calculating the indices**

	TP3207	TP3275	TP3276	AP3203 AP3203-F (3)	HP3201 TP3204S	HP3217 R	HP3217DM
<b>IREQ</b> : Required clothing insulation	•	•		•		•	•
<b>DLE</b> : Duration limit exposure	•			•		•	•
<b>RT</b> : Recovery time				•		•	•
<b>WCI</b> : Wind chill index				•		•	•

(2) **Using IREQ, DLE, RT, WCI it is possible to calculate:**

- Ratio of surface area of the clothed body to the surface area of the nude body
- Mean skin temperature
- Fraction of wet skin
- Total convective heat conduction
- Total radiative heat conduction
- Partial water pressure at ambient temperature
- Surface temperature of clothing
- Evaporative resistance of limiting layer and clothing

- Heat exchange by evaporation
- Respiratory heat exchange by convection and evaporation
- Heat exchange by radiation
- Heat exchange by convection
- Duration limit exposure
- Required clothing insulation
- Intrinsic clothing insulation

(3) **AP3203: 0°C...+80°C**  
**AP3203-F: -30°C...+30°C**

**Table of probes for HD32.1 B operating program: Analysis of Discomfort**

TP3227K	Temperature probe composed of 2 independent probes, temperature of the head and abdomen.
TP3227PC	Temperature probe composed of 2 independent probes, temperature of the ankles and the floor.
TP3207P	Temperature probe Pt100 sensor, floor temperature.
TP3207TR	Probe for measuring radiant temperature (net-radiometer)

The following table lists all the necessary probe for determining the microclimatic indices. The following indices are obtained by using the **DeltaLog10 Analysis of Discomfort** software:

Each line shows the combination of probes to use for calculating the indices

		TP3227K	TP3227PC	TP3207P	TP3207TR	LP 471 PHOT
PD <sub>v</sub> :	Percentage Dissatisfied with vertical temperature difference (head-ankles).	•	•			
PD <sub>f</sub> :	Percentage Dissatisfied with floor temperature.		•			
PD <sub>Δ</sub> :	Percentage Dissatisfied with radiant asymmetry.			•		
FLD:	Average Day Light Factor. Requires HD32.1 program C					•

**ORDERING CODES**

**HD32.1 Kit basic:** It is composed of **HD32.1 instrument, A operating program: Analysis of the Microclimate, C operating program: Physical Quantities**, four 1.5V alkaline batteries size C-BABY, instructions manual. The instrument includes atmospheric pressure sensor.

**DeltaLog10 Basic moderate environments Software** (for Windows®) downloadable from Delta OHM website.

**DeltaLog10 Hot environments Software (code MC1):** The use of this software requires the **complete HD32.1 basic Kit**.

**DeltaLog10 Cold environments Software (code MC2):** The use of this software requires the **complete HD32.1 basic Kit**.

**DeltaLog10 Analysis of discomfort Software + B operating program (code MC3):** for discomfort measurements in moderate environments. It requires the **complete HD32.1 basic Kit**.

Probes, holder, case and cables must be ordered separately.

**Accessories:**

**VTRAP32:** Tripod equipped with 6-input head and 5 probe holders code **HD3218K**

**9CPRS232:** Connection cable 9 - pole Sub-D female connector for RS232C.

**CP22:** USB 2.0 connection cable connector type A - connector type B.

**BAG32:** Carrying case for the HD32 and its accessories.

**SWD10:** 100-240Vac/12Vdc-1A Stabilized mains power supply.

**HD3218K:** Probe shaft

**AM32:** Two-clamp shaft for two probes

**AQC:** 200cc. distilled water and 3 braids for HP3201 or HP3217DM probes.

**Delta OHM metrological laboratories are Accredia LAT accredited in Temperature, Humidity, Pressure, Photometry/Radiometry, Acoustics and Air velocity. Probes can be supplied with calibration certificate on request.**



**TP3227PC:** Temperature probe with dual Pt100 sensor. It measures floor temperature and the temperature at the ankles.



**Probes for operating programs:**

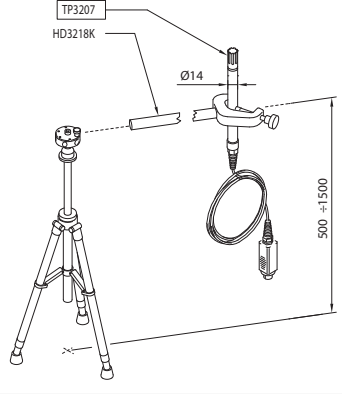
**A: Microclimatic Analysis**

**B: Analysis of Discomfort**

**TP3207:** Temperature probe, Pt100 sensor. Probe stem  $\varnothing$  14mm, length 140 mm. Cable length 2 metres. Equipped with SICRAM module.

Used for calculating the following indices: **IREQ, WCI, DLE, RT, PMV, PPD, WBGT, SR.** Used for calculating Mean radiant temperature.

Measuring range:  $-40^{\circ}\text{C} \dots +100^{\circ}\text{C}$

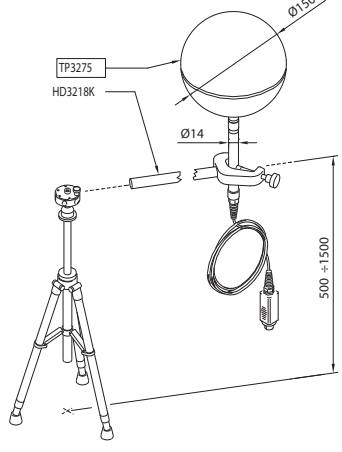


**TP3275:** Globe temperature probe, Pt100 sensor, globe  $\varnothing$  150 mm.

Stem  $\varnothing$  14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.

