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English

Operating manual

Thermal Microclimate

HD32.1

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1. GENERAL CHARACTERISTICS

The **HD32.1** Thermal Microclimate has been designed for microclimate analysis in the workplace; the instrument is used to detect the necessary parameters to establish if a certain workspace is suitable to perform certain activities.

The instrument can manage **three operating programs** that can be loaded by the user, according to the measurements program and the quantities being detected.

The instrument has eight inputs for probes with SICRAM module: The probes are fitted with an electronic circuit that communicates with the instrument. The calibration settings are memorized inside.

All SICRAM probes, except the vane probe, can be plugged into any input: They will be automatically detected when you turn the instrument on.

NOTE: The vane probe, complete with SICRAM module, for wind speed measurement can be exclusively connected to input 8.

The instrument comes with a barometric pressure sensor. The barometric pressure is displayed only by the Microclimate Analysis operating program.

The machine can be programmed to perform the logging (capture) of a measurement session. You can specifically set a sampling interval per each session.

Furthermore, the auto-start function can be used to activate the setting of the measurements' initial date and time, and the automatic start and end of the data logging session.

NOTE: The set capture interval is valid for all the probes connected to the machine.

Other operating programs user selectable/settable common parameters are:

- The units of measurement for the displayed temperature quantities: °C, °F, °K.
- The system date and time
- The display of the **maximum, minimum, and average** statistic parameters and their deletion.
- The data transfer speed via the serial RS232 port.
- The setting and enabling/disabling of the keyboard protection password.

The operating programs are:

- **prog. A: HD32.1 Microclimate Analysis**
- **prog. B: HD32.1 Discomfort Analysis**
- **prog. C: HD32.1 Physical Quantities**

The **operating program A: Microclimate Analysis,** HD32.1, can simultaneously detect the following quantities:

- Globe thermometer temperature
- Natural ventilation wet bulb temperature
- Environment temperature
- Atmospheric pressure
- Relative humidity
- Wind speed

The **operating program A: Microclimate Analysis** displays also:

- The local turbulence intensity **Tu**, for DR (Draught Rating) calculation.
- The **WBGT** index (Wet Bulb Glob Temperature) with or without solar radiation.
- The **WCI** index (Wind Chill Index)
- The average radiation temperature $\mathbf{t_r}$.

The **operating program B: Discomfort Analysis,** HD32.1, can simultaneously detect the following quantities:

- Air temperature detected at head height (1.7 m for a standing person; 1.1 m for a seated person).
- Air temperature detected at abdomen height (1.1 m for a standing person; 0.6 m for a seated person).
- Air temperature detected at ankle height (0.1 m).
- Temperature at floor level.
- Temperature of the net radiometer.
- Net radiation.
- Radiant asymmetry temperature.

The **operating program B: Discomfort Analysis** is used to calculate the local discomfort indexes due to vertical temperature gradients or radiant asymmetry temperature.

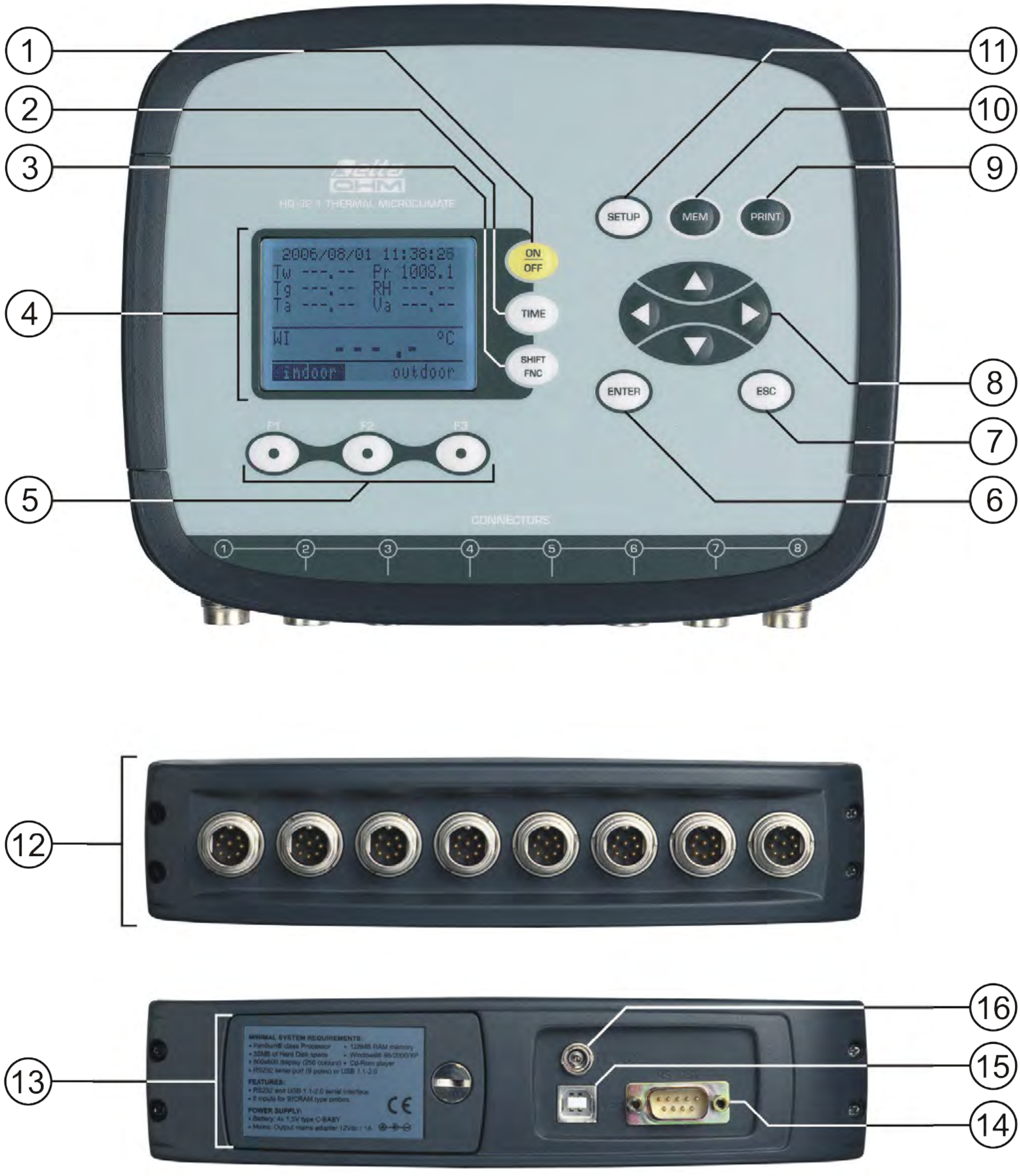
The **operating program C: Physical Quantities,** HD32.1, can simultaneously detect the following physical quantities:

- Temperature
- Relative humidity
- Illuminance, luminance, PAR, irradiance
- Wind speed
- carbon monoxide concentration CO.
- carbon dioxide concentration CO_2

By using the **operating program C: Physical Quantities,** HD32.1 **can simultaneously manage up to six different probes** complete with SICRAM module: one or two light probes and a probe for each of the other physical quantities. **If two or more probes of the same physical quantity are connected (light probes excluded), the instrument recognizes only one probe**. If, for example, you insert two Pt100 temperature probes complete with SICRAM module to inputs 1 and 2, the probe connected to input 1 is immediately recognized while the probe connected to input 2 is ignored. **The probe is detected during turn on**, therefore if a probe is changed, it is necessary to turn the machine off and on. During turn on the instrument performs a scan from input 1 to input 8. The probes arrangement in relation to the inputs is arbitrary, except for the vane probes.

The vane probe, complete with SICRAM module, for wind speed measurement can be exclusively connected to input 8.

Thermal Microclimate
HD32.1



HD32.1

1. **ON/OFF** key: Turns the instrument on and off.
2. **TIME** key: Allows the display of **date** and **time**, in the first line for about 8 seconds.
3. **SHIFT FNC** key: Activates the Shortcut window.
4. Graphic display.
5. Function keys **F1**, **F2**, **F3**: Activate the function in the bottom line of the display.
6. **ENTER** key: In the menu, confirms the data entered.
7. **ESC** key: Allows exiting from the menu or, in case of a submenu, exiting from the current level display.
8. Navigation keys ▲▼◄►: Allows navigation through the menus.
9. **PRINT** key: Starts and ends the data transfer to the serial/USB communication port.
10. **MEM** key: Starts and ends the recording of the data.
11. **SETUP** key: Allows entering and exiting the instrument's functioning parameter setting menu.
12. SICRAM inputs for the probes.
13. Battery cover.
14. RS232 serial port.
15. USB port.
16. Power supply input.

2. WORKING PRINCIPLE

2.1 THE OPERATING PROGRAM A: MICROCLIMATE ANALYSIS

By ***microclimate*** is meant those environmental parameters that influence the heat exchange between the person and the surrounding spaces, and that determinate the so-called " thermal well-being".

The microenvironment climatic factors, together with the type of work performed, generate a series of biological responses linked to thermal well-being (Comfort) or uneasiness (Discomfort).

The human organism, indeed, tends to maintain a thermal balance so that the body temperature is optimum.

The **HD32.1, Thermal Microclimate,** through its **operating program A: Microclimate Analysis** measures the following quantities:

- t_{nw}**:** natural ventilation wet bulb temperature
- t_g**:** globe thermometer temperature
- t_a**:** environment temperature
- p_r**:** atmospheric pressure
- ***RH*****:** relative humidity
- v_a**:** wind speed

In addition to the direct measurements performed with the probes connected, the instrument can directly calculate and display the following well-being data:

- ***WBGT index***
- ***Tu index***
- ***WCI index***
- ***Average radiation temperature*** t_r

2.1.1 WBGT Index

WBGT (Wet Bulb Globe Temperature) is one of the indexes used to determine the thermal stress of a person in a hot environment. It represents the value, related to the metabolic output linked to a specific work activity, that causes a thermal stress when exceeded. The WBGT index combines the measurements of the natural ventilation wet bulb temperature $\mathbf{t_{nw}}$ with the globe thermometer temperature $\mathbf{t_g}$ and, in some situations, with the air temperature $\mathbf{t_a}$**.** The calculation formula is the following:

- Inside and outside buildings without solar radiation:

$$WBG_{enclosed\ spaces} = 0.7\ t_{nw} + 0.3\ t_g$$

- Outside buildings with solar radiation:

$$WBGT_{outdoor\ spaces} = 0.7\ t_{nw} + 0.2\ t_g + 0.1\ t_a$$

where:

t_{nw} = natural ventilation wet bulb temperature;
t_g = globe thermometer temperature;
t_a = air temperature.

The measured data should be confronted with the limit values prescribed by regulations; when exceeded you have to:

- Reduce directly the thermal stress on the workplace being examined;
- Proceed to a detailed analysis of the thermal stress.

In the following table are reported the thermal stress index WBGT limit values as provided for by ISO 7243:

<table>
<tr><th rowspan="2">METABOLIC RATE CLASS</th><th colspan="2">METABOLIC RATE, M</th><th colspan="4">WBGT LIMIT VALUE</th></tr>
<tr><th>RELATIVE TO A UNIT AREA OF THE SKIN
W/m²</th><th>TOTAL (FOR A SKIN SURFACE AVERAGE AREA OF 1.8 m²)
W</th><th colspan="2">PERSON ACQUAINTED TO THE HEAT
°C</th><th colspan="2">PERSON NOT ACQUAINTED TO THE HEAT
°C</th></tr>
<tr><td>0
(RESTING)</td><td>M ≤ 65</td><td>M ≤ 117</td><td colspan="2">33</td><td colspan="2">32</td></tr>
<tr><td>1</td><td>65 < M ≤ 130</td><td>117 < M ≤ 234</td><td colspan="2">30</td><td colspan="2">29</td></tr>
<tr><td>2</td><td>130 < M ≤ 200</td><td>234 < M ≤ 360</td><td colspan="2">28</td><td colspan="2">26</td></tr>
<tr><td>3</td><td>200 < M ≤ 260</td><td>360 < M ≤ 468</td><td>DEAD AIR
25</td><td>NON DEAD AIR
26</td><td>DEAD AIR
22</td><td>NON DEAD AIR
23</td></tr>
<tr><td>4</td><td>M > 260</td><td>M > 468</td><td>23</td><td>25</td><td>18</td><td>20</td></tr>
<tr><td colspan="7">NOTE – THESE VALUES HAVE BEEN DETERMINED BY USING A MAXIMUM REFERENCE RECTAL TEMPERATURE OF 38 °C FOR THE PEOPLE BEING EXAMINED.</td></tr>
</table>

In order to calculate the WBGT index, the following probes should be connected:

- **The natural ventilation wet bulb temperature probe.**
- **The globe thermometer probe.**
- **The dry bulb temperature probe, if the measurement is performed with solar radiation.**

In order to measure the WBGT index, you should refer to the following regulations:

- **ISO 7726**
- **ISO 7243**

2.1.2 Turbulence Intensity (Tu index)

Turbulence Intensity: Local turbulence intensity percentage, defined as the ratio between the local wind speed standard deviation and the local air average speed (ISO 7726):

$$\boldsymbol{Tu} = \frac{\boldsymbol{SD}}{\boldsymbol{v_a}} \times 100$$

where:

$\boldsymbol{v_a}$ = average local wind speed
$\boldsymbol{SD}$ = local wind speed standard deviation

$$\boldsymbol{SD} = \sqrt{\frac{1}{\boldsymbol{n}-1} \cdot \sum_{\boldsymbol{i}=1}^{\boldsymbol{n}} \left(\boldsymbol{v}_{\boldsymbol{a}_i} - \boldsymbol{v_a}\right)^2}$$

From the turbulence calculation, knowing the average values of the local wind speed and environment temperature, you can get the ***DR*** (Draught Rating), according to ISO 7730:

$$\boldsymbol{DR} = (34 - \boldsymbol{t_a}) \cdot (\boldsymbol{v_a} - 0{,}05)^{0{,}62} \cdot (0{,}37 \cdot \boldsymbol{v_a} \cdot \boldsymbol{Tu} + 3{,}14)$$

The discomfort from air current is defined as an undesired local cooling of the body due to air motion. The *DR* indicates the percentage of unsatisfied people due to air current. **The *DR* index is calculated when the temperature goes from 20 °C to 26 °C and the average wind speed is < 0.5 m/s.**

The *DR* index is calculated using the DeltaLog10 software.

2.1.3 WCI Index

WCI (Wind Chill Index) allows a synthetic evaluation of the effects of cold environments on man. It shows the cooling index due to the wind. It allows evaluating the discomfort perceived during exposure to low temperatures and wind. The index does not consider the clothing and the work intensity. **The WCI index is calculated by the instrument in presence of air under 10°C.**
The WCI index calculation formula is:

$$WCI = 13.12 + 0.6215\, t_a - 11.37\, v_a^{0.16} + 0.4275\, t_a v_a^{0.16}$$

where:

t_a: air temperature (in °C);
v_a: Wind speed (in km/h) calculated at 10 m from the ground.

As the instrument measures the wind speed at 1.5 m from the ground, the formula is corrected as follows:

$$WCI = 13.12 + 0.6215\, t_a - 11.37(1.5\ \ v_{1.5})^{0.16} + 0.4275\, t_a (1.5\ \ v_{1.5})^{0.16}$$

where $v_{1.5}$ is the wind speed measured by the instrument at 1.5 m from the ground.

The following tables report some WCI values and the relevant frostbite risks (source: NOAA – National Weather Service).

		Air temperature °C												
		10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
Wind speed v_a Km/h	10	8.6	2.7	-3.3	-9.3	-15.3	-21.1	-27.2	**-33.2**	**-39.2**	**-45.1**	**-51.1**	**-57.1**	**-63.0**
	15	7.9	1.7	-4.4	-10.6	-16.7	-22.9	**-29.1**	**-35.2**	**-41.4**	**-47.6**	**-51.1**	**-59.9**	**-66.1**
	20	7.4	1.1	-5.2	-11.6	-17.9	-24.2	**-30.5**	**-36.8**	**-43.1**	**-49.4**	**-55.7**	**-62.0**	**-68.3**
	25	6.9	0.5	-5.9	-12.3	-18.8	-25.2	**-31.6**	**-38.0**	**-44.5**	**-50.9**	**-57.3**	**-63.7**	**-70.2**
	30	6.6	0.1	-6.5	-13.0	-19.5	-26.0	**-32.6**	**-39.1**	**-45.6**	**-52.1**	**-58.7**	**-65.2**	**-71.7**
	35	6.3	-0.4	-7.0	-13.6	-20.2	-26.8	**-33.4**	**-40.0**	**-46.6**	**-53.2**	**-59.8**	**-66.4**	**-73.1**
	40	6.0	-0.7	-7.4	-14.1	-20.8	-27.4	**-34.1**	**-40.8**	**-47.5**	**-54.2**	**-60.3**	**-67.6**	**-74.2**
	45	5.7	-1.0	-7.8	-14.5	-21.3	-28.0	**-34.8**	**-41.5**	**-48.3**	**-55.1**	**-61.8**	**-68.6**	**-75.3**
	50	5.5	-1.3	-8.1	-15.0	-21.8	-28.6	**-35.4**	**-42.2**	**-49.0**	**-55.8**	**-62.7**	**-69.5**	**-76.3**
	55	5.3	-1.6	-8.5	-15.3	-22.2	**-29.1**	**-36.0**	**-42.8**	**-49.7**	**-56.6**	**-63.4**	**-70.3**	**-77.2**
	60	5.1	-1.8	-8.8	-15.7	-22.6	**-29.5**	**-36.5**	**-43.4**	**-50.3**	**-57.2**	**-64.2**	**-71.1**	**-78.0**

The values that can cause frostbite within ≤ 30 minutes are reported in bold.