Used for measuring: **Mean radiant temperature, WBGT.**

Measuring range:  $-10^{\circ}\text{C} \dots +100^{\circ}\text{C}$

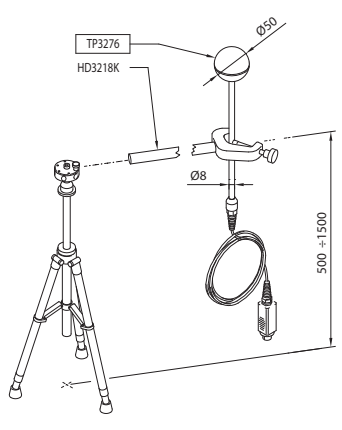


**TP3276:** Globe temperature probe, Pt100 sensor, globe  $\varnothing$  50 mm.

Stem  $\varnothing$  8 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.

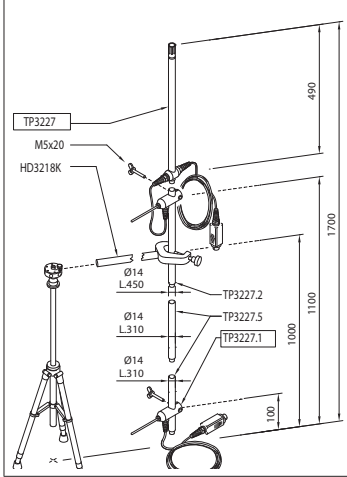
Used for measuring: **Mean radiant temperature, WBGT.**

Measuring range:  $-10^{\circ}\text{C} \dots +100^{\circ}\text{C}$

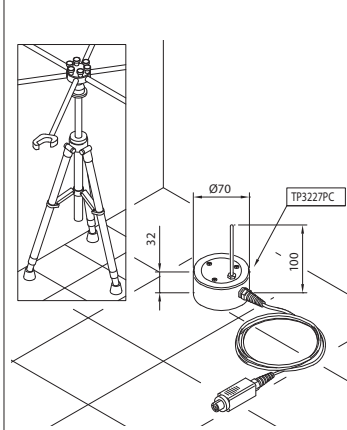


**TP3227K:** Temperature probe composed of 2 independent probes, Pt100 sensor. Stem diameter  $\varnothing$  14 mm, length 500 mm. Cable length 2 metres. Equipped with double SICRAM module and TP3227.2 extension shaft  $\varnothing$  14 mm, length 450 mm. Used for measuring **local discomfort due to vertical thermal gradient.** It can be used for studying subjects sitting or standing. The height of one probe can be regulated.

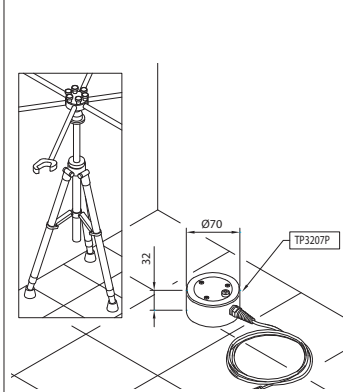
Measuring range:  $-10^{\circ}\text{C} \dots +100^{\circ}\text{C}$



**TP3227PC:** Temperature probe composed of 2 independent probes, Pt100 sensor, one for measuring floor temperature (diameter  $\varnothing$  70 mm, height 30 mm), the other for measuring temperature at the height of the ankles (diameter  $\varnothing$  3 mm, height 100 mm). Cable length 2 metres. Equipped with double SICRAM module. Used for measuring **local discomfort due to vertical thermal gradient.** Measuring range:  $-10^{\circ}\text{C} \dots +100^{\circ}\text{C}$

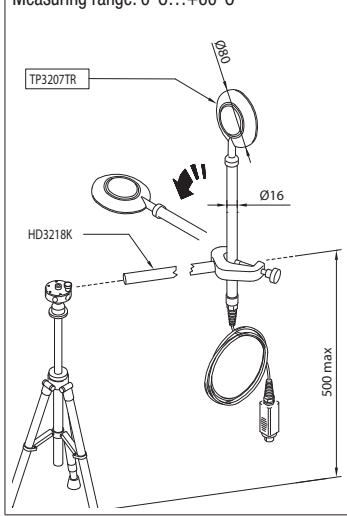


**TP3207P:** Pt100 sensor temperature probe, for measuring floor temperature (diameter  $\varnothing$  70 mm, height 30 mm). Cable 2 meters long. Equipped with SICRAM module. Used for the assessment of dissatisfied people to floor temperature due to radiant asymmetry. Measuring range  $-10^{\circ}\text{C} \dots +100^{\circ}\text{C}$



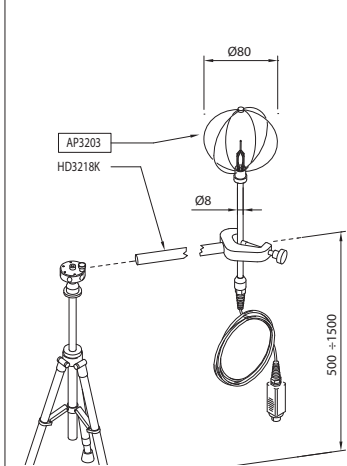
**TP3207TR:** Probe for measuring radiant temperature. Probe stem  $\varnothing$  16 mm, length 250 mm. Cable length 2 metres. Equipped with SICRAM module.

Used for the **evaluation of dissatisfied people due to evaluation asymmetry.** Measuring range:  $0^{\circ}\text{C} \dots +60^{\circ}\text{C}$



**AP3203:** Omnidirectional hotwire probe. Measuring range: air velocity  $0.05 \div 5$  m/s. Probe stem  $\varnothing$  14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module. Measuring range:  $0^{\circ}\text{C} \dots +80^{\circ}\text{C}$ .

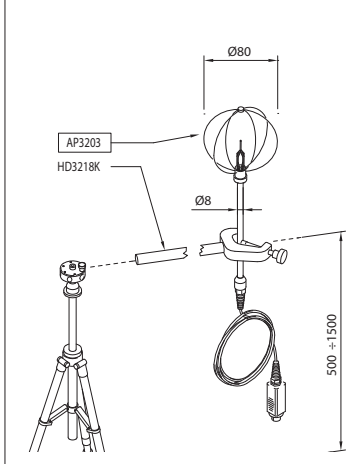
Used for calculating the following indices: **IREQ, WCI, DLE, RT, PMV, PPD, SR.** Used for calculating Mean radiant temperature.



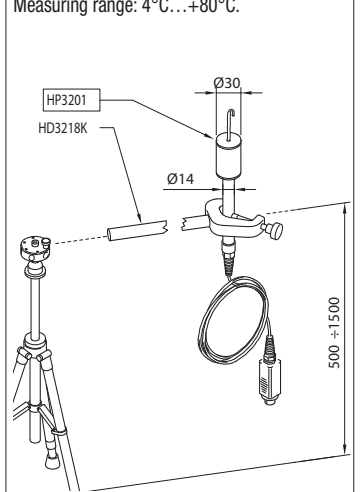
**AP3203-F:** Omnidirectional hotwire probe. Measuring range: air velocity  $0.05 \div 5$  m/s, temperature  $-30^{\circ}\text{C} \dots +30^{\circ}\text{C}$ .

Probe stem  $\varnothing$  14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.

Used for calculating the following indices: **IREQ, WCI, DLE, RT, PMV, PPD, SR.** Used for calculating Mean radiant temperature.



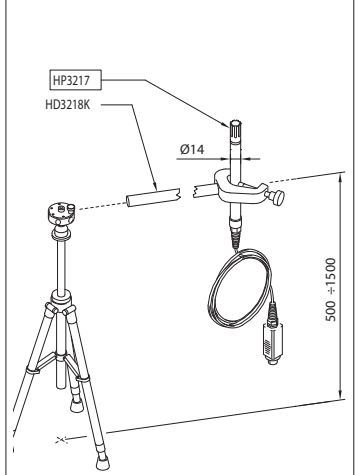
**HP3201:** Natural wet bulb probe. Pt100 sensor. Probe stem  $\varnothing$  14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module, spare braid and 50cc. distilled water. Used for measuring: **WBGT.** Measuring range:  $4^{\circ}\text{C} \dots +80^{\circ}\text{C}$ .



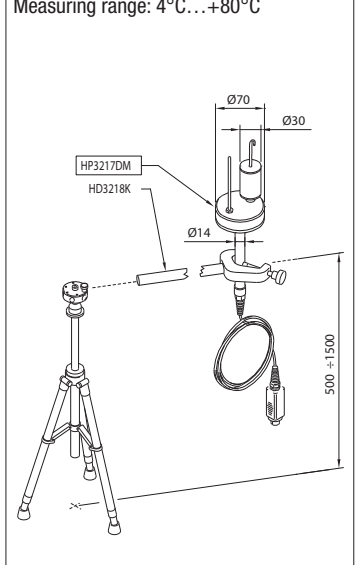
**HP3217R:** Combined temperature and relative humidity probe. Capacitive RH sensor, Pt100 temperature sensor. Probe stem  $\varnothing$  14 mm, length 110 mm. Cable length 2 metres. Equipped with SICRAM module.

Used for calculating the following indices: **IREQ, WCI, DLE, RT, PMV, PPD, SR.**

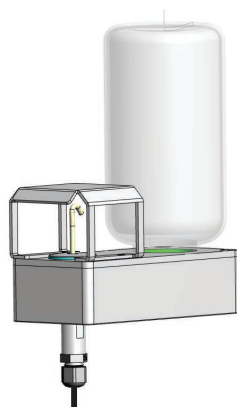
Measuring range:  $-40^{\circ}\text{C} \dots +100^{\circ}\text{C}$ ,  $0 \dots 100\% \text{RH}$ .



**HP3217DM:** Double natural wet bulb probe and temperature probe (dry bulb). Probe stem  $\varnothing$  14 mm, length 110 mm. Cable length 2 metres. Equipped with double SICRAM module, spare braid and 50cc. distilled water. Measuring range:  $4^{\circ}\text{C} \dots +80^{\circ}\text{C}$



**TP3204S:** Natural ventilation wet bulb probe for long-lasting measurements. Capacity: 500 cc of distilled water. Autonomy: 15 days @ 40 °C. Pt100 sensor. 2 m cable. Complete with SICRAM module, 500 cc bottle and 2 spare cotton wicks.