Wind Chill (°C)	Frostbite risk
> -28	Low
-28 to -39	Medium: The exposed body parts can freeze within 10 to 30 minutes
-40 to -44	High: The exposed body parts can freeze within 5 to 10 minutes **(*)**
Alarm level -44 to -47	High: The exposed body parts can freeze within 2 to 5 minutes **(*)**
-48 and colder	High: The exposed body parts can freeze in less than 2 minutes **(*)**

(*): With $\mathbf{v_a}$ higher than 50 km/h the frostbite process can be faster.

In order to calculate the WCI index, the following probes should be connected:

- **The dry bulb temperature probe for air temperature measurement t_a.**
- **The hot-wire probe for wind speed measurement.**

In order to measure the WCI index, refer to the following:

- **ISO 7726**
- **NOAA Specifications, National Weather Service.**

2.1.4 Average Radiation Temperature t_r

The average radiation temperature is defined as the temperature of a thermally uniform simulated environment that would exchange with a man the same thermal radiation power exchanged in the real environment.

In order to evaluate the average radiation temperature you have to measure: The globe thermometer temperature, the air temperature and the wind speed measured near the globe thermometer. The average radiation temperature calculation formula is the following:

- In case of **natural convection:**

$$\boldsymbol{t_r} = \left[\left(\boldsymbol{t_g} + 273\right)^4 + \frac{0.25 \times 10^8}{\varepsilon_g} \left(\frac{\left|\boldsymbol{t_g} - \boldsymbol{t_a}\right|}{\boldsymbol{D}} \right)^{1/4} \times \left(\boldsymbol{t_g} - \boldsymbol{t_a}\right) \right]^{1/4} - 273$$

- In case of **forced convection:**

$$\boldsymbol{t_r} = \left[\left(\boldsymbol{t_g} + 273\right)^4 + \frac{1.1 \times 10^8 \times \boldsymbol{v_a}^{0.6}}{\varepsilon_g \times \boldsymbol{D}^{0.4}} \left(\boldsymbol{t_g} - \boldsymbol{t_a}\right) \right]^{1/4} - 273$$

where:

$\boldsymbol{D}$ = globe thermometer diameter
$\boldsymbol{\varepsilon_g}$ = 0.95 assumed emissivity of the globe thermometer
$\boldsymbol{t_g}$ = globe thermometer temperature
$\boldsymbol{t_a}$ = air temperature.
$\boldsymbol{v_a}$ = wind speed

The average radiation temperature does not correspond to air temperature: If within a room very high temperature surfaces are present (for example, a fireplace), these hot areas remarkably influence the average radiation temperature.

The average radiation temperature is detected with the globe thermometer. A temperature probe formed by a 150 mm copper ball, painted black matt, with emissivity equal to $\boldsymbol{\varepsilon_g}$ = 0.95 (according to **ISO 7726**), and a Pt100 sensor inside. The globe thermometer temperature could be remarkably higher than the air temperature. For example in a mountain cottage, in which air is at 0°C but the presence of a fireplace produces an average radiation temperature of 40°C, ensuring a comfortable condition. In normal conditions, maintaining a certain difference between average radiation temperature and air temperature (where T_{MR} is remarkably higher than T_A) is preferable in order to get a better environment quality. In houses, where fireplaces and ranges are absent, generally the average radiation temperature is equal to the air temperature, or even lower. These conditions (mainly in buildings with large window surfaces) are not particularly healthy as the warm humid air facilitates the development of pathogenic organisms. From this point of view, using lamps or radiating panels is more healthy. It is much more hygienic to use a higher average radiation temperature than the air temperature, in order to guarantee comfort conditions. The regulations use air temperature and not average radiation temperature to assess heating system, but this is wrong.

In order to calculate the average radiation temperature you have to connect the following probes:

- **Globe thermometer probe**
- **Air temperature measurement probe**
- **Hot-wire probe for wind speed measurement**

In order to measure the average radiation temperature, you should refer to the following regulations:

- **ISO 7726**

2.2 THE OPERATING PROGRAM B: DISCOMFORT ANALYSIS

The **HD32.1, Thermal Microclimate,** through its **operating program B: Discomfort Analysis,** measures the following quantities.

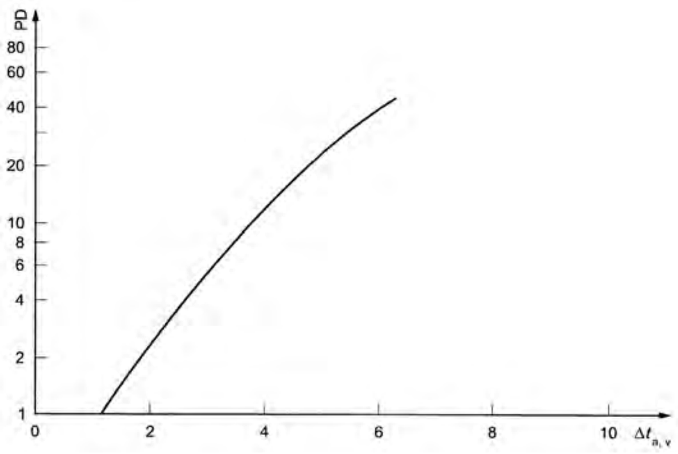
- t_h head temperature: air temperature detected at head height
- t_b: body temperature: air temperature detected at abdomen height
- t_k: ankle temperature: air temperature detected at ankle height
- t_f: floor temperature: air temperature at floor level
- ***P***: net radiation: net radiation, measured in Wm^{-2}.

By knowing the temperatures at head t_h, abdomen t_b, ankles t_k and floor t_f height, you can determine, according to **ISO 7730**, the following local thermal discomfort indexes:

- ***Unsatisfied with the vertical difference of temperature;***
- ***Unsatisfied with the floor temperature;***
- ***Unsatisfied with the radiant asymmetry.***

2.2.1 Unsatisfied with the vertical difference of temperature

By detecting the temperatures at various heights you can check the presence of a air temperature vertical gradient. This gradient could cause a local discomfort feeling. In the following figure you can see the percentage value of the **unsatisfied with the vertical difference of temperature** PD_v , according to the temperature gradient between head (1.10 m) and ankles (0.10 m) for a seated person. **This index is calculated using the DeltaLog10 software.**



In order to calculate the PD_v index (unsatisfied with the vertical difference of temperature) you have to connect the following probes:

- **Probe for the air temperature detected at head height**
- **Probe for the air temperature detected at ankle height**

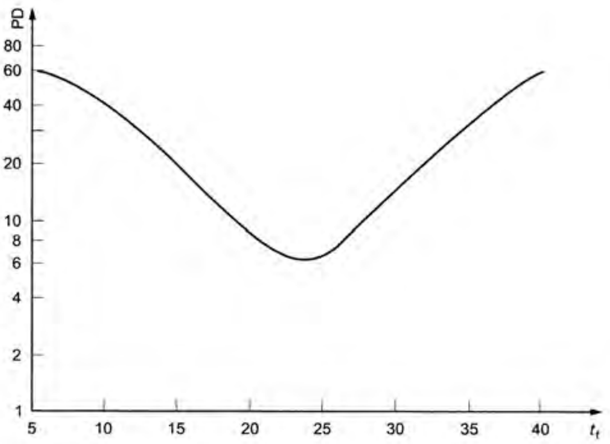
The PD_v index is calculated by the DeltaLog10 software.

In order to calculate the PD_v index (unsatisfied with the vertical difference of temperature) you should refer to the following regulations:

- **ISO 7730**

2.2.2 Unsatisfied with the floor temperature

By measuring the floor temperature you can calculate the **percentage index of the unsatisfied with the floor temperature**. The following diagram shows the ***PD***PD_f index trend according to the floor temperature.



In order to calculate the PD_f index (unsatisfied with the floor temperature) you have to connect the following probe:

- **Floor temperature probe**

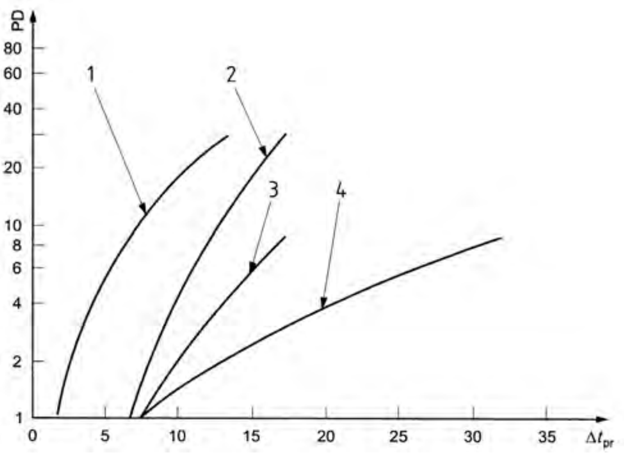
The PD_f index is calculated by the DeltaLog10 software.

In order to calculate the PD_f index (unsatisfied with the floor temperature) you should refer to the following regulations:

- **ISO 7730**

2.2.3 Unsatisfied with the radiant asymmetry

The radiant temperature asymmetry Δt_{pr} is the difference between the radiant temperatures measured with the net radiometer. The index of the unsatisfied with the radiant asymmetry is calculated according to a vertical (ceiling-floor) or horizontal (wall-wall) asymmetry. Form the radiant temperature Δt_{pr} measured by the instrument, you can determine the **percentage of the unsatisfied with the radiant asymmetry** using the **DeltaLog10 software**. This is reported in the following figure.



1 Hot ceiling
2 Cold wall
3 Cold ceiling
4 Hot wall

In order to calculate the percentage of the unsatisfied with the floor temperature you have to connect the following probe:

- **Net radiometer probe for radiant temperature measurement**

The percentage of the unsatisfied with the radiant asymmetry is calculated using the DeltaLog10 software.

In order to calculate the percentage of the unsatisfied with the radiant asymmetry, you should refer to the following regulations:

- **ISO 7730**

2.3 THE OPERATING PROGRAM C: PHYSICAL QUANTITIES

The **HD32.1, Thermal Microclimate,** through its **operating program C: Physical Quantities,** measures the following quantities:

- Temperature.
- Relative humidity and resulting measurements.
- Illuminance, luminance, PAR, irradiance.
- Wind speed and resulting measurements.
- carbon monoxide concentration CO.
- carbon dioxide concentration CO_2

3. THE USER INTERFACE

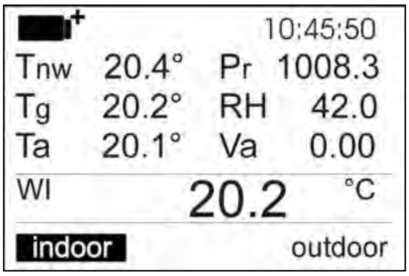
The user interface consist of an LCD display and of the power, function, and setting keys.
Turn the instrument on and off with the **ON/OFF** key. When you turn the instrument on, the logo and model will be displayed for a few seconds, and then the main display.

3.1 THE DISPLAY

The display changes according to the loaded **operating program**.

3.1.1 The Operating Program A, Microclimate Analysis, Display

The **Thermal Microclimate HD32.1** main display, is divided in three areas:



The first area displays the **battery's charge status** and the current **time** on the first line and the **measured quantities** arranged on two columns:

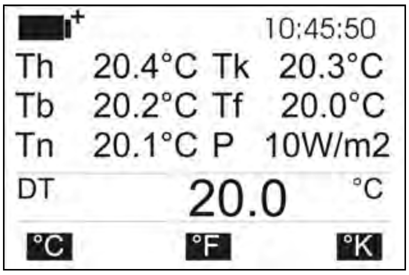
Tnw: natural ventilation wet bulb temperature
Tg: globe thermometer temperature
Ta: environment temperature
Pr: atmospheric pressure
RH: relative humidity
Va: wind speed

The second area displays the resulting measurements, that is, the indoor or outdoor WBGT indexes (WI or WO), the WCI and the average radiant temperature Tr (see the previous chapter for further details).

The third area displays the **F1**, **F2** and **F3** options. Please see the **SHIFT FNC** key in the following paragraph.

3.1.2 The Operating Program B, Discomfort Analysis, Display

The **Thermal Microclimate HD32.1** main display, is divided in three areas:



The first area displays the **battery's charge status** and the current **time** on the first line and the **measured quantities** arranged on two columns:

Th: head temperature: air temperature detected at head height
Tb: body temperature: air temperature detected at abdomen height
Tn: net temperature: temperature of the net radiometer
Tk: ankle temperature: air temperature detected at ankle height
Tf: floor temperature: air temperature at floor level
P: net radiation: net radiation, measured in Wm^{-2}

The second area displays the radiant asymmetry temperature **DT**. By knowing this parameter you can obtain the **percentage of the unsatisfied with the radiant asymmetry** using DeltaLog10, according to ISO 7730.

The third area displays the **F1**, **F2** and **F3** options. Please see the **SHIFT FNC** key in the following paragraph.

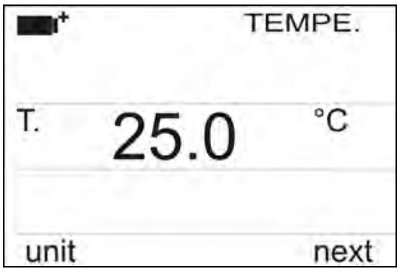
3.1.3 The Operating Program C, Physical Quantities, Display

The **Thermal Microclimate, HD32.1,** display of the **Operating Program C: Physical Quantities,** shows the quantities of the probes connected to the instrument inputs.
The display is divided into three areas:
The first area (first line) displays the **battery's charge status,** the current **date** and **time** and the type of probe:

Displayed message	Displayed SICRAM probe
TEMPE	Pt100 probe
RH-TEMPE	RH-temperature combined probe
AIR-TEMP	Vane probe or hot-wire probe and temperature probe
LUX	Light probe
CO	CO probe
CO2	CO_2 probe

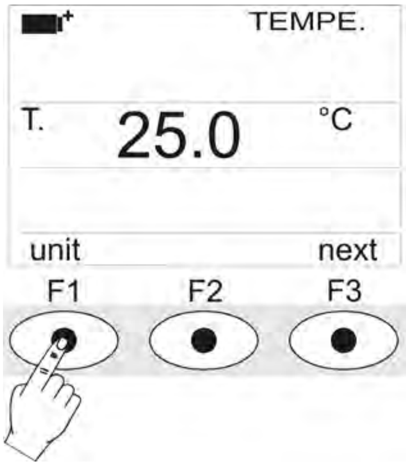
The second area of the display shows the measurements detected by the probes. Each display is associated to the relevant probe. In order to display the measurements, press F3 when the message **next** appears on the last line.
The third area displays the **F1**, **F2** and **F3** options. Please see the **SHIFT FNC** key in the following paragraph.

If a **Pt100 temperature probe** with SICRAM module is present, the following is displayed:

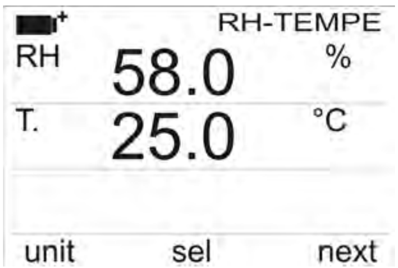


The first display line shows "**TEMPE.**" indicating that the temperature of a **Pt100 probe** complete with SICRAM module is displayed.

By repeatedly pressing **F1** with **unit** on the last line, you can change the unit of measurement: The available units are °C and °F; by pressing **F1** again you can return to °C.



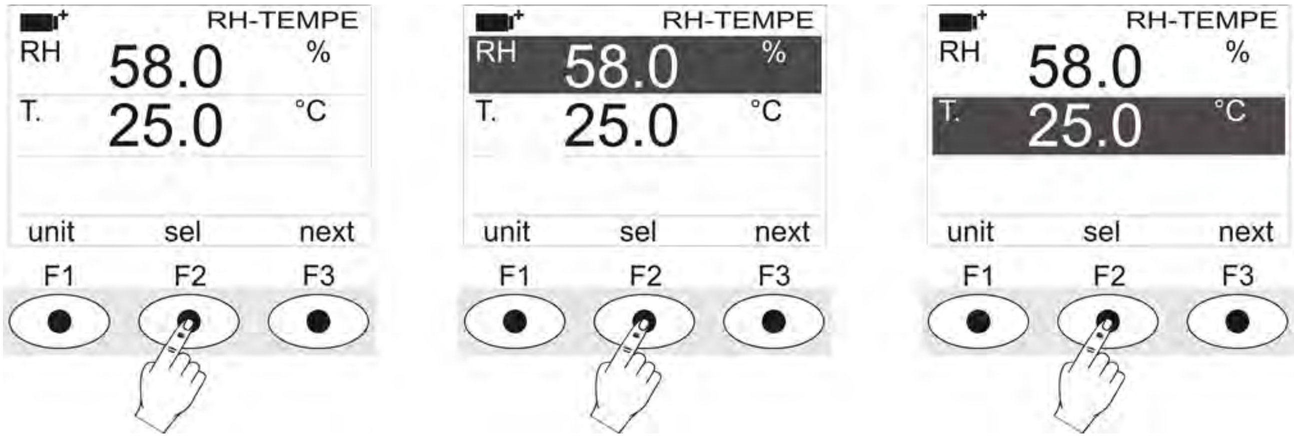
By pressing **F3** with **next** on the last line, you go to the **combined humidity/temperature probe** complete with SICRAM module:



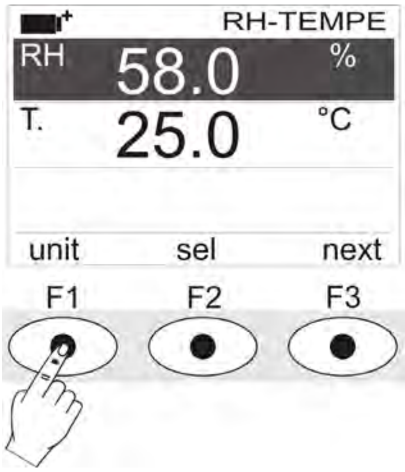
The first display line shows "**RH-TEMPE**" indicating that the measurements of a **combined humidity/temperature probe** complete with SICRAM module are displayed.

The second line displays the relative humidity. The third line displays the temperature.

In order to change the unit of measurement, press **F2** with **sel** displayed on the last line.



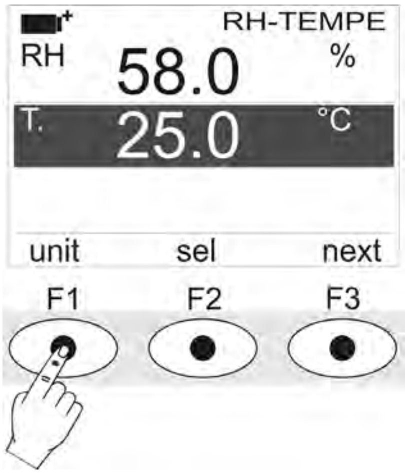
By pressing **F1** when the second line is selected, you can change the relative humidity unit of measurement:



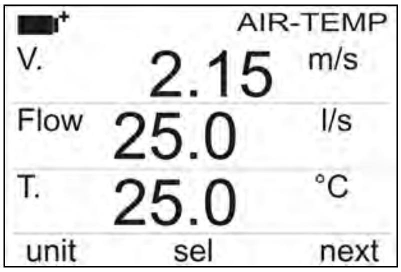
The available units of measurement are:

- **RH:** % of relative humidity (**%RH - Relative Humidity**)
- **SH:** Grams of vapor in a kilogram of dry air (**g/Kg - Specific Humidity**, calculated)
- **AH:** Grams of vapor in a cubic meter of dry air (**g/m^3 - Absolute Humidity**, calculated)
- **Pa:** Partial vapor pressure (**hPa,** calculated)
- **H**: Enthalpy (**J/g**, calculated)
- **Td**: Dew point (**°C or °F**, calculated)
- **Tw:** Wet bulb temperature (**°C or °F**)

By pressing **F1** when the third line is selected, you can change the temperature unit of measurement: The available units are °C and °F; by pressing **F1** again you can return to °C.



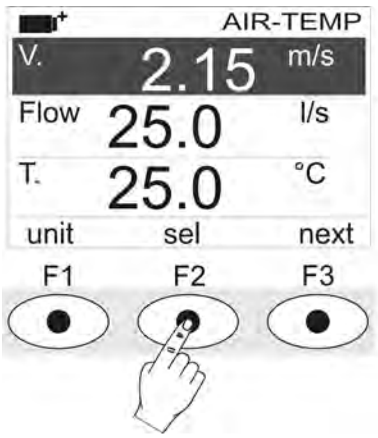
By pressing **F3** with **next** on the last line, you go to the **combined speed/temperature probe** complete with SICRAM module: **The vane probes for wind speed measurement can be exclusively connected to input 8**. The display is as follows:

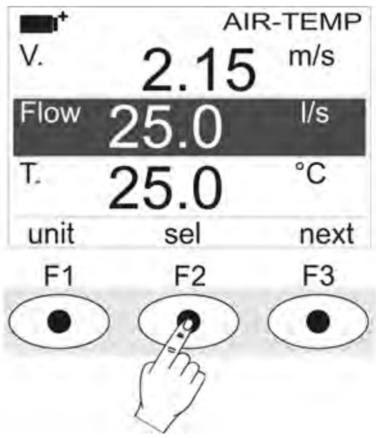


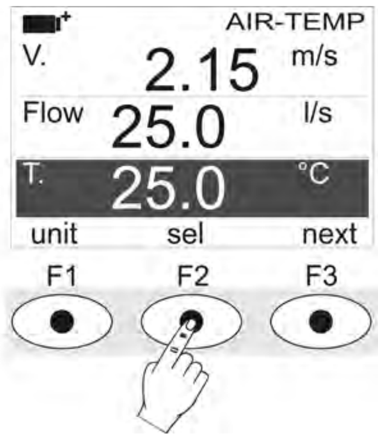
The first display line shows “**AIR-TEMP”** indicating that the measurements of a **combined speed/temperature probe** complete with SICRAM module are displayed.

The second line displays the wind speed. The third line displays the flow rate measurement. In order to get this measurement, you have to set the duct section (see next paragraph). The fourth line displays the temperature, if required.

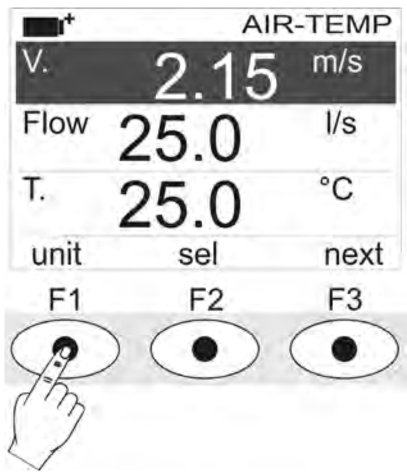
In order to change the unit of measurement, press **F2** with **sel** displayed on the last line.







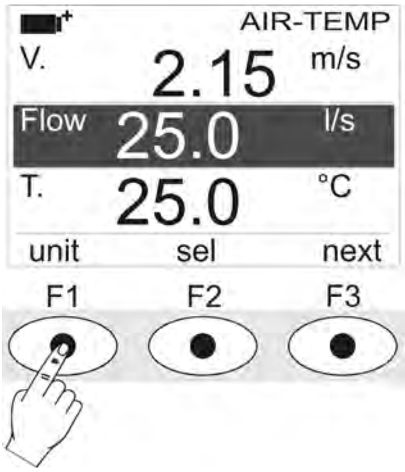
By pressing **F1** when the second line is selected, you can change the wind speed unit of measurement:



The units of measurement for the wind speed are:

- m/s
- km/h
- ft/min
- mph (mile/hour)
- knot

By pressing **F1** when the third line is selected, you can change the flow rate unit of measurement:

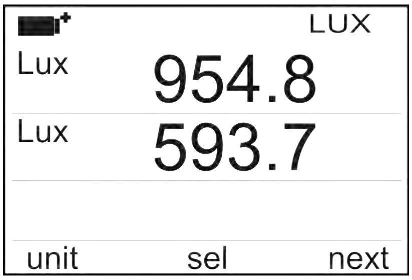


The units of measurement for the flow rate are:

- l/s (liter/s)
- m^3/s
- m^3/min
- m^3/h
- ft^3/s
- ft^3/min

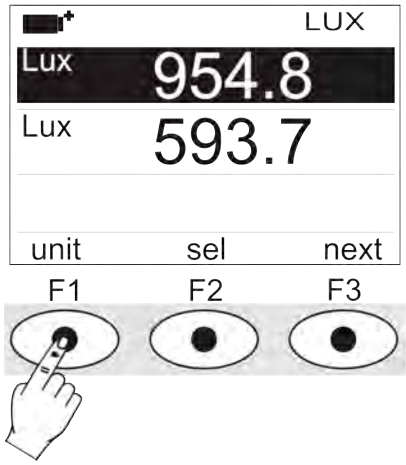
By pressing **F1** when the fourth line is selected, you can change the temperature unit of measurement: The available units are °C and °F; by pressing **F1** again you can return to °C.

By pressing **F3** with **next** on the last line, you go to the **light probes** complete with SICRAM module:



The first display line shows "**LUX"** indicating that the measurement of a **light probes** complete with SICRAM module are displayed.

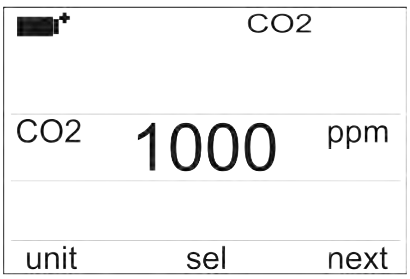
To change the unit of measurement, select one of the rows with F2 key and then press repeatedly **F1**:



The available units of measurement depend on the type of probe:

Type of measurement	**Unit of Measurement**
Illuminance (Phot)	lux - fcd
Irradiance (RAD - UVA - UVB - UVC)	W/m^2 - $\mu W/cm^2$
PAR	$\mu mol/(m^2 \cdot s)$
Luminance (LUM 2)	cd/m^2

Pushing the **function key F3** when there is the writing **next** on the last line you go on visualizing the measurements detected by **CO_2** probe complete with SICRAM module. The visualization is the following one:



The first line of the display indicates the acronym **“CO2”,** indicating that the measurement of **carbon dioxide concentration** detected by the **CO_2 probe** with SICRAM module is visualized on the display.

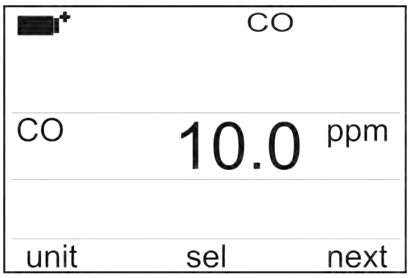
The measurement unit in **ppm** (parts per million) can’t vary.

When you start the instrument up, it realizes a warm-up (the heating) of at least 30 seconds of the probe before visualizing CO_2 measurement. The writing “warm-up” stays on for other 30 seconds together with the measurement to indicate that the indicated values could not already be within the declared accuracy limits. When the writing “warm-up” switches off, the instrument is working.

The probe is calibrated by the company and usually doesn’t request any other intervention by the user.

However, there is the possibility to calibrate again: see the chapter that deals with the Probe "*Probe HD320B2 for the measurement of CO_2 carbon dioxide concentration*".

Pushing the **function key F3** when there is the writing **next** on the last line you go on visualizing the measurements detected by **CO_2** probe complete with SICRAM module. The visualization is the following one:



The first line of the display indicates the symbol **“CO”,** indicating that the measurement of **carbon monoxide concentration** detected by the **CO probe** with SICRAM module is visualized on the display.

The measurement unit in **ppm** (parts per million) can’t vary.

When you start the instrument up, it realizes a warm-up (the heating) of at least 30 seconds of the probe before visualizing CO measurement. The writing “warm-up” stays on for other 30 seconds together with the measurement to indicate that the indicated values could not already be within the declared accuracy limits. When the writing “warm-up” switches off, the instrument is working.

The probe is calibrated by the company and usually doesn’t request any other intervention by the user.

However, there is the possibility to calibrate again: see the chapter that deals with the Probe "*Probe HD320A2 for the measurement of CO carbon monoxide concentration*".

Pushing the **function key F3** at the end of the cycle, when on the last line of the display there is the indication **next**, you go back to the visualization of the measurements detected by the Pt100 probe.

If one of the probe described is not connected to the instrument when switching on, the corresponding visualization does not appear.

3.2 THE KEYBOARD

The keys on the instrument perform the following functions:

ON-OFF key

Turns the instrument on and off.
When turning on the instrument using this key, the first screen will be displayed. After few seconds the measured quantities will be displayed.

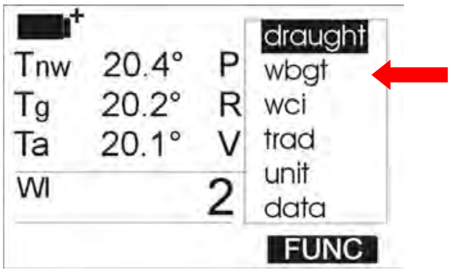
NOTE: If no probes were connected on turning on, only the barometric pressure will be displayed. The other quantities will be indicated by dashes, instead of the value.

TIME key

It allows the display of **year/month/day** and **hour/minutes/seconds**, in the first line for about 8 seconds. Normally the display shows, on the left, the icon for the battery's charge status, on the right, hour/minutes/seconds. The battery symbol becomes **[~]** when the external power supply is connected.

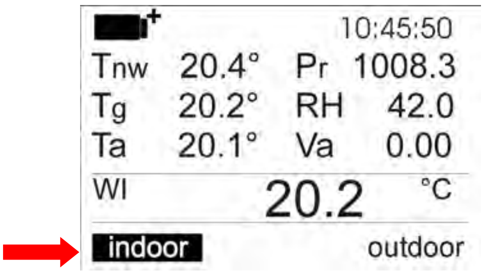
SHIFT FUNCTION key

Activates the Shortcut window. The figure shows the Shortcut menu for the **Microclimate Analysis** operating program.



Function keys F1, F2, F3

These are "function keys": They activate the function in the last line of the display (indicated by the arrow in the figure); the function, enabled by **SHIFT FNC,** is selected and displayed in "reverse" (e.g. in the figure the **Microclimate Analysis** operating program "WBGT indoor" function is enabled).



SETUP key

Allows entering and exiting the instrument’s functioning parameter setting menu.

ENTER key

In the menu, confirms the entered data.

ESC key

Allows exiting from the menu or, in case of a submenu, exiting from the current level display.

MEM key

Allows starting and ending a “logging” session; the data sending interval must be set in the menu.

PRINT key

Allows direct printing of the data via serial port; the data sending interval must be set in the menu.

Arrow keys

Allow navigation through the menus.

4. OPERATION

Before turning on the instrument, connect the SICRAM probes to the inputs: 8-pole male DIN45326 connectors, located in the lower part of the instrument (see figure on page 2), according to the measurement being performed.

<u>NOTE:</u> Connect the probes when the instrument is off. If a probe is connected and the instrument is on, it will be ignored. In this case, it is necessary to turn it off and on.

If a probe is connected when the instrument is on, you will get an acoustic signal (one beep per second) and an indication on the display relevant to the physical quantity being disconnected. The “LOST” message will be displayed.
If you connect multiple probes of the same type, only the first recognized probe is accepted (the first two if light probes): The probes scanning starts fro input 1 to input 8.
The barometric pressure sensor is internal: Upon turning on the instrument, should no probes be connected, only the atmospheric value is displayed.

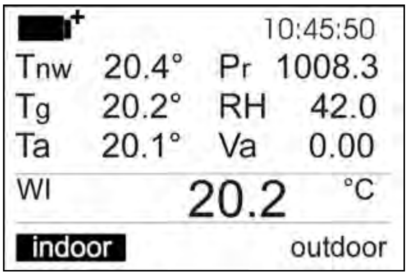
During turning on, the following message is displayed for about 10 seconds:

In addition to the **Delta Ohm logo** the **tab name and the operating program code** are displayed:

- **prog. A: HD32.1 Microclimate Analysis**
- **prog. B: HD32.1 Discomfort Analysis**
- **prog. C: HD32.1 Physical Quantities**

4.1 THE OPERATING PROGRAM A: MICROCLIMATE ANALYSIS

Connect the probes. Turn on the instrument: After 10 seconds, the measurement display mode will appear:



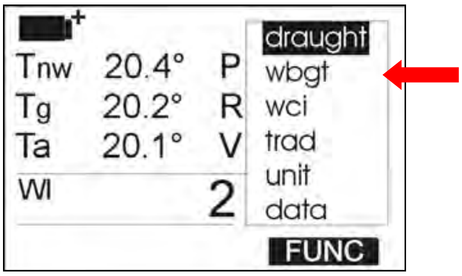
The battery charge symbol and current time are up on the left (for further details, see the par. 10).

The following quantities are reported:

Tnw: Humid temperature, measured by a natural ventilation wet bulb probe
Tg: Globe thermometer temperature, measured by a globe thermometer probe
Ta: Environment temperature, measured by a Pt100 probe
Pr: Barometric pressure, measured by an internal sensor
RH: Relative humidity, measured by a combined humidity/temperature probe
Va: Wind speed, measured by a hot-wire probe

A resulting quantity is displayed in the central part of the display: In this example, the WI index, that is, the WBGT index measured indoor or outdoor without solar radiation.

In order to select the displayed index, press **SHIFT FNC:** A drop-down menu is shown with the following information:

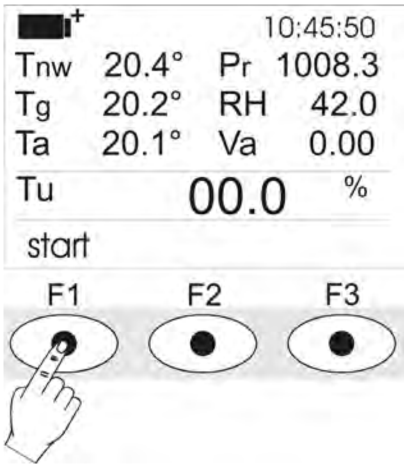


- **draught**: DR index: draught risk
- **wbgt**: WBGT index: wet bulb globe temperature
- **wci**: WCI index: wind chill index
- **trad**: average radiation temperature Tr
- **unit**: temperature measurement unit
- **data**: maximum, medium, average values

4.1.1 DR Index – Draught Risk

In order to calculate the ***DR*** index you need to know the **turbulence intensity *Tu*** obtained from the wind speed. For the turbulence intensity ***Tu*** calculation, the instrument starts an automatic procedure to capture the wind speed within a preset interval; at the end, the instrument displays the turbulence intensity percentage value. The DeltaLog10 software is then used to obtain the ***DR*** index.
To start the ***Tu*** index calculation, proceed as follows after opening the drop-down menu with **SHIFT FNC**:

1. Use the arrow keys ▲▼ to select **“draught**”;
2. Press ENTER to confirm: the ***Tu*** message is displayed in the central line of the display;
3. Press ESC to exit the drop-down menu without making any change.
   The following screen will appear:



Press **F1** to start the capture procedure:
On the first line, the blinking **TU** symbol and the **start** message replaced by **running**, indicate that the procedure was started.