**TP3204S**

**TECHNICAL DATA OF PROBES AND MODULES EQUIPPED WITH INSTRUMENT**  
**Temperature probes Pt100 sensor with SICRAM module**

Model	Type	App. range	Accuracy
TP472I	Immersion	-196°C...+500°C	±0.25°C (-196°C...+300°C) ±0.5°C (+300°C...+500°C)
TP472I.0 1/3DIN - Thin film	Immersion	-50°C...+300°C	±0.25°C (-50°C...+300°C)
TP473P.0 1/3DIN - Thin film	Penetration	-50°C...+300°C	±0.25°C (-50°C...+300°C)
TP474C.0 1/3DIN - Thin film	Contact	-50°C...+300°C	±0.3°C (-50°C...+300°C)
TP475A.0 1/3DIN - Thin film	Air	-50°C...+250°C	±0.3°C (-50°C...+250°C)
TP472I.5	Penetration	-50°C...+400°C	±0.3°C (-50°C...+300°C) ±0.6°C (+300°C...+400°C)
TP472I.10	Penetration	-50°C...+400°C	±0.30°C (-50°C...+300°C) ±0.6°C (+300°C...+400°C)

*Common characteristics*

Temperature drift @ 20°C 0.003%/°C

**Probes equipped with SICRAM module**

**TP472I:** Immersion probe, Pt100 wirewound sensor. Stem Ø 3 mm, length 300 mm. Cable 2 meters long.

**TP472I.0:** Immersion probe, Pt100 thin film sensor. Stem Ø 3 mm, length 230 mm. Cable 2 meters long.

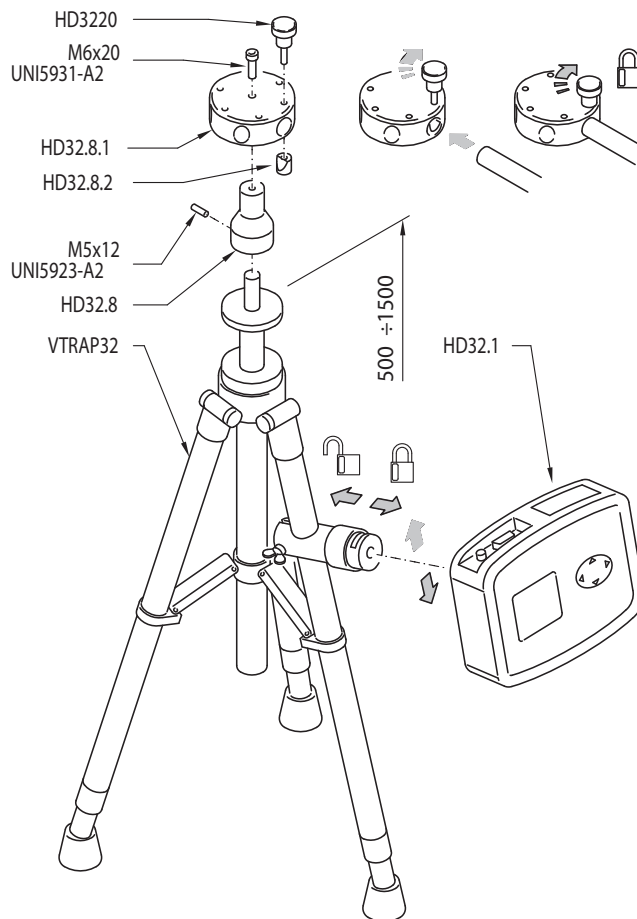
**TP473P.0:** Penetration probe, Pt100 sensor. Stem Ø 4mm, length 150 mm. Cable 2 meters long.

**TP474C.0:** Contact probe, Pt100 thin film sensor. Stem Ø 4mm, length 230mm, contact surface Ø 5mm. Cable 2 meters long.

**TP475A.0:** Air probe, Pt100 thin film sensor. Stem Ø 4mm, length 230mm. Cable 2 meters long.

**TP472I.5:** Penetration probe, Pt100 thin film sensor. Stem Ø 6mm, length 500 mm. Cable 2 meters long.

**TP472I.10:** Penetration probe, Pt100 thin film sensor. Stem Ø 6mm, length 1,000mm. Cable 2 meters long.



### Relative humidity and temperature probes using SICRAM module

Model	Temperature sensor	Working range		Accuracy	
		%RH	Temperature	%RH	Temp
HP472ACR	Pt100	0...100%RH	-20°C...+80°C	±1,5%RH (0...90%RH) ±2,0%RH remaining range For T = 15...35°C	±0.3°C
HP572ACR	Thermocouple K	0...100%RH	-20°C...+80°C		±0.5°C
HP473ACR	Pt100	0...100%RH	-20°C...+80°C	-----	±0.3°C
HP474ACR	Pt100	0...100%RH	-40°C...+150°C		±0.3°C
HP475ACR	Pt100	0...100%RH	-40°C...+150°C	±(1,5+1.5% of the displayed value)%RH in the remaining temperature range	±0.3°C
HP475AC1R	Pt100	0...100%RH	-40°C...+180°C		±0.3°C
HP477DCR	Pt100	0...100%RH	-40°C...+100°C		±0.3°C
HP478ACR	Pt100	0...100%RH	-40°C...+150°C		±0.3°C

#### Common characteristics

##### Relative humidity

Sensor	Capacitive
Temperature drift @ 20°C	0.02%RH/°C
Response time %RH	10sec (10÷80%RH; air speed=2m/s, at constant temperature)

##### Temperature with Pt100 sensor

Temperature drift @ 20°C	0.003%/°C
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##### Temperature with thermocouple K - HP572AC

Temperature drift @ 20°C	0.02%/°C
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### Relative humidity and temperature probes complete with SICRAM module

**HP472ACR:** %RH and temperature combined probe, dimensions Ø 26x170 mm. 2 m connecting cable.

**HP572ACR:** %RH and temperature combined probe, **K thermocouple sensor**. Dimensions Ø26x170 mm. 2 m connecting cable.

**HP473ACR:** %RH and temperature combined probe. Dimensions: handle Ø 26x130 mm, probe Ø 14x120 mm. 2m connecting cable.

**HP474ACR:** %RH and temperature combined probe. Dimensions: handle Ø 26x130 mm, probe Ø 14x215 mm. 2m connecting cable.

**HP475ACR:** %RH and temperature combined probe. 2 m connecting cable. Handle Ø 26x110 mm. Stainless-steel tube Ø 12x560 mm. Terminal tip Ø 14x75 mm.

**HP475AC1R:** %RH and temperature combined probe. 2 m connection cable. Handle Ø 26x80 mm. Stainless steel stem Ø 14x480 mm.

**HP477DCR:** %RH and temperature combined sword probe. 2 m connecting cable. Handle Ø 26x110 mm. Probe tube 18x4 mm, length 520 mm.

**HP478ACR:** %RH and temperature combined probe. Dimensions Ø 14x130 mm. 5m connection cable.



### PROBES AND MODULES TECHNICAL DATA EQUIPPED WITH INSTRUMENT Wind speed measurement probes

#### Hot-wire probes: AP471 S1 - AP471 S2 - AP471 S3 - AP471 S4

	AP471 S1 - AP471 S3	AP471 S2	AP471 S4
Type of measure	Air speed, calculated flow rate, air temperature		
Type of sensor			
Speed	NTC thermistor	Omnidirectional NTC thermistor	
Temperature	NTC thermistor	NTC thermistor	
Measurement range			
Speed	0,1...40m/s	0,1...5m/s	
Temperature	-25...+80°C	-25...+80°C	0...80°C
Measurement resolution:			
Speed	0.01 m/s 0.1 km/h 1 ft/min 0.1 mph 0.1 knot		
Temperature	0.1°C		
Measurement accuracy:			
Speed	±0.2 m/s (0...0.99 m/s)	±0.2m/s (0...0.99 m/s)	
	±0.4 m/s (1.00...9.99 m/s)	±0.3m/s (1.00...5.00 m/s)	
	±0.8 m/s (10.00...40.0 m/s)		
Temperature	±0.8°C (-10...+80°C)	±0.8°C (-10...+80°C)	
Minimum speed	0.1 m/s		
Air temperature compensation	0...80°C		
Sensor working conditions	Clean air, RH<80%		
Battery life	Approx. 20 hours @ 20 m/s with alkaline batteries	Approx. 30 hours @ 5 m/s with alkaline batteries	
Unit of Measurement			
Speed	m/s – km/h – ft/min – mph – knot		
Flow rate	l/s - m³/s - m³/min - m³/h - ft³/s - ft³/min		
Pipeline section for flow rate calculation	0.0001...1.9999 m²		
Cable length	~2m		

#### Vane probes: AP472 S1 - AP472 S2

	AP472 S1	AP472 S2
Type of measure	Air speed, calculated flow rate, air temperature	Air speed, calculated flow rate
Diameter	100mm	60mm
Type of measurement		
Speed	Vane	Vane
Temperature	K thermocouple	----
Measurement range		
Speed (m/s)	0.6...25	0.5...20
Temperature (°C)	-25...+80 (*)	
Resolution		
Speed	0.01 m/s 0.1 km/h 1 ft/min 0.1 mph 0.1 knot	
Temperature	0.1°C	----
Accuracy		
Speed	±(0.4 m/s +1.5%f.s.)	±(0.4m/s +1.5%f.s.)
Temperature	±0.8°C	----
Minimum speed	0.6m/s	0.5m/s
Unit of Measurement		
Speed	m/s – km/h – ft/min – mph – knot	
Flow rate	l/s - m³/s - m³/min - m³/h - ft³/s - ft³/min	
Pipeline section for flow rate calculation	0.0001...1.9999 m²	
Cable length	~2m	

(\*) The indicated value refers to the vane's working range.

**Probes complete with SICRAM module  
AIR speed hot-wire probes**

- AP471 S1:** Hot-wire telescopic probe, measuring range: 0.1...40m/s. Cable length 2 metres.
- AP471 S2:** Omni-directional hot-wire probe, measuring range: 0.1...5m/s. Cable length 2 metres.
- AP471 S3:** Hot-wire telescopic probe with pliable terminal tip, measuring range: 0.1...40m/s. Cable length 2 metres.
- AP471 S4:** Omni-directional hot-wire telescopic probe with base, measuring range: 0.1...5m/s. Cable length 2 metres.

**Vane probes:**

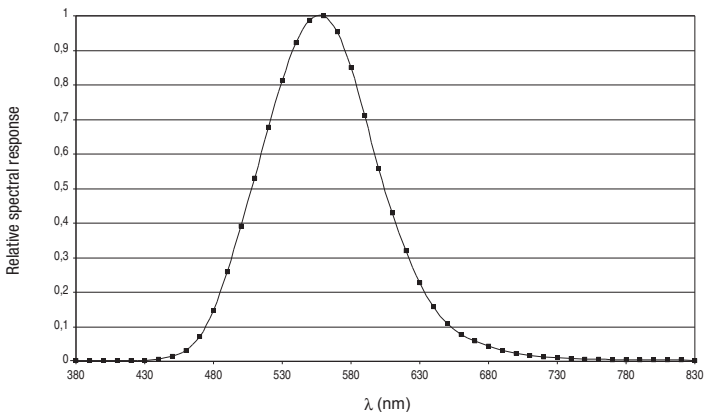
- AP472 S1:** Vane probe with K thermocouple, Ø 100mm. Speed from 0.6 to 25m/s; temperature from -25 to 80°C. Cable length 2 metres.
- AP472 S2:** Vane probe, Ø 60mm. Speed from 0.5 to 20m/s. Cable length 2 metres.