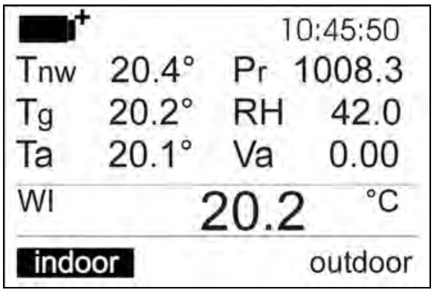
After few seconds the **TU** symbol will disappear, the **running** message will be replaced by **start** and the turbulence intensity value will be displayed.

4.1.2 WBGT Index

To display the ***WBGT*** index, proceed as follows after opening the drop-down menu with **SHIFT FNC**:

4. Use the arrow keys ▲▼ to select **WBGT**;
5. Press **ENTER** to confirm: The selected quantity is displayed in the central line of the display;
6. Press **ESC** to exit the drop-down menu without making any change.

Now you can display the ***Indoor*** (***WI***) or ***Outdoor*** (***WO***) values, by selecting them using the **F1** or **F3** keys (see figure).



4.1.3 WCI Index

To display the ***WCI*** index, proceed as follows after opening the drop-down menu with **SHIFT FNC**:

1. Use the arrow keys ▲▼ to select **WCI**;
2. Press **ENTER** to confirm: the selected quantity is displayed in the central line of the display;
3. Press **ESC** to exit the drop-down menu without making any change.

4.1.4 Radiation Temperature Tr.

To display the radiation temperature ***Tr***, proceed as follows after opening the drop-down menu with **SHIFT FNC**:

1. Use the arrow keys ▲▼ to select **TRAD**;
2. Press **ENTER** to confirm: the selected quantity is displayed in the central line of the display;
3. Press **ESC** to exit the drop-down menu without making any change.

4.1.5 The unit of measurement "Unit"

By using the "Functions" menu, you can display the temperature in °C (Celsius), °F (Fahrenheit) or °K (Kelvin) degrees, as follows:

1. Use **SHIFT FNC** to open the drop-down menu;
2. Use the arrow keys ▲▼ to select ***unit***;
3. Press **ENTER** to confirm: the selected quantity is displayed in the central line of the display;
4. The three different temperature units of measurement are shown in the bottom line of the display, using **F1**, **F2** or **F3**: The unit is selected and displayed near the value shown in the central line;
5. Press **ESC** to exit the drop-down menu without making any change.

4.1.6 The maximum, minimum and average values of the captured quantities

In order to display the maximum, minimum and average values of the measured quantities, proceed as follows:

1. Use **SHIFT FNC** to open the drop-down menu;
2. Use the arrow keys ▲▼ to select **data**;
3. Press **ENTER** to confirm: the selected quantity is displayed in the central line of the display;
4. The three quantities ***max*** (maximum), ***min*** (minimum) and ***avg*** (average) are shown in the bottom line of the display, using **F1** or **F2**.

<u>NOTE:</u> Once selected, for example ***max***, all displayed quantities represent the maximum value. **The average is calculated on the first five minutes of samples, and then on the current average.**

The **F3** key allows choosing to clear (***Clr***) the maximum, minimum and average data of the captured measurements:

1. In order to clear the data, select ***Clr*** with **F3**;
2. Another drop-down menu will open;
3. Use the arrow keys ▲▼ to select ***yes***;
4. Press **ENTER** to confirm.
5. Press **ESC** or select ***no***, to exit without clearing the data.

4.1.7 Instrument Setup

In order to set the instrument, you have to open the main menu by pressing **SETUP**. See the next chapter for further details.

4.1.8 Start of a new logging session

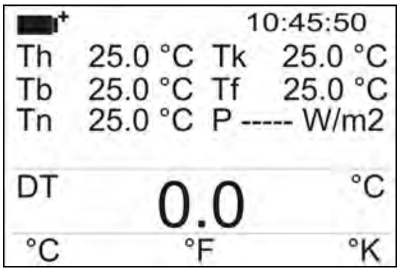
Press **MEM** to start a **Logging** session: This key starts and stops the logging of a data block to be saved in the instrument's internal memory. The data logging frequency is set in the **"Log interval"** menu parameter. The data logged between a start and subsequent stop represent a measurement block.

When the logging function is on, the ***LOG*** indication is displayed, the battery symbol blinks and a beep is issued each time a logging occurs.
To end the logging, press **MEM** again.

The instrument can turn off during logging between one capture and the next: The function is controlled by the **Auto_shut_off_Mode** parameter. When the logging interval is less than one minute, the logging instrument remains on; with an interval of at least one minute, it turns off between one capture and the next.

4.2 The Operating Program B: Discomfort Analysis

Connect the probes. Turn on the instrument: After few seconds, the measurement display mode will appear:

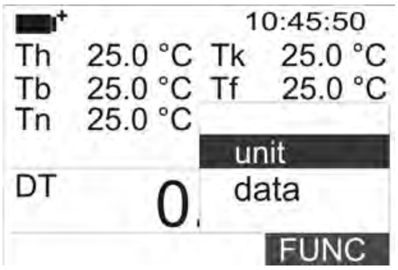


The battery charge symbol and current time are up on the left (for further details, see the par. 10). The following quantities are reported:

Th: Air temperature detected at head height (1.7 m for a standing person; 1.1 m for a seated person)
Tb: Air temperature detected at abdomen height (1.1 m for a standing person; 0.6 m for a seated person)
Tn: Temperature of the net radiometer
Tk: Air temperature detected at ankle height (0.1 m)
Tf: Temperature at floor level
P: Net radiation
DT: Radiant asymmetry temperature

By pressing **SHIFT FNC**, a drop-down menu is shown with the following information:

- **unit**: allows selection of the **unit of measurement**
- **data**: allows display of the **maximum, minimum, and average** values



4.2.1 The unit of measurement "Unit"

Proceed as follows to access **unit** function:

- Use **SHIFT FNC** to open the drop-down menu;
- Use the arrow keys ▲▼ to select ***unit***;
- Press **ENTER** to confirm: the selected quantity is displayed in the central line of the display;
- The three different temperature units of measurement are displayed in the bottom line of the display, using **F1**, **F2** or **F3**: The unit is selected and displayed near the value shown in the central line;
- Press **ESC** to exit the drop-down menu without making any change.

4.2.2 The maximum, minimum and average values of the captured quantities

Proceed as follows to access **data** function:

- Use **SHIFT FNC** to open the drop-down menu;
- Use the arrow keys ▲▼ to select **data**;
- Press **ENTER** to confirm: the selected quantity is displayed in the central line of the display;
- The three quantities ***max*** (maximum), ***min*** (minimum) and ***avg*** (average) are shown in the bottom line of the display, using **F1** or **F2**.

The **F3** key allows choosing to clear (***Clr***) the maximum, minimum and average data of the captured measurements:

- In order to clear the data, select ***Clr*** with **F3**;
- Another drop-down menu will open;
- Use the arrow keys ▲▼ to select ***yes***;
- Press **ENTER** to confirm.
- Press **ESC** or select ***no***, to exit without clearing the data.

4.3 THE OPERATING PROGRAM C: PHYSICAL QUANTITIES

Connect the probes. Turn on the instrument: After few seconds, the measurement display mode will appear (according to the selected page):
To shift from one display to the other, press **F3**.

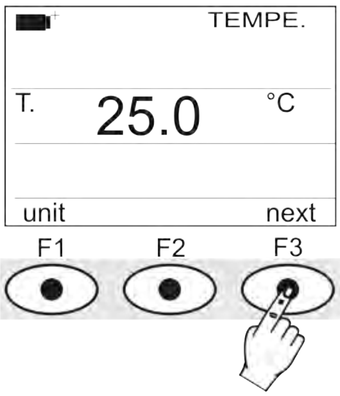


fig. 1-a

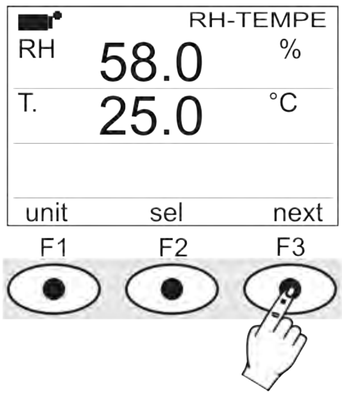


fig. 1-b

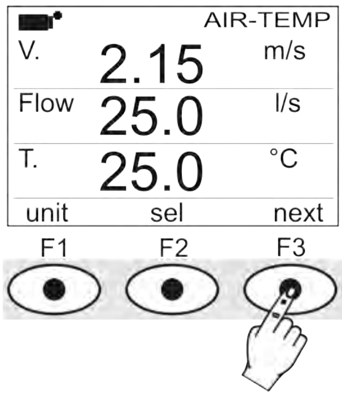


fig. 1-c

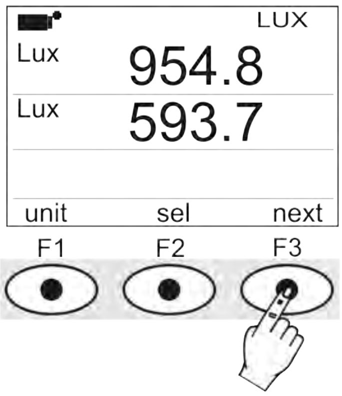


fig. 1-d

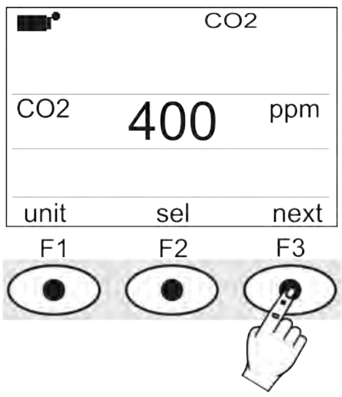


fig. 1-e

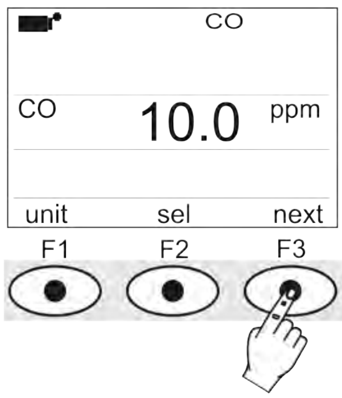


fig. 1-f

fig. 1-a: Display of the measurement using the **Pt100 SICRAM probe**
fig. 1-b: Display of the measurement using the **combined humidity/temperature SICRAM probe**
fig. 1-c: Display of the measurement using the **combined speed/temperature SICRAM probe**
fig. 1-d: Display of the measurement using the **photometric/radiometric SICRAM probe**
fig. 1-e: Display of the measurement using the **CO_2 SICRAM probe**
fig. 1-f: Display of the measurement using the **CO SICRAM probe**

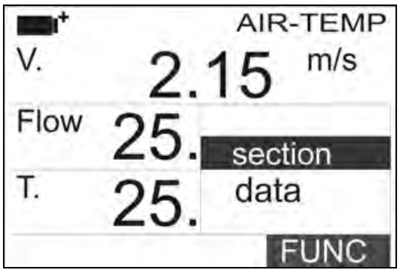
By pressing **SHIFT FNC**, a drop-down menu is shown with the following information:

- **unit**: allows selection of measuring unit for the actual variable.
- **data:** Allows display of the maximum, minimum, and average values.
- **section:** Allows setting the pipeline section for flow rate calculation
- **Cal CO2**: allows starting of calibration procedure for the CO_2 probe.
- **Cal CO**: allows starting of calibration procedure for the CO probe and sensor change.

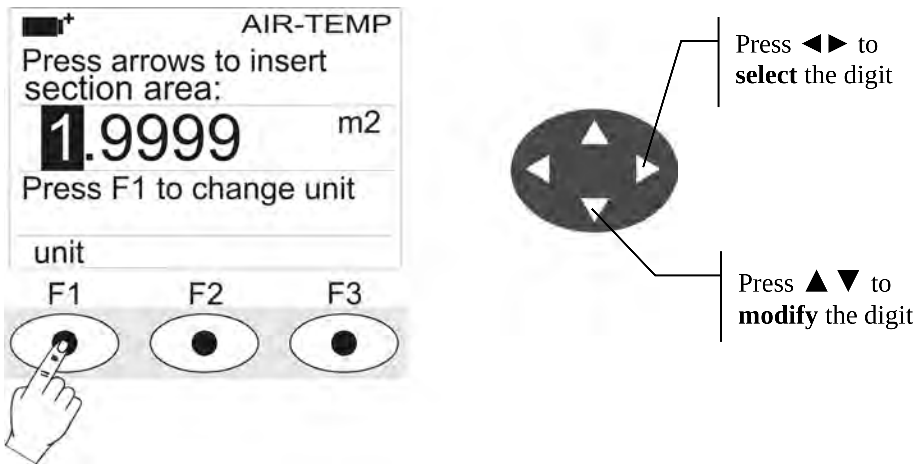
4.3.1 Setting the pipeline section

Proceed as follows to access **section** function:

- Use **SHIFT FNC** to open the drop-down menu;
- Use the arrow keys ▲▼ to select ***section***;
- Press **ENTER** to confirm;
- The Shortcut menu will appear:



- Use the ▲▼ navigation keys to select **section** and press **enter**. The following screen will appear:



- Use the ◄► navigation keys to highlight the digit in the section. Use the ▲▼ navigation keys to modify the highlighted digit.

  The area comprised must be between 0.0001 m^2 (1 cm^2) and 1.9999 m^2.

Pressing **F1** toggles the display between **m2 and inch2**;

- Press **enter** to confirm the information and exit from the setting section.
- Press **ESC** to exit the drop-down menu without making any change.

4.3.2 The maximum, minimum and average values of the captured quantities

Proceed as follows to access **data** function:

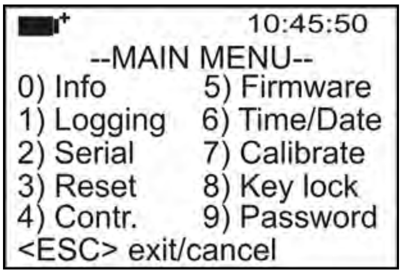
- Use **SHIFT FNC** to open the drop-down menu;
- Use the arrow keys ▲▼ to select **data**;
- Press **ENTER** to confirm: the selected quantity is displayed in the central line of the display;
- The three quantities ***max*** (maximum), ***min*** (minimum) and ***avg*** (average) are shown in the bottom line of the display, using **F1** or **F2**.

The **F3** key allows choosing to clear (***Clr***) the maximum, minimum and average data of the captured measurements:

- In order to clear the data, select ***Clr*** with **F3**;
- Another drop-down menu will open;
- Use the arrow keys ▲▼ to select ***yes***;
- Press **ENTER** to confirm.
- Press **ESC** or select ***no***, to exit without clearing the data.

5. MAIN MENU

To access the programming menu press **SETUP**: The setting menu will be displayed with the following items:

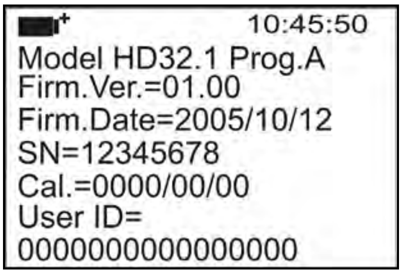


0) Info 5) Firmware
1) Logging 6) Time/date
2) Serial 7) Calibrate
3) Reset 8) Key lock
4) Contr. 9) Password

If you do not press any key within 2 minutes, the instrument goes back to the main display.
Use the arrow keys ▲▼ ◄► and press **ENTER** to select an item.
To exit the selected item and return to the previous menu, press **ESC**.
To exit immediately from the main menu, press **SETUP** again.

5.1 INFO MENU

Once you enter the main menu by pressing **SETUP**, press ▼ and **ENTER** to access the **Info** menu, The following information on the instrument will be displayed: Instrument code and operating program, firmware date and version, serial number, instrument calibration date, user identification code.



- **Model HD32.1 Prog. A: Microclimate Analysis Operating Program**
- **Model HD32.1 Prog. B: Discomfort Analysis Operating Program**
- **Model HD32.1 Prog. C: Physical Quantities Operating Program**

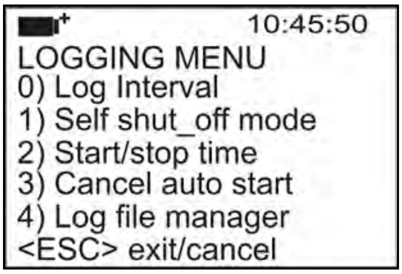
To change the **USER ID**, press ENTER. Using the arrows ◄ ►, select the digit you want to change and modify it with arrows ▲ ▼. Proceed for all other digits and, at the end, confirm with the **ENTER** key. Note: The **USER ID** can also be changed by software.