**Technical characteristics of photometric and radiometric probes complete with SICRAM module.**

ILLUMINANCE measurement probe LP 471 PHOT				
Measurement range (lux):	0.01...199.99	...1999.9	...19999	...199.99·10 <sup>3</sup>
Resolution (lux):	0.01	0.1	1	0.01·10 <sup>3</sup>
Spectral range:	in agreement with standard photopic curve V(λ)			
Class	B			
Calibration uncertainty:	<4%			
f <sub>1</sub> (in agreement with photopic response V(λ)):	<6%			
f <sub>2</sub> (response according to the cosine law):	<3%			
f <sub>3</sub> (linearity):	<1%			
f <sub>4</sub> (instrument reading error):	<0.5%			
f <sub>5</sub> (fatigue):	<0.5%			
α (temp. coefficient) f <sub>6</sub> (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...200·10<sup>3</sup> lux.

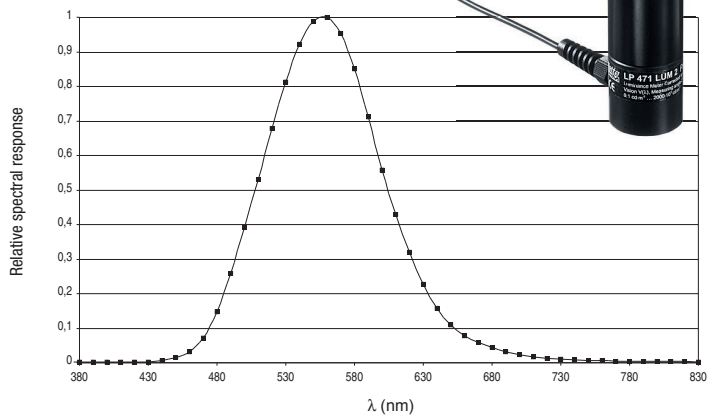
Typical response curve: LP 471 PHOT



LUMINANCE measurement probe LP 471 LUM 2				
Measurement range (cd/m <sup>2</sup> ):	0.1...1999.9	...19999	...199.99·10 <sup>3</sup>	...1999.9·10 <sup>3</sup>
Resolution (cd/m <sup>2</sup> ):	0.1	1	0.01·10 <sup>3</sup>	0.1·10 <sup>3</sup>
Optical angle:	2°			
Spectral range:	in agreement with standard photopic curve V(λ)			
Class	C			
Calibration uncertainty:	<5%			
f <sub>1</sub> (in agreement with photopic response V(λ)):	<8%			
f <sub>3</sub> (linearity):	<1%			
f <sub>4</sub> (instrument reading error):	<0.5%			
f <sub>5</sub> (fatigue):	<0.5%			
α (temp. coefficient) f <sub>6</sub> (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/m<sup>2</sup>...2000·10<sup>3</sup> cd/m<sup>2</sup>.

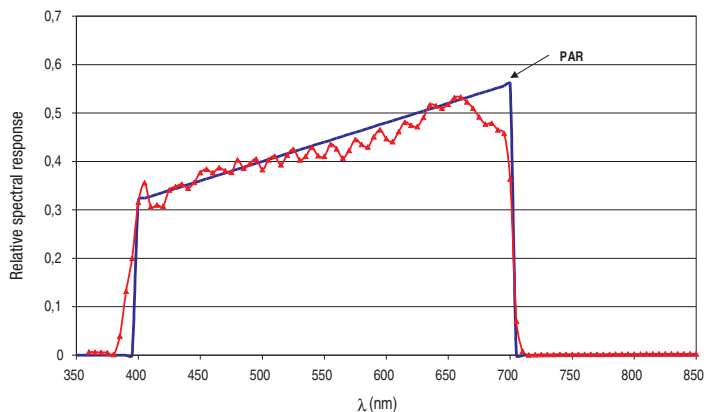
Typical response curve: LP 471 LUM2



Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range PAR LP 471 PAR			
Measurement range (μmol/m <sup>2</sup> s):	0.01...199.99	200.0...1999.9	2000...10000
Resolution (μmol/m <sup>2</sup> s):	0.01	0.1	1
Spectral range:	400nm...700nm		
Calibration uncertainty:	<5%		
f <sub>1</sub> (in agreement with photopic response V(λ)):	<6%		
f <sub>3</sub> (linearity):	<1%		
f <sub>4</sub> (instrument reading error):	±1 digit		
f <sub>5</sub> (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<sup>2</sup>s. Measurement range: 0.01μmol/m<sup>2</sup>s...10·10<sup>3</sup>μmol/m<sup>2</sup>s.