Press **ESC** to return to the main menu. Press **SETUP** to exit the menu.

5.2 LOGGING MENU

Once you enter the main menu by pressing **SETUP**, to access the **Logging** menu proceed as follows:

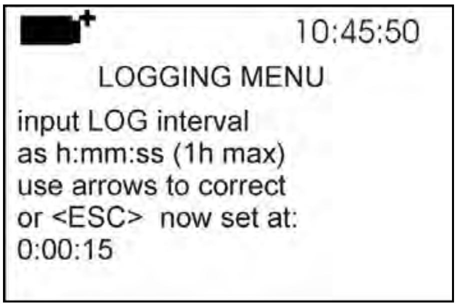
1. Use the arrow keys ▲▼ to select **Logging**;
2. Press **ENTER**:
   The parameter setting submenu for the logging sessions (measured data capture) will be displayed.



You can set the data capture frequency (***Log interval***) and the automatic logging start (***Start/stop time***). **The capture interval is the same for all probes.**

5.2.1 Log Interval

Use this item to set the LOG interval (interval between two subsequent sample captures): To enter this setting, proceed as follows:
Once you have accessed the ***LOGGING*** submenu (previous par.) use the arrow keys ▲ ▼ to select ***Log Interval***:



1. Use the arrow keys ▲ ▼ to select the interval duration from 15 seconds to one hour;
2. Press **ENTER** to confirm and return to the Logging menu;
3. Press **ESC** to return to the **Logging** menu without making any change;
4. Press **ESC** again to return to the main menu;
5. Press **SETUP** to exit immediately from the menu.

These are the available values: 15 seconds - 30 seconds - 1 minute - 2 minutes - 5 minutes - 10 minutes - 15 minutes - 20 minutes - 30 minutes - 1 hour

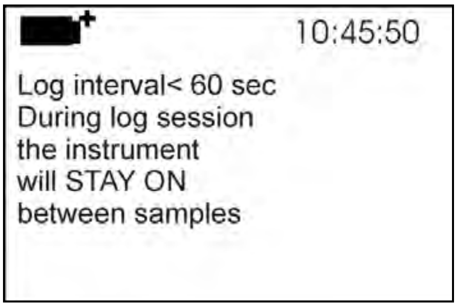
Storage interval	Storage Capacity	Storage interval	Storage Capacity
15 seconds	About 11 days and 17 hours	10 minutes	About 1 year and 104 days
30 seconds	About 23 days and 11 hours	15 minutes	About 1 year and 339 days
1 minute	About 46 days and 22 hours	20 minutes	About 2 years and 208 days
2 minutes	About 93 days and 21 hours	30 minutes	About 3 years and 313 days
5 minutes	About 234 days and 17hours	1 hour	About 7 years and 261 days

5.2.2 *Self Shut-off mode*

The ***Self shut-off mode*** item controls the instrument's automatic turning off during logging, occurring between the capture of a sample and the next one. **When the interval is lower than 60 seconds, the instrument will always remain on**. With intervals greater than or equal to 60 seconds, it is possible to turn off the instrument between loggings: it will turn on at the moment of sampling and will turn off immediately afterwards, thus increasing the battery life.

Once you have accessed the ***LOGGING*** submenu (previous par.) use the arrow keys ▲ ▼ to select ***Self shut_off mode***:

- If the set ***Log Interval*** (see previous par.) is lower than 60 seconds, the following will be displayed



- If the set ***Log Interval*** (see previous par.) is greater or equal to 60 seconds, the following will be displayed

1. By using the arrow keys ▲ ▼ you can select:

   STAY ON (the instrument stays on)
   SHUT OFF (the instrument stays off)

2. Press **ESC** to return to the ***Logging*** menu;
3. Press **ESC** again to return to the main menu;
4. Press **SETUP** to exit immediately from the menu.

5.2.3 Start/stop time – Automatic start

The logging start and end can be programmed by entering the date and time. When called, the function suggests the current time plus 5 minutes as the start time: Press <ENTER> to confirm or set the date and time using the arrow keys. Then you are asked to set the data to end the recording: By default the instrument suggests the start time plus 10 minutes. The default suggested values are such to allow the user to setup an instrument ready for measurement.

NOTE: By default the set time is 5 minutes after the current time.

To enter this setting, proceed as follows.

Once you have accessed the ***LOGGING*** submenu (previous par.) use the arrow keys ▲ ▼ to select ***Start/Stop time***: The following message "Enter start time" will be displayed:

1. Use the arrow keys ◄ ► to select the data to be changed (year/month/day and hour:minutes:seconds);
2. Once selected, the data will start blinking;
3. Use the arrow keys ▼▲ to change its value;
4. Confirm by pressing **ENTER**;
6. Press ***ESC*** to return to the **Logging** menu without making any change;
7. Press **ESC** again to return to the main menu;
8. Press **SETUP** to exit immediately from the menu.

After setting the logging start time, the logging end time (enter stop time) window will be displayed:

1. Use the arrow keys ◄ ► to select the data to be changed (year/month/day and hour:minutes:seconds);
2. Once selected, the data will start blinking;
3. Use the arrow keys ▼▲ to change its value;
4. Confirm by pressing **ENTER**;
5. Press ***ESC*** to return to the **Logging** menu without making any change;
6. Press **ESC** again to return to the main menu;
7. Press **SETUP** to exit immediately from the menu.

<u>NOTE</u>: By default the acquisition end time is 10 minutes after the logging session start time.

8. Once both values have been set, a summary will be displayed: Start and end time of the LOG session.

9. Press **ENTER** to confirm or **ESC** to exit without enabling the automatic start: In both cases, you will return to the ***LOGGING*** menu.

10. Press **SETUP** to exit immediately from the main menu.

When the instrument starts automatically a LOG session, a beep is issued on each capture and the blinking **LOG** message is shown at the top of the display.
Press **MEM** to stop the session before the set time.
To cancel the automatic start setting, use the **Cancel auto start** function as illustrated in the following paragraph.

<u>NOTE:</u> The automatic logging session is started even when the instrument is off. If it is off when the automatic logging session is started, the instrument is turned on few seconds earlier and remains on at the end of logging. If it is powered by the battery, it is turned off when idle for some minutes at the end of the logging session.
See paragraph 4.2.2 to set the automatic shut off.

5.2.4 Cancel auto start

Once the LOG session start and end times are set, you can prevent the session automatic start by using ***Cancel auto start***.
Once you have accessed the ***LOGGING*** submenu:
1. Use the arrow keys ▲ ▼ to select ***Cancel auto start***
2. The LOG session start and end times will be displayed:

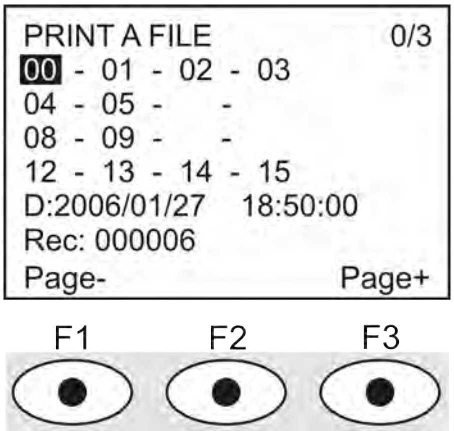
3. By pressing ▲ the following message will be displayed: ”Self timer not active”;

4. Press **ENTER** to cancel the automatic start;
5. Press **ESC** to exit without cancelling the automatic start;
6. Press **ESC** again to exit from the submenus;
7. Or press **SETUP** to exit immediately from the main menu.

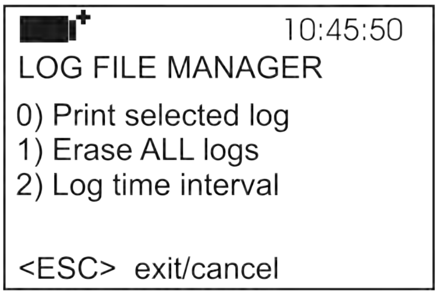
See the previous paragraph to set a new automatic start time after cancelling the previous one.

5.2.5 Log File Manager

This item allows managing the captured logs: the instrument allows printing the files of the captured data (***Print selected log***)and deleting all memory (***Erase ALL logs***) . The instrument can store up to 64 LOG sessions numbered progressively from 00 to 63, in a 4-line and 4-column layout. If there are more than 16 sessions, press F1 (**Page-**) to go back to the previous screen and F3 (**Page+**) to go to the next one. The current page (0,1,2 or 3) and the total pages with stored data are displayed in the upper right corner: in the example below, “0/3” refers to page 0 of 3 with stored data.



Once you have accessed the ***LOGGING*** submenu:
1. Use the arrow keys ▲ ▼ to select **Log File manager**: the following submenu will display

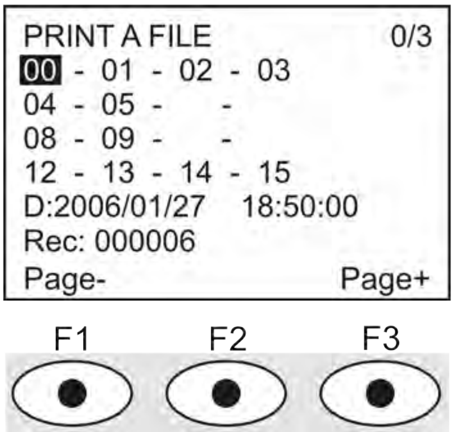


0) Print selected log
1) Erase ALL logs
2) Log time interval

2. Use the arrow keys ▲▼ to select a menu item;
3. Press **ENTER** to confirm;
4. Press **ESC** to go back to menu;
5. Press **SETUP** to exit the main menu directly.

<u>NOTE:</u> you can connect a PC or a serial port printer to the instrument RS232 serial port. If you connect a parallel port printer, you will need a parallel-serial converter between the instrument and the printer (not supplied with the instrument).Before starting the printing via the RS232C port, set the baud rate. To do so, select ***Baud Rate*** in the ***Serial*** menu (see par. 5.3.1 Baud Rate
) and select the maximum value equal to **38400 baud**. If you connect a printer, set its maximum value allowed.
The instrument to Pc or printer communication is possible provided that the instrument baud rate is the same as that of computer or printer.

0) Print selected log:
By selecting this item, the page of the log to be printed will be displayed:

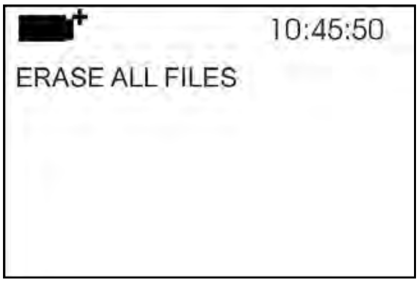


1. Use the arrow keys ▲▼◄►to select the log to be printed ;press F1 and F3 to go to another page;
2. once you select a file, the acquisition start date and time and the number of samples in the file (Rec)are displayed in the lower corner of the display. **Files are stored in ascending order.** Each file is identified by date and time only**, both shown on the display.** In the example above**,** the 00 file is selected: logging began on 27Th January 2006 at 18.50. The file contains 6 samples.
3. Press **ENTER** to print the selected log (or press **ESC** to return to the previous menu, without printing);

<u>NOTE:</u> You can print a file only by using the same operating program that generated the data.

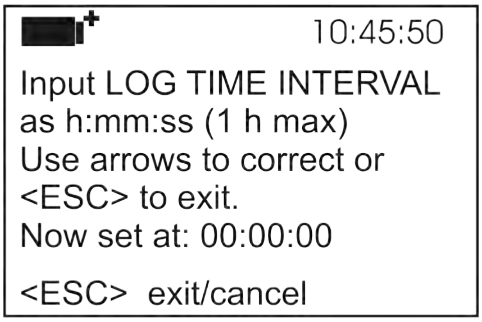
4. The data transfer message will be displayed a few seconds, then the instrument will go back to the **Print selected log** page to select another log to be printed;
5. Repeat the procedure to print the required sessions or press **ESC** to exit this menu;
6. Press **SETUP** to exit immediately from the main menu.

1) Erase all memory
If you select this item, "ERASE ALL FILES" will display:



1. press ENTER to erase all files;
2. press ESC to undo and back to the previous menu;
3. press SET to exit the main menu directly.

2) Log time interval
It refers to logging time: when the set time interval expires, logging stops. Press the MEM key to stop logging before the set time interval expires.
To disable this function, set time at 0. In this case, if you press the MEM key or the memory is full, logging will stop.



Use the arrow keys to change the set time, the allowed maximum value is 1 hour.
Press **ENTER** to confirm.
Press **ESC** to exit this submenu without saving changes.
Press **SETUP** to exit the main menu directly.

5.3 SERIAL MENU (SERIAL COMMUNICATION)

The ***Serial*** submenu allows setting the data transfer speed via serial port (***Baud rate***) and the record printing interval (***Print Interval***).

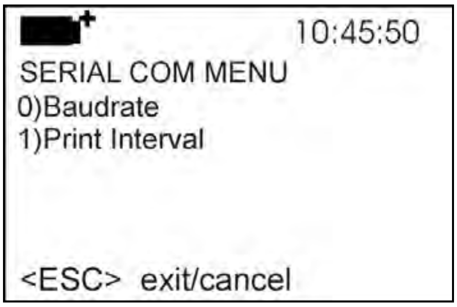
The LOG sessions can be downloaded on a PC, through serial **RS232** or **USB** connection.
In case of serial connection, the transfer speed can be set by the user (see next par.) but it can not be higher than 38400 bps.
In case of USB connection, the transfer speed is fixed at 460800 bps.

After downloading the data on the PC, using the dedicated software, they will be processed by this software for graphic display and the calculation of the comfort/stress indexes.

The instrument can be connected directly to an 80 column serial printer.

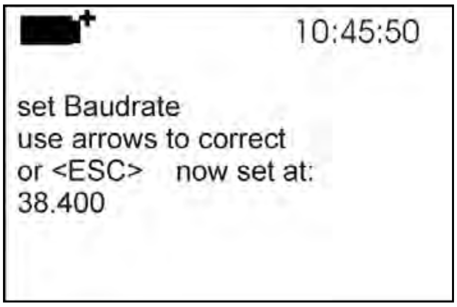
To access the ***Serial*** submenu, proceed as follows:

1. Press **SETUP**;
2. Use the arrow keys ▲▼ to select ***Serial***;
3. Press **ENTER**;
4. You will get the ***Serial*** submenu.



5.3.1 Baud Rate

The ***Baud Rate*** indicates the speed used for the serial communication with the PC.
To set the ***Baud rate***, proceed as follows:
1. Use the arrow keys ▲▼ to select the item;
2. Press **ENTER**: You will get the following message:



3. Use the arrow keys ▼▲ to set the value;
4. Press **ENTER** to confirm and return to the previous page, or press **ESC** to cancel the change and exit the menu item;
5. Press **ESC** over and over to exit from the submenus;
6. Press **SETUP** to exit immediately from the main menu.

WARNING: The communication between instrument and PC (or serial port printer) only works if the instrument and PC baud rates are the same. If the USB connection is used this parameter value is automatically set.

NOTE: When setting the baud-rate, check the printer speed.

5.3.2 The Print Interval

To set the ***Print Interval***, proceed as follows:
1. Use the arrow keys ▲▼ to select the item;
2. Press **ENTER**: You will get the following message:

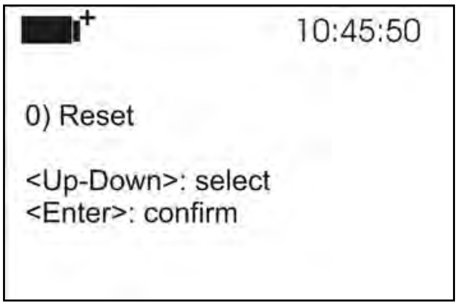
3. Use the arrow keys ▼▲ to set the value;
4. Press **ENTER** to confirm and return to the previous page, or press **ESC** to cancel the change and exit the menu item;
5. Press **ESC** over and over to exit from the submenus;
6. Press **SETUP** to exit immediately from the main menu.

The print interval can be set from 0 seconds to one hour:
0 s - 15 s - 30 s - 1 min. - 2 min. - 5 min. - 10 min. - 15 min. - 20 min. - 30 min. - 1 hour.

5.4 RESET

To enter the ***Reset*** submenu in order to carry out a complete reset of the instrument, proceed as follows:

1. Press **SETUP**
2. Use the arrow keys ▲▼ to select ***Reset***
3. Press **ENTER**: You will get the following message



4. Use the arrow keys ▲▼ to select ***Reset***
5. Press **ENTER** to confirm, or press **ESC** over and over to exit from the submenus
6. Press **SETUP** to exit immediately from the main menu.

5.5 CONTRAST

This menu item allows increasing or decreasing the contrast on the display:
To access the ***Contrast*** submenu, proceed as follows:

1. Press **SETUP**;
2. Use the arrow keys ▲▼ to select ***Contr.***
3. Press **ENTER**:
4. You will get the following message

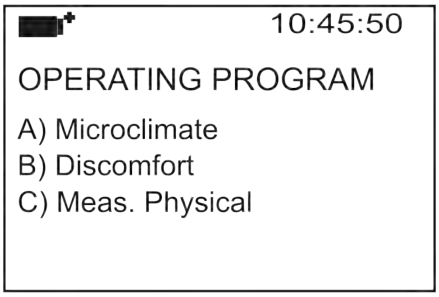
5. Use the arrow keys ◄► to decrease or increase the contrast;
6. Press **ENTER** or **ESC** to return to the main menu;
7. Press **SETUP** to exit immediately from the main menu.

5.6 FIRMWARE

This menu item allows changing the instrument's **operating program**.

To access the ***Firmware*** submenu, proceed as follows:

1. Press **SETUP**;
2. Use the arrow keys ▲▼ to select ***Firmware***;
3. Press **ENTER**;
4. You will get the following display:



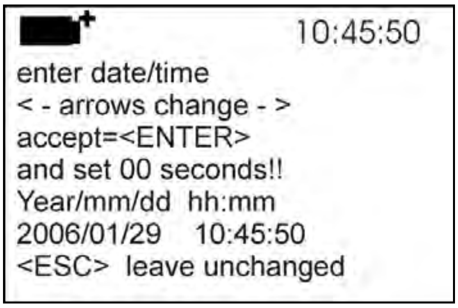
5. Use the arrow keys ▲▼ to select the operating program that you want to install;
6. Press **ENTER** to confirm and wait for the chosen program self-installation;
7. At the end the instrument will reset and get ready for the chosen program.

Note: The operating program must be present in the instrument.

5.7 TIME/DATE

This menu item allows setting the date and time that will be shown at the top of the display.
To access the ***Time/date*** submenu, proceed as follows:

1. Press **SETUP**;
2. Use the arrow keys ▲▼ to select ***Time/date***
3. Press **ENTER**:
4. You will get the following message

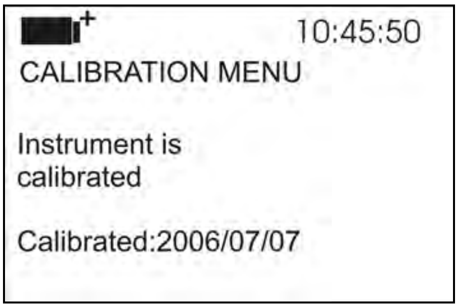


5. Use the arrow keys ◄ ► to select the data to be set (year/month/day and hour:minutes);
6. Once selected, the data will start blinking;
7. Use the arrow keys ▼▲ to enter the correct value;
8. Press **ENTER** to confirm and return to the main menu;
9. Or press **ESC** to return to the menu without making any change;
10. Press **SETUP** to exit immediately from the main menu.

NOTE: In regard to the time, you can set hours and minutes. The seconds are always set to 00 (set 00 seconds!!).

5.8 CALIBRATE

The ***Calibrate*** menu is reserved to Technical Support. It reports the calibrations and the last calibration performed:
To access the ***Calibrate*** submenu, proceed as follows:
1. Press **SETUP**;
2. Use the arrow keys ▲▼ to select ***Calibrate***
3. Press **ENTER**:
4. You will get the following message:



5. Press **ENTER** or **ESC** to go back to the main menu: you cannot change anything: **only Technical Support can calibrate the instrument.**
6. Press **SETUP** to exit the main menu directly.

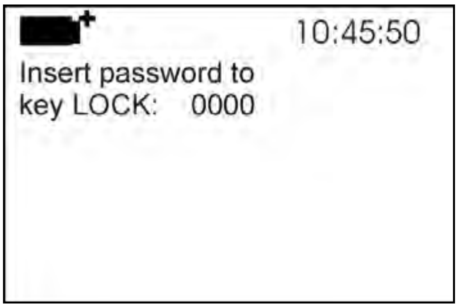
NOTE: You cannot change the calibration date.

5.9 KEY LOCK

This menu item allows LOCKING/UNLOCKING the instrument, when the password has been input: See the next chapter for further details.

To access the ***Key lock*** submenu, proceed as follows:
1. Press **SETUP**;
2. Use the arrow keys ▲▼ to select ***Key lock***
3. Press **ENTER**:

4. You will get the following message: “Enter password”



5. Use the arrow keys ▼▲ to enter the correct password;
6. Press **ENTER** to confirm (or **ESC** to cancel);

By pressing **ENTER** you return to the main menu and the instrument is locked: A “key” is displayed at the top left of the display;

WARNING! When the instrument is locked by a password, all keys are locked, except **MEM**, used to start the LOG session and **SETUP, ENTER** and **ESC** that allow entering the main menu to unlock the instrument.
Therefore the user has to set all required parameters, protect the instrument using the KEY LOCK function and start the LOG session, in order to prevent any undesired access by unauthorized personnel.

To *unlock* the instrument, repeat the steps above: Enter the main menu and unlock the instrument using the ***Key lock*** and entering the password.

If the password is wrong, you will get the message “Wrong password”.

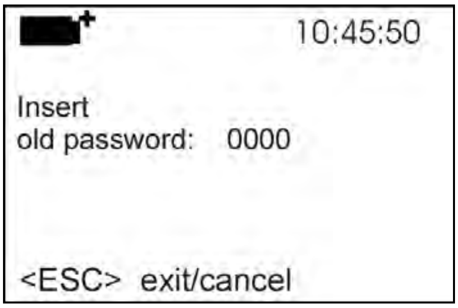
5.10 PASSWORD

This menu item allows setting a password to protect the instrument from unauthorized access. There are two types of passwords available, **both consisting of four characters**:

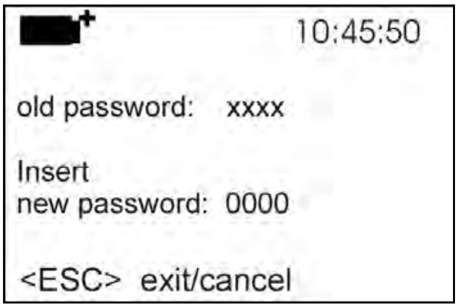
The default password consists of four zeros: 0000.

- The *user password*: can be set by the user to protect the instrument from unauthorized access;
- The *factory password* **is reserved to Technical Support.**

To access the ***Password*** submenu, proceed as follows:
1. Press **SETUP**;
2. Use the arrow keys ▲▼ to select ***Password***
3. Press **ENTER**:
4. The following message will appear:



5. Use the arrow keys ▲▼ to select the current password
6. Press **ENTER** to confirm (or **ESC** to cancel);
7. The following message will appear:

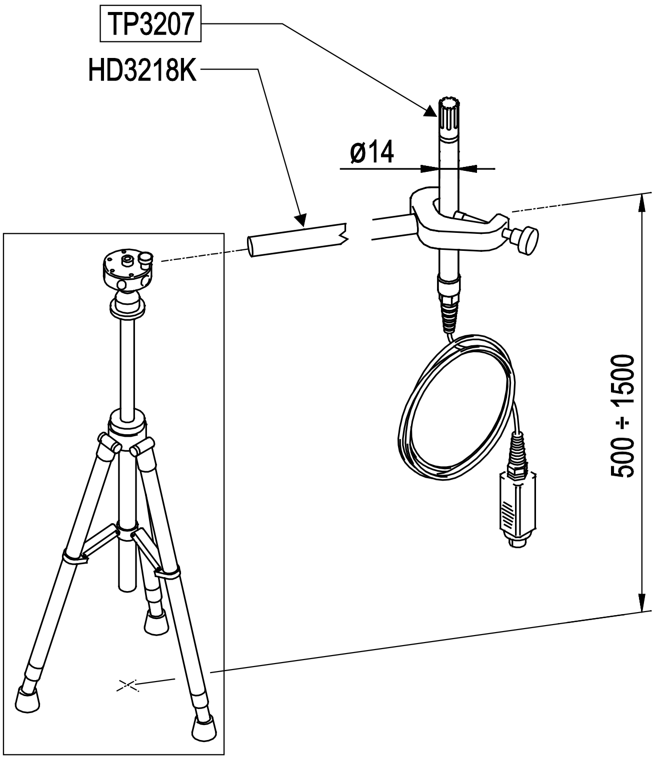


8. Use the arrow keys ▼▲ to enter the new password;
9. Press **ENTER** to confirm (or **ESC** to cancel) and go back to the main menu;
10. Press **SETUP** to exit the main menu directly.

<u>**WARNING!**</u> The ***User password*** allows you to lock/unlock the instrument (see paragraph 5.9 Key lock).

6. PROBES AND MEASUREMENTS

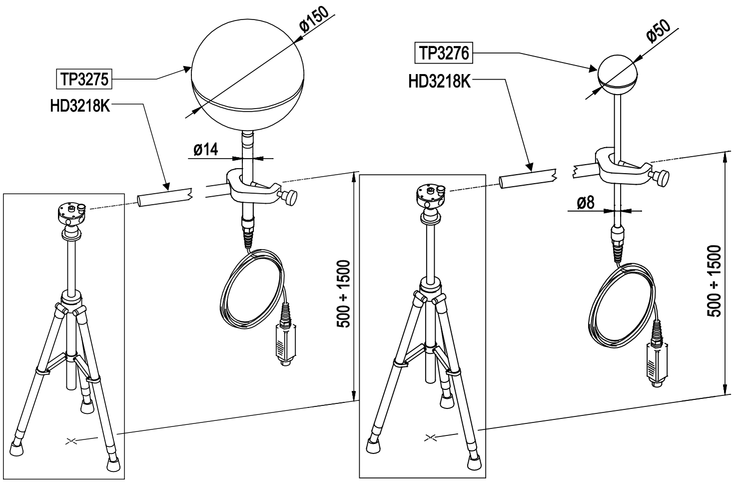
6.1 A AND B OPERATING PROGRAM PROBES :
A: Microclimate Analysis
B: Discomfort Analysis



TP3207

Temperature probe

Sensor type:	Pt100
Measurement range:	-40… +100 °C
Accuracy	1/3 DIN
Connector:	8-pole female DIN45326
Cable length:	2 meters
Dimensions:	Ø=14 mm L=140 mm
Response Time T_{95}	15 minutes

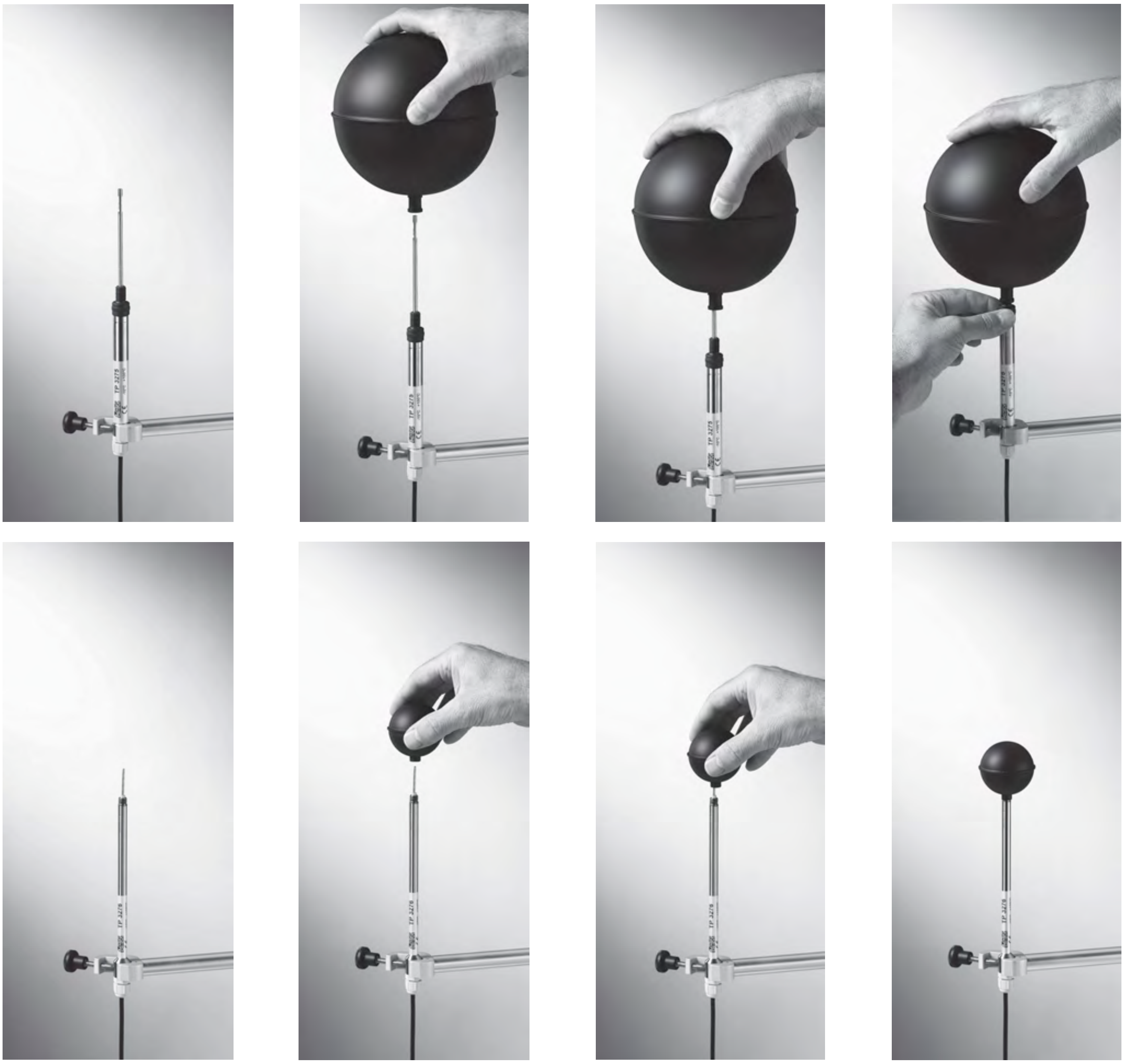


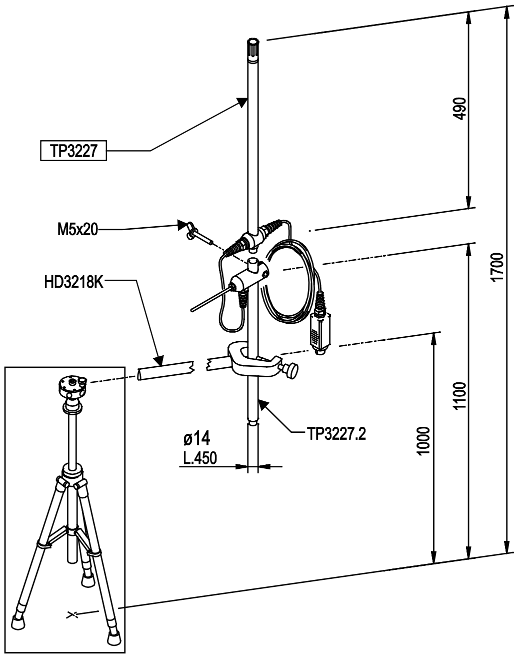
TP3275 and TP3276

TP3275 - Globe thermometer probe Ø=150 mm according to ISO 7243 - ISO 7726

TP3276 - Globe thermometer probe Ø=50 mm

Sensor type:	Pt100
Measurement range:	-30…+120 °C
Accuracy	1/3 DIN
Connector:	8-pole female DIN45326
Cable length:	2 meters
T_{95} Response Time	15 minutes





TP3227K

Probe composed of 2 standalone temperature probes, Pt100 sensor. Used for local discomfort measurement

Due to vertical temperature gradient in order to study standing or seated persons. Adjustable height, complete with extension code **TP3227.2** (L=450 mm, Ø=14)

Sensor type:	Pt100
Measurement range:	-10…+100°C
Accuracy:	1/3 DIN
Connector:	8-pole female DIN45326
Cable length:	2 meters
Upper probe T_{95}	15 minutes
Lower probe T_{95}	4 minutes

The **TP3227K** probe can be used for simultaneous measurement of temperature at 1.10 m and 0.10 m.

In order to perform simultaneous measurements at different heights:

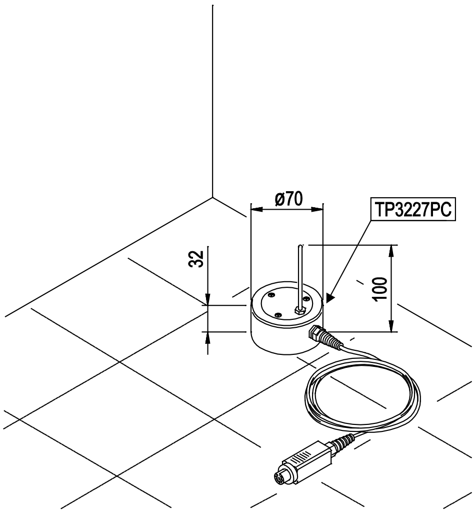
- In case of a standing person: 1.70 m, 1.10 m and 0.10 m from the floor
- In case of a seated person: 1.10 m, 0.60 m and 0.10 m from the floor

You can use the following probes:

TP3227K Dual probe capable of measuring:

- Temperature at 1.70 m and 1.10 m from the floor in case of standing person;
- Temperature at 1.10 m and 0.60 m from the floor in case of seated person;

TP3227PC Dual probe for temperature measurement at floor level and at ankle height (0.10 m).



TP3227PC

Probe composed of 2 standalone temperature probes. Used for local discomfort measurement due to vertical temperature gradient. Suitable for temperature measurement at floor level and at ankle height (0.10 m). The TP3227PC has priority on the TP3227.1, if both are connected.