Typical response curve: LP 471 PAR

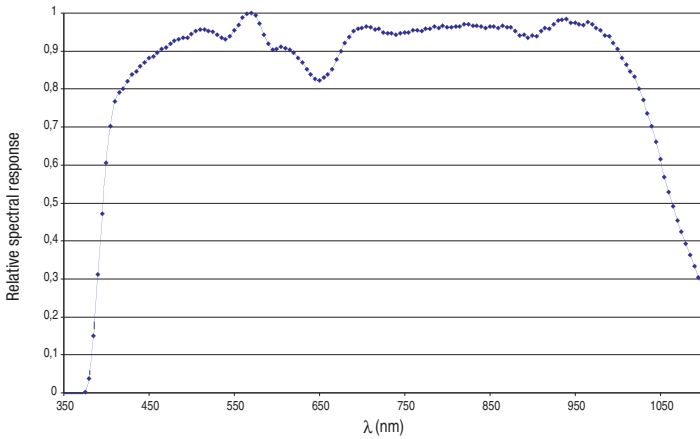




IRRADIANCE measurement probe LP 471 RAD				
Measurement range (W/m <sup>2</sup> ):	0.1·10 <sup>-3</sup> ... 999.9·10 <sup>-3</sup>	1.000...19.999	20.00...199.99	200.0...1999.9
Resolution (W/m <sup>2</sup> ):	0.1·10 <sup>-3</sup>	0.001	0.01	0.1
Spectral range:	400nm...1050nm			
Calibration uncertainty:	<5%			
f <sub>1</sub> (in agreement with photopic response V(λ)):	<6%			
f <sub>3</sub> (linearity):	<1%			
f <sub>4</sub> (instrument reading error):	±1 digit			
f <sub>5</sub> (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<sup>-3</sup>W/m<sup>2</sup> ... 2000 W/m<sup>2</sup>.

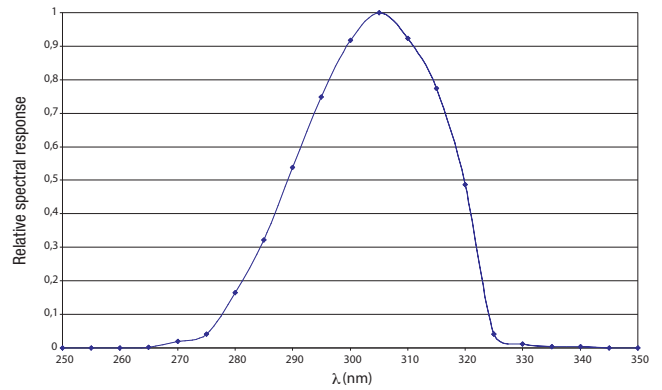
Typical response curve: LP 471 RAD



IRRADIANCE measurement probe LP 471 UVB				
Measurement range (W/m <sup>2</sup> ):	0.1·10 <sup>-3</sup> ... 999.9·10 <sup>-3</sup>	1.000...19.999	20.00...199.99	200.0...1999.9
Resolution (W/m <sup>2</sup> ):	0.1·10 <sup>-3</sup>	0.001	0.01	0.1
Spectral range:	280nm...315nm (Peak 305-310nm)			
Calibration uncertainty:	<5%			
f <sub>3</sub> (linearity):	<2%			
f <sub>4</sub> (instrument reading error):	±1 digit			
f <sub>5</sub> (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0...50°C			

Radiometric probe for **IRRADIANCE** measurement, in the **UVB** spectral range 280nm...315nm, peak 305nm - 310nm. Measurement range: 0.1·10<sup>-3</sup> W/m<sup>2</sup>...2000 W/m<sup>2</sup>.

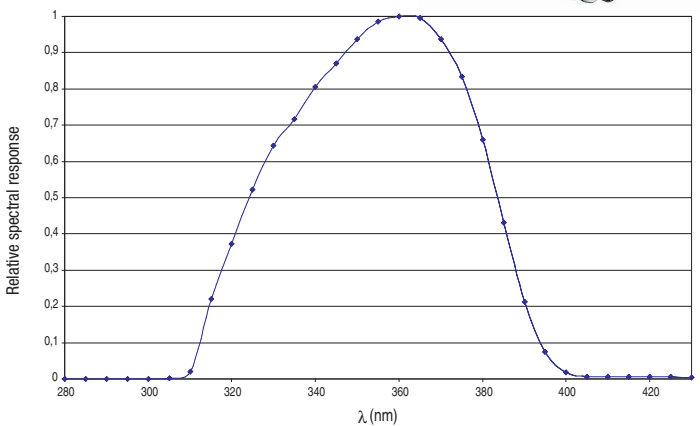
Typical response curve: LP 471 UVB



IRRADIANCE measurement probe LP 471 UVA				
Measurement range (W/m <sup>2</sup> ):	0.1·10 <sup>-3</sup> ... 999.9·10 <sup>-3</sup>	1.000...19.999	20.00...199.99	200.0...1999.9
Resolution (W/m <sup>2</sup> ):	0.1·10 <sup>-3</sup>	0.001	0.01	0.1
Spectral range:	315nm...400nm (Peak 360nm)			
Calibration uncertainty:	<5%			
f <sub>3</sub> (linearity):	<1%			
f <sub>4</sub> (instrument reading error):	±1 digit			
f <sub>5</sub> (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0...50°C			

Radiometric probe for **IRRADIANCE** measurement, in the **UVA** spectral range, 315nm...400nm, peak 360nm,. Measurement range: 0.1·10<sup>-3</sup>W/m<sup>2</sup> ... 2000 W/m<sup>2</sup>.

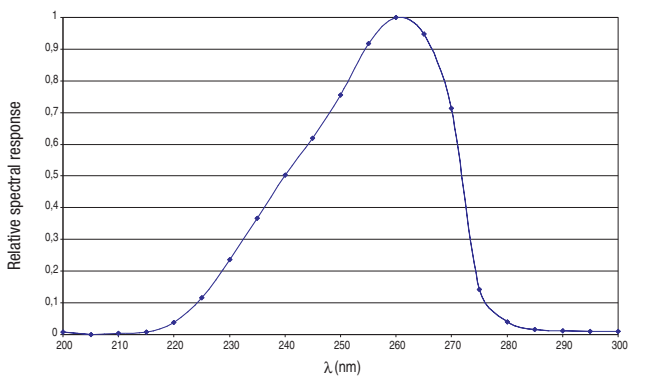
Typical response curve: LP 471 UVA



IRRADIANCE measurement probe LP 471 UVC				
Measurement range (W/m <sup>2</sup> ):	0.1·10 <sup>-3</sup> ... 999.9·10 <sup>-3</sup>	1.000...19.999	20.00...199.99	200.0...1999.9
Resolution (W/m <sup>2</sup> ):	0.1·10 <sup>-3</sup>	0.001	0.01	0.1
Spectral range:	220nm...280nm (Peak 260nm)			
Calibration uncertainty:	<5%			
f <sub>3</sub> (linearity):	<1%			
f <sub>4</sub> (instrument reading error):	±1 digit			
f <sub>5</sub> (fatigue):	<0.5%			
Drift after 1 year:	<2%			
Working temperature:	0...50°C			