Sensor type:	Pt100
Measurement range:	-10°C … +100°C
Accuracy:	1/3 DIN
Connector:	8-pole female DIN45326
Cable length:	2 meters
Ankles T_{95}	4 minutes
Floor T_{95}	20 minutes

TP3227K probe composed of 2 standalone temperature probes, Pt100 sensor and TP3227PC probe composed of 2 standalone temperature probes, Pt100 sensor:

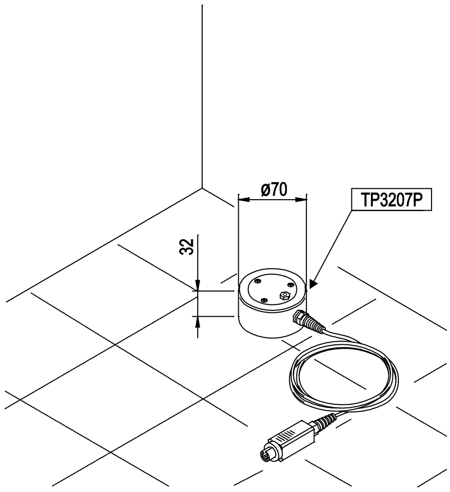
- **Adjustment of the sensors at 1.7 m, 1.10 m and 0.10 m:**

  Screw the telescopic rod code **TP3227.2 L = 450 mm** to the probe **TP3227.** Once the rod has been fastened on the clamp, adjust the height to 1.7 m for the fixed sensor. The sliding probe should be placed at 1.1 m from the floor. You should use the combined ankle/floor probe **TP3227PC** to perform the measurements at 0.1 m from the floor.

TP3227K probe composed of 2 standalone temperature probes, Pt100 sensor and TP3227PC probe composed of 2 standalone temperature probes, Pt100 sensor:

- **Adjustment of the sensors at 1.1 m, 0.6 m and 0.1 m:**

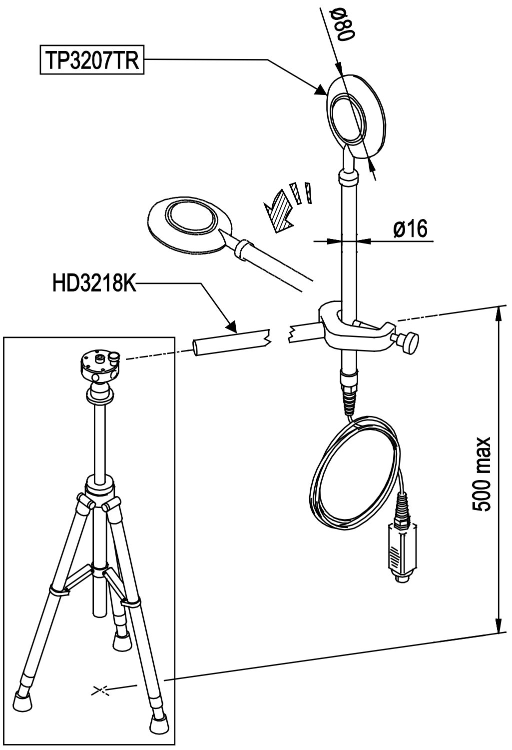
Screw the telescopic rod code **TP3227.2 L = 450 mm** to the probe **TP3227.** Once the rod has been fastened on the clamp, adjust the height to 1.1 m for the fixed sensor. The sliding probe should be placed at 0.6 m from the floor. You should use the combined ankle/floor probe **TP3227PC** to perform the measurements at 0.1 m from the floor.



TP3207P

Temperature measurement probe at floor level, used for local discomfort measurement due to vertical temperature gradient.

Sensor type:	Pt100
Measurement range:	-10…+100 °C
Accuracy:	1/3 DIN
Connector:	8-pole female DIN45326
Cable length:	2 meters
Response Time T_{95}	20 minutes

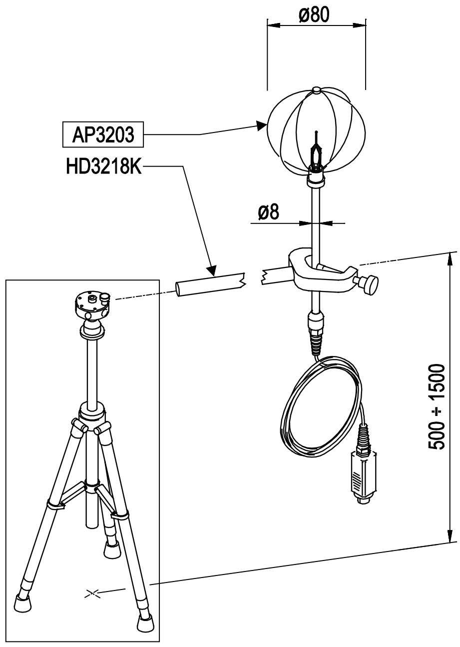


TP3207TR

Combined probe for radiant temperature measurement. Used to assess the unsatisfied with the radiant asymmetry percentage.

Sensor type:	Pyranometer / NTC
Measurement range:	0…+60 °C
Accuracy	NTC ± 0.15
	Typical spectral sensitivity 10µV/(W/m^2)
Connector:	8-pole female DIN45326
Cable length:	2 meters
Net radiometer T_{95}	90 seconds
NTC T_{95}	20 minutes

The face of the probe marked by the symbol is the air flow hot side. It should be oriented toward the hot source (wall/wall ceiling/floor or floor/ceiling).

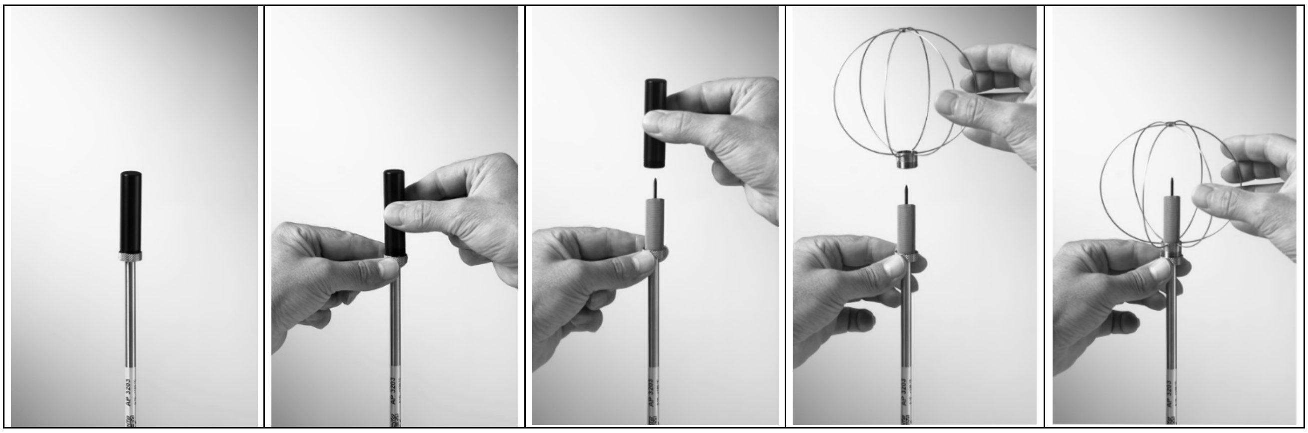


AP3203 / AP3203F

Omni directional hot-wire probe.

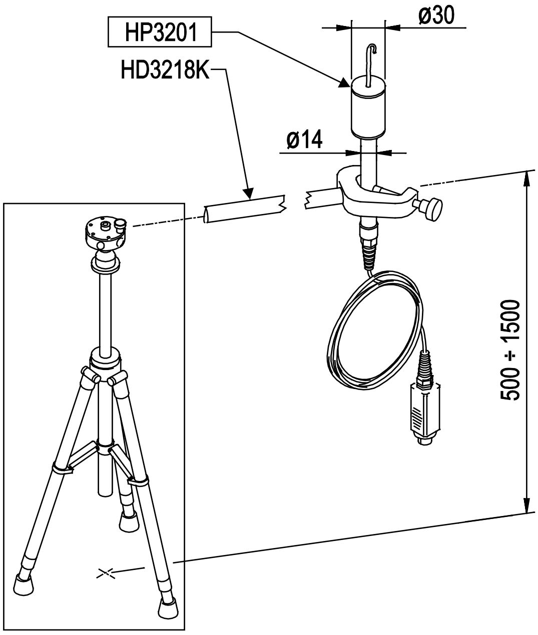
Sensor type:	NTC 10Kohm
Measurement range:	0.02…5 m/s **0…+80°C (AP3203) / -30…+30°C (AP3203F)**
Accuracy:	± (0,05 + 5% measure) m/s
Connector:	8-pole female DIN45326
Stem dimensions	Ø=8 mm, L=230 mm
Cable length:	2 meters

Unscrew the sensor protection cylinder and screw the spherical metal grid.



- The sensor of the probes is heated. **In case of vapours or gases, a fire or an explosion could be triggered. Do not use the probe in the presence of flammable gases. Make sure that in the environment where the measurement are made there are no gas leaks or potentially explosive vapours.**

- **The probe is fragile and must be handled with extreme care**. A simple shock can make the probe unusable.
- After finishing the measurement, the sensor placed on the probe head must be protected with the provided threaded protection cylinder.
- During the use, the probe must be protected with the proper spherical metal grid.
- Do not touch the sensor.
- For cleaning the probe use only distilled water.

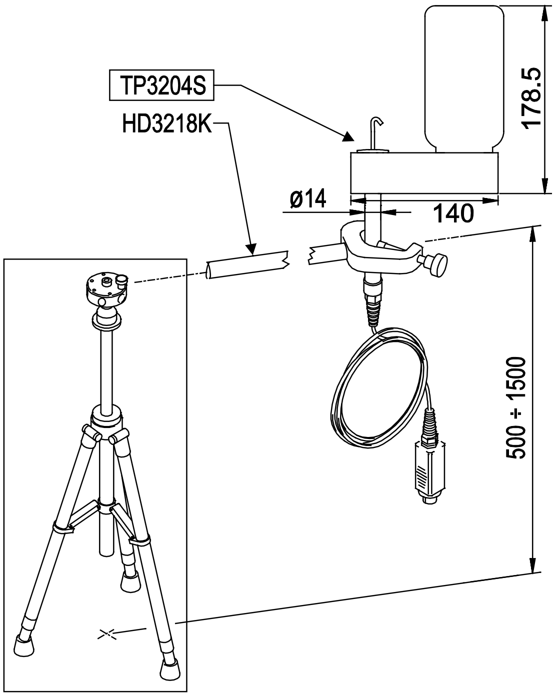


HP3201

Natural ventilation wet bulb probe for WBGT index measurement

Sensor type:	Pt100
Measurement range:	+4…+80°C
Accuracy:	Class A
Connector:	8-pole female DIN45326
Cable length:	2 meters
Cotton wick length:	10 cm
Tank capacity:	15 cc
Tank autonomy:	96 hours with RH=50%, t=23°C
Response time T_{95}	15 minutes

- Remove the sensor cap (the cap is not screwed).
- Insert the cotton wick, previously dipped with distilled water, into the temperature probe. The cotton wick must protrude from the probe for about 20 mm.
- Fill the reservoir up till ¾ with **distilled water**.
- Replace the cap.
- **Warning**: keep the probe vertical to prevent water from leaking.

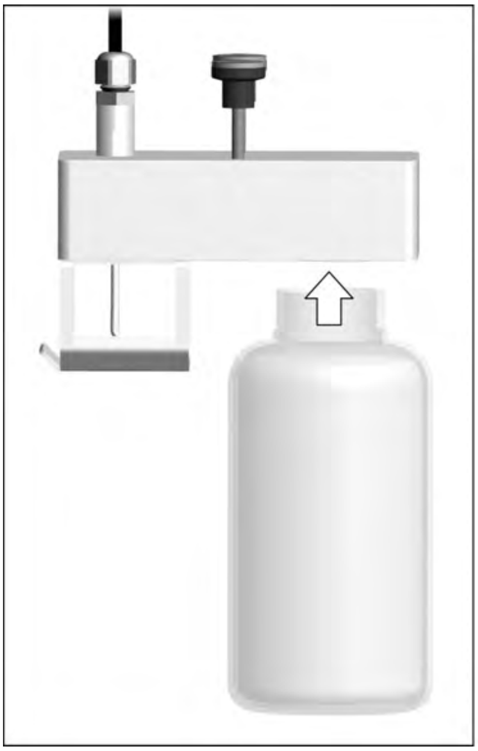


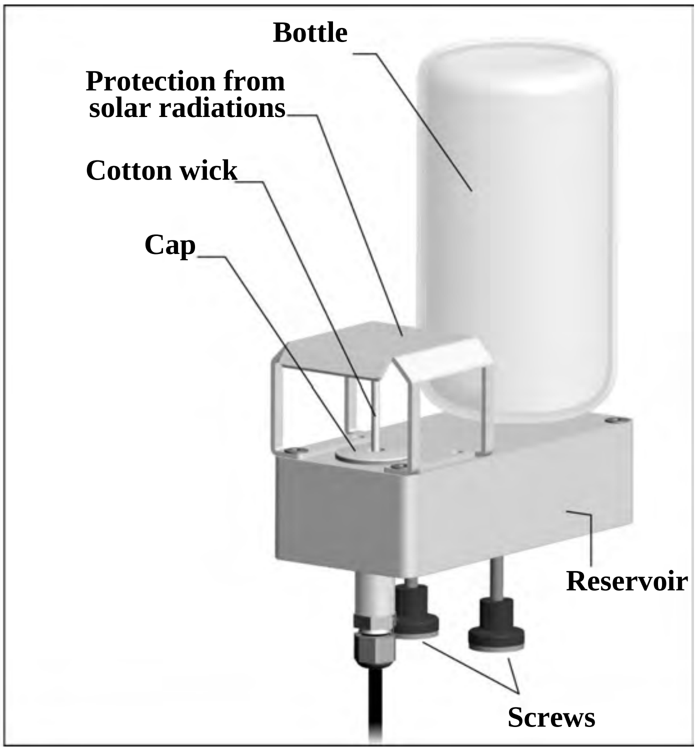
TP3204S
Natural ventilation wet bulb probe for WBGT index measurement

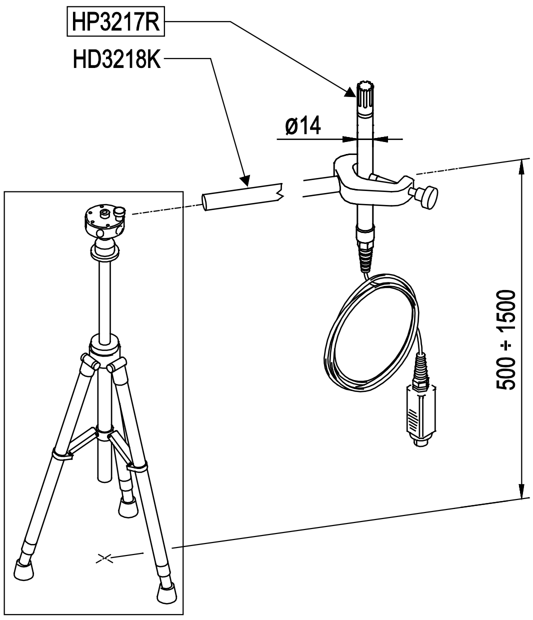
Sensor type:	Pt100
Measurement range:	4…+80°C
Accuracy:	Class A
Connector:	8-pole female DIN45326
Cable length:	2 meters
Cotton wick length:	10 cm approx.
Tank capacity:	500 cc
Tank autonomy:	15 days @ t = 40 °C
Response time T_{95}	15 minutes

For the start up go on as indicated below:

- Remove the sensor cap (the cap is not screwed).
- Insert the cotton wick, previously dipped with distilled water, into the temperature probe. The cotton wick must protrude from the probe for about 20 mm.
- Replace the cap.
- Fill the bottle with 500 cc of **distilled water**.
- Turn the probe over and firmly screw the bottle to the probe reservoir.
- Turn the probe quickly (to avoid water spillage).
- Secure the probe to the **HD32.2.7.1** support by using the two screws at the bottom of the probe.





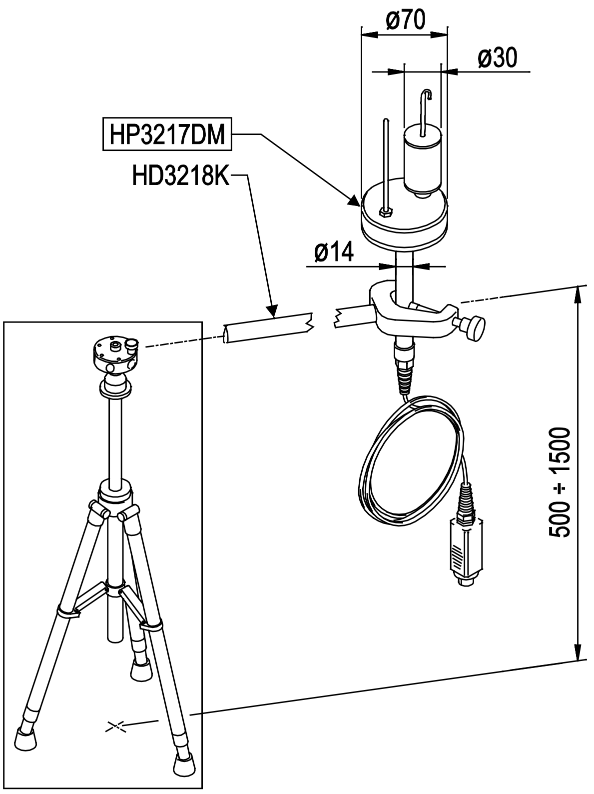


HP3217R

Relative humidity and temperature combined probe. Used for environment comfort indexes measurement

Sensors type:	Temperature: Pt100 R.H.: capacitive
Measurement range:	Temperature: -40°C … +100°C Relative humidity: 0…100%RH
Accuracy:	Temperature: 1/3 DIN Relative humidity: ±1,5% (0…90%UR) ±2% (90…100%UR) @ T=15…35 °C (1,5 + 1,5% measurement)% @ T= remaining range
Connector:	8-pole female DIN45326
Cable length:	2 meters
%RH T_{95}	1 minute
Temperature T_{95}	15 minutes

- Do not let fingers touch the sensors. Avoid staining them with oil, grease, resins.
- The sensor base is in alumina so it could easily break.
- The sensors can be cleaned from dust and smog using distilled water and a very soft brush (e.g. badger);
- If the measurements are not consistent, check that the sensors are not dirty, corroded, splintered or broken.
- In order to check the RH measurement consistency you can use the standard saturated salt solutions: HD75 (75% RH) and HD33 (33% RH).



HP3217DM

Two-sensor probe for natural ventilation wet bulb temperature and dry bulb temperature measurement. Used for environment comfort indexes measurement.

Sensor type:	Pt100
Measurement range:	
Natural wet	4…+80 °C
Dry temperature	-30…+100 °C
Accuracy:	Class A
Connector:	8-pole female DIN45326
Cable length:	2 meters
Tank capacity:	15 cc
Tank autonomy:	96 hours with RH=50%, t=23 °C
Dry bulb T_{95}	4 minutes
Wet bulb T_{95}	30 minutes

The TP3217DM has priority on the HD3201 and TP3207, if connected.

- Remove the sensor cap (the cap is not screwed).
- Insert the cotton wick, previously dipped with distilled water, into the temperature probe. The cotton wick must protrude from the probe for about 20 mm.
- Fill the reservoir up till ¾ with **distilled water**.
- Replace the cap.
- **Warning**: keep the probe vertical to prevent water from leaking.

HD320B2

CO_2 Carbon Dioxide probe

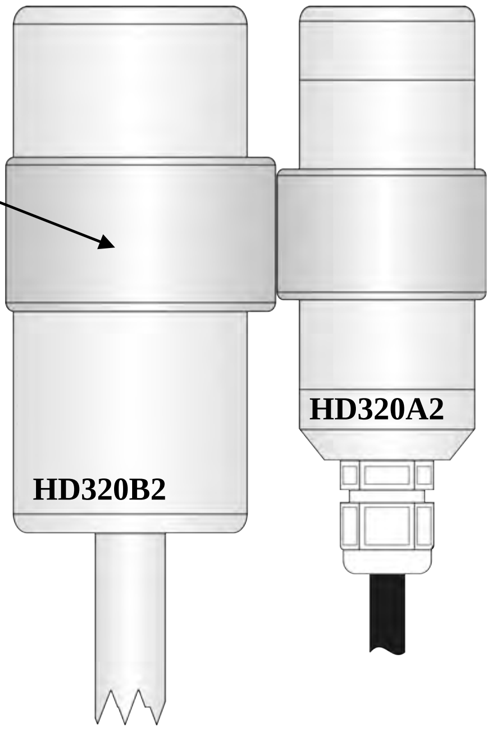
CO_2 measurement principle:	Infrared technology (NDIR) with double source
Measurement range:	0…5000 ppm
Accuracy:	±(50 ppm+3% of the measurement) at 20 °C, 50 %RH and 1013 hPa
Resolution:	1 ppm
Connector:	8 female poles DIN45326
Cable length:	2 metres
Response Time T_{63}:	2 minutes
Temperature Effect:	0.2%/°C CO_2 (Typical value)
Atmospheric pressure effect:	Compensated with the atmospheric pressure, inside the instrument
Long-term stability:	5% of the range/5 years (Typical value)
Calibration:	At one point on 0 ppm or 400 ppm
Work Relative Temperature/Humidity :	-5…+50 °C, 0...95% RH no condensing

HD320A2

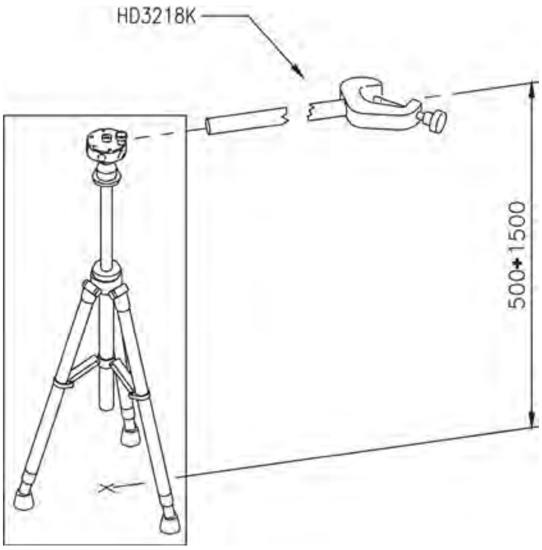
CO Carbon Monoxide probe

CO measurement principle:	Electro chemical cell with two electrodes
Measurement range:	0…500 ppm
Accuracy:	±(3 ppm+3% of the measurement) at 20 °C, 50% RH and 1013 hPa
Resolution:	0.1 ppm
Connector:	8 female poles DIN45326
Cable length:	2 metres
Response Time T_{63}:	1 minute
Expected life of the probe:	Usually, 5 years in normal environment conditions
Long-term stability:	5% of the measurement/year (Typical value)
Calibration:	At one point on 0 ppm
Work Relative Temperature/Humidity:	-5…+50 °C, 0...95 %RH no condensing

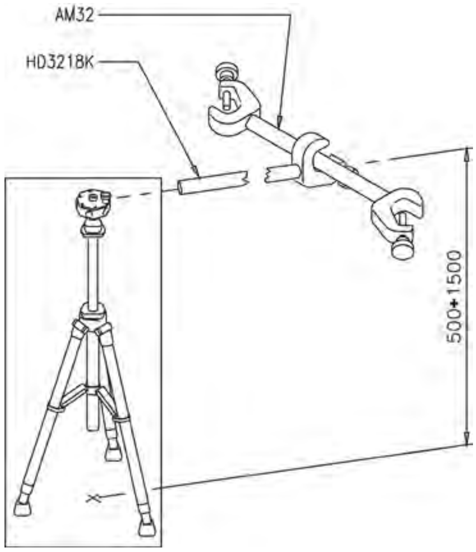
The CO HD320A2 probe fixes on the HD320B2 probe through the suitable magnetic support code "**HD320A2S**".



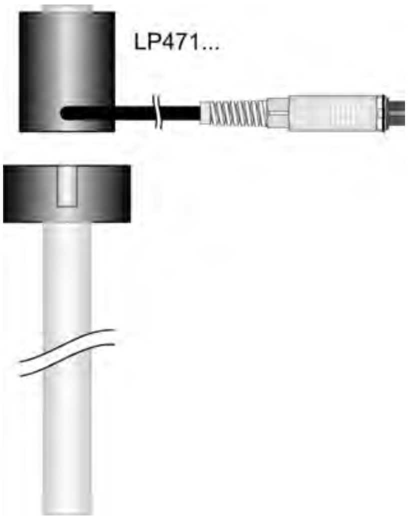
Please note: The response time T_{95} is the time needed to reach 95% of the final value. The measurement of the response time is done with a negligible air speed (motionless air).



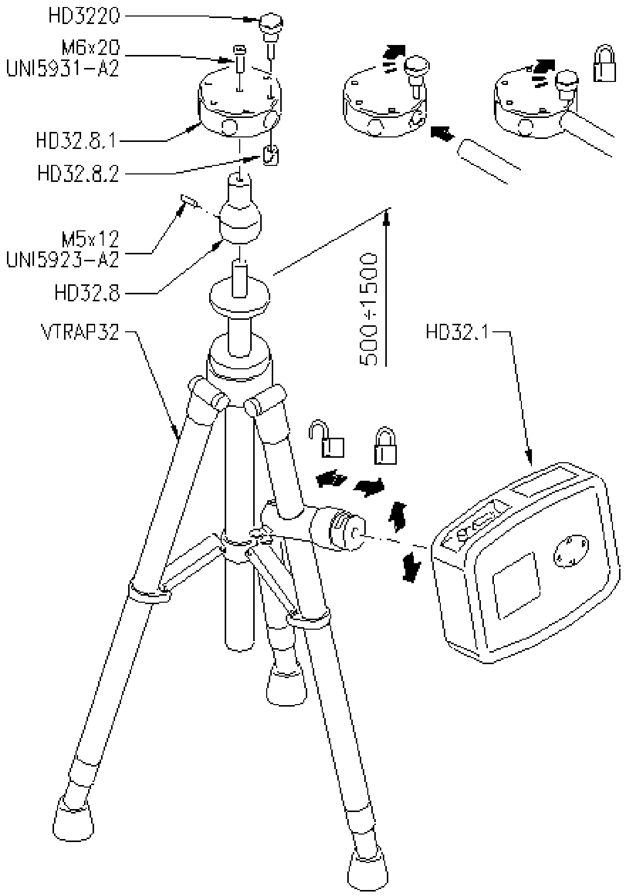
HD3218K
Rod complete with clamp and fastening screw to support the probes.



AM32
Rod complete with 2 clamps and fastening screws to support the probes.



LP32F/R
Support bracket for photometric-radiometric probes for Light measurement LP471...



VTRAP32

A tripod code VTRAP32 is available for the measurements. Adjustable height up to 1.5 meters, complete with head that can host up to 6 measurement probes. The same tripod can be used to support the measurement instrument during data capture.

The arms fitted with suitable clamps for the measurement probes can be inserted in the head, code **HD3218K**.

Performing the measurement

The tripod and required probes are assembled where you wish to perform the measurement. Then you need to setup the instrument and start the measurement. If you have to carry out the measurement s in another location, you need to move everything in that new location.

At the end of the measurement session, or later, the data are transferred to a PC for processing and reports.

6.1.1 Warnings, care and maintenance of the probes

- Do not expose the probes to gases or liquids that could corrode the material of the probe. Clean the probes carefully after each measurement.
- Do not bend the probe connectors or force them upward or downward.
- Comply with the correct polarity of the probes.
- Do not bend or force the contacts when inserting the probe connector into the instrument.
- Do not bend, deform or drop the probes, as this could cause irreparable damage.
- Always select the most suitable probe for your application.
- To obtain reliable measurements, temperature variations that are too rapid must be avoided.
  - Some probes are not insulated from their external casing; be very careful not to come into contact with live parts (above 48V). This could be extremely dangerous for the instrument as well as for the operator, who could be electrocuted.
- Avoid taking measurements in presence of high frequency sources, microwave ovens or large magnetic fields; results may not be very reliable.
- The instrument is water resistant, but should not be immersed in water. Should the instrument fall into the water, check for any water infiltration.

6.2 PROBES FOR THE OPERATING PROGRAM C: PHYSICAL QUANTITIES

6.2.1 Temperature measurement using the probe Pt100 complete with SICRAM module

The instrument works with temperature probes fitted with the SICRAM module (with a Platinum Pt100 sensor with 100Ω resistance at 0 °C). The excitation current was chosen in order to minimize the sensor self-heating effects. The SICRAM module acts as an interface between the sensor on the probe and the instrument. There is a microprocessor circuit with a permanent memory inside the module that enables the instrument to recognize the type of probe connected and to read its calibration information.

Upon turning on the instrument automatically detects the probes fitted with SICRAM module:

The probes are detected during turn on, and this cannot be performed when the instrument is already on, therefore if a probe is connected and the instrument is on, it is necessary to turn it off and on.

In all versions the temperature sensor is housed in the end part of the probe.

The response time for the measurement of the temperature in air is greatly reduced if the air is moving. If the air is still, stir the probe back and forth. The response times are longer than those for liquid measurements.

The temperature measurement by **immersion** is carried out by inserting the probe in the liquid for at least 60 mm; the sensor is housed in the end part of the probe.

In the temperature measurement by **penetration** the probe tip must be inserted to a depth of at least 60 mm, the sensor is housed in the end part of the probe. when measuring the temperature on frozen blocks it is convenient to use a mechanical tool to bore a cavity in which to insert the tip probe.

In order to perform a correct **contact** measurement, the measurement surface must be even and smooth, and the probe must be perpendicular to the measurement plane. A contact measurement is hard to perform due to various factors: The operator must be experienced in handling the probe and consider all the factors influencing it.
So as to obtain the correct measurement, the insertion of a drop of oil or heat-conductive paste is useful (do not use water or solvents). This method improves the response time, in addition to accuracy.
The °C or °F unit of measurement can be chosen for display, printing, and logging.

The sensor is calibrated in the factory, and the Callendar Van Dusen parameters are recorded in the SICRAM module.

6.2.2 Technical information on temperature probes Pt100 using SICRAM module

Model	Type	Application range	Accuracy
TP472I	Immersion	-196°C…+500°C	±0.1 °C (t = 0 °C) ±0.2 °C (-50 °C ≤ t ≤ 250°C) ±0.3 °C (t < -50 °C; t > 250 °C)
TP472I.O	Immersion	-50°C…+300°C	
TP473P.I	Penetration	-50°C…+400°C	
TP473P.O	Penetration	-50°C…+300°C	
TP474C.O	Contact	-50°C…+300°C	
TP475A.O	Air	-50°C…+250°C	
TP472I.5	Penetration	-50°C…+400°C	
TP472I.10	Penetration	-50°C…+400°C	

Common characteristics

Resolution	**0.01°C in the range ±199.99°C,** **0.1°C in the remaining range**
Temperature drift @20°C	0.003%/°C

6.2.3 Measurement of relative humidity using the combined humidity/temperature probe

The instrument works by using combined humidity/temperature probes (temperature with Pt100 sensor). The combined humidity/temperature probes are fitted with SICRAM module that acts as an interface between the sensor on the probe and the instrument. There is a microprocessor circuit with a permanent memory inside the module that enables the instrument to recognize the type of probe connected and to read its calibration information.

The probes are detected during turn on, and this cannot be performed when the instrument is already on, therefore if a probe is connected and the instrument is on, it is necessary to turn it off and on.

Measurement of relative humidity
The humidity probes are humidity/temperature combined probes: The humidity sensor is a capacitive type sensor, the temperature sensor is a Pt100 (100Ω at 0°C).
The instrument measures relative humidity %RH and temperature, and starting from the fixed barometric pressure value of 1013.25mbar it calculates the following resulting quantities:

- g/kg Grams of vapor in a kilogram of dry air
- g/m^3 Grams of vapor in a cubic meter of dry air
- hPa Partial vapor pressure (hPa)
- J/g Enthalpy
- Td Dew point (°C or °F)
- Tw Wet bulb temperature (°C or °F)

A measurement is performed by placing the probe in the area of whose parameters you wish to measure. Keep the probe far from elements that might interfere with measurement such as: heat or sources of cooling, walls, air-streams, etc. Avoid temperature drops that might cause condensation. A reading taken when no heat drop occurs is practically immediate. In contrast, in conditions involving heat drops, it is necessary to wait until the sensors and their housing have reached a thermal equilibrium in order to prevent heat irradiation or absorption on the relative humidity

sensor, which would cause a faulty measurement. Since temperature affects relative humidity; move the probe like a fan in order to speed the response time in the presence of heat drops.
The calibration of the humidity/temperature sensor by the user is not required.
The humidity sensor is calibrated in our laboratory at 23 °C at the points of 75 %RH, 33 %RH and 11.4 %RH. On request, the probes can be checked at different isotherms.
The temperature sensor is calibrated in the factory and the Callendar Van Dusen parameters are recorded in the SICRAM module.

6.2.4 Technical information on relative humidity and temperature probes using SICRAM module

Model	Temperature sensor	Application range		Accuracy	
		%RH	Temperature	%RH	Temp.
HP472ACR	Pt100	0…100%RH	-20…+80 °C	±1.5% (0…85%RH) ±2.5% (85…100%RH) @ T=15…35 °C (2 + 1.5% measure)% @ T= remaining range	±0.3 °C
HP473ACR	Pt100	0…100%RH	-20…+80 °C		±0.3 °C
HP474ACR	Pt100	0…100%RH	-40…+150 °C		±0.3 °C
HP475ACR	Pt100	0…100%RH	-40…+150 °C		±0.3 °C
HP475AC1R	Pt100	0…100%RH	-40…+180 °C		±0.3 °C
HP477DCR	Pt100	0…100%RH	-40…+100 °C		±0.3 °C
HP478ACR	Pt100	0…100%RH	-40…+150 °C		±0.3 °C

Common characteristics

Relative humidity

Sensor	Capacitive
Resolution	0.1 %RH
Temperature drift @20°C	0.02 %RH/°C
Response time %RH at constant temperature	10 sec (10→80 %RH; air speed = 2 m/s)

Temperature

Resolution	0.1 °C
Temperature drift @20°C	0.003 %/°C

Important notes:

1) Do not let hands touch the RH sensor.
2) The sensor base is in alumina so it could easily break
3) Storage of the saturated solutions: The saturated solutions must be stored in a dark environment at a constant temperature of about 20 °C with the container well closed inside a dry room.

Relative humidity of saturated salts at different temperatures

Temp. °C	Lithium Chloride	Magnesium Chloride	Sodium Chloride
0	11.23 ± 0.54	33.66 ± 0.33	75.51 ± 0.34
5	11.26 ± 0.47	33.60 ± 0.28	75.65 ± 0.27
10	11.29 ± 0.41	33.47 ± 0.24	75.67 ± 