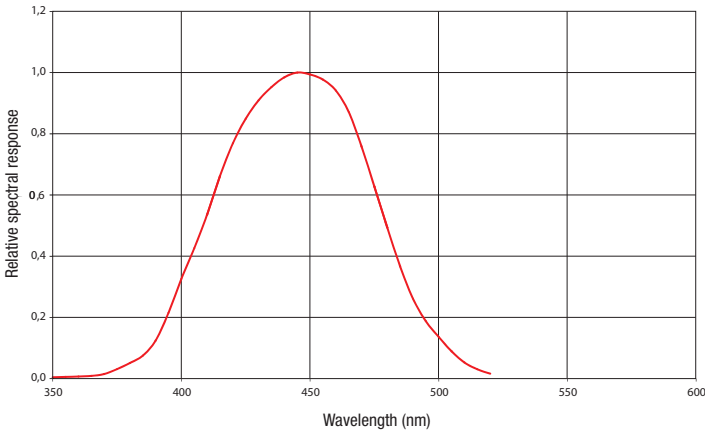
Radiometric probe for **IRRADIANCE** measurement, in the **UVC** spectral range 220nm...280nm, peak 260nm, Measurement range: 0.1·10<sup>-3</sup> W/m<sup>2</sup>...2000 W/m<sup>2</sup>.

Typical response curve: LP 471 UVC



Measurement probe of TOTAL EFFECTIVE IRRADIANCE in the blue light spectral range LP 471BLUE complete with SICRAM module				
Measurement range ( $W_{\text{eff}}/m^2$ ):	0.1·10 <sup>-3</sup> ... 999.9·10 <sup>-3</sup>	1.000...19.999	20.00...199.99	200.0...1999.9
Resolution ( $W_{\text{eff}}/m^2$ ):	0.1·10 <sup>-3</sup>	0.001	0.01	0.1
Spectral range:	(380nm...550nm) UV Blue light hazard action curve B ( $\lambda$ )			
Calibration uncertainty:	<10%			
$f_1$ (in agreement with photopic response $V(\lambda)$ ):	<6%			
$f_3$ (linearity):	<3%			
$f_4$ (instrument reading error)	±1 digit			
$f_5$ (fatigue):	<0.5%			
Drift after 1 year	<2%			
Working temperature:	0...50°C			

Typical response curve: LP 471 BLUE



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

### 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: 0.01lux...200·10<sup>3</sup> lux.
- LP 471 LUM2:** Photometric probe for **LUMINANCE** measurement complete with SICRAM module, spectral response in agreement with standard photopic vision, vision angle 2°. Measurement range: 0.1cd/m<sup>2</sup>...2000·10<sup>3</sup> cd/m<sup>2</sup>.
- LP 471 PAR:** Quantum radiometric probe for the measurement of the photon flow across the chlorophyll range **PAR** (Photosynthetically Active Radiation 400nm...700nm) complete with SICRAM, measurement in  $\mu\text{molm}^{-2}\text{s}^{-1}$ , diffuser for cosine correction. Measurement range: 0.01 $\mu\text{molm}^{-2}\text{s}^{-1}$ ...10·10<sup>3</sup> $\mu\text{molm}^{-2}\text{s}^{-1}$ .
- 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<sup>-3</sup>W/m<sup>2</sup>...2000 W/m<sup>2</sup>.
- 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<sup>-3</sup>W/m<sup>2</sup>...2000 W/m<sup>2</sup>.
- LP 471 UVB:** Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module, in the 280nm...315nm, **UVB** spectral range, peak 305nm-310nm, quartz diffuser for cosine correction. Measurement range: 0.1·10<sup>-3</sup>W/m<sup>2</sup>...2000 W/m<sup>2</sup>.
- LP 471 UVC:** Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module, in the 220nm...280nm, **UVC** spectral range, peak 260nm, quartz diffuser for cosine correction. Measurement range: 0.1·10<sup>-3</sup>W/m<sup>2</sup>...2000 W/m<sup>2</sup>.
- LP 471 BLUE:** Radiometric probe for **IRRADIANCE** ( $W/m^2$ ) in spectral band of blue light, complete with SICRAM module. Spectral range: 380nm...550nm, quartz diffuser for cosine correction. Measurement range: 0.1·10<sup>-3</sup>W<sub>eff</sub>/m<sup>2</sup>... 2000 W<sub>eff</sub>/m<sup>2</sup>.
- LP BL:** Base with levelling device (except LP 471 LUM 2).

### CO and CO<sub>2</sub> probes equipped with SICRAM module

- HD320A2:** Carbon monoxide (CO) probe, measuring range 0...500ppm. 2m cable. Complete with SICRAM module.
- HD320B2:** Carbon dioxide (CO<sub>2</sub>) probe, measuring range 0...5000 ppm. Ø 14 mm, total length 200 mm. 2m cable. Complete with SICRAM module.



HD320AS2



HD320A2

HD320AS2

HD320B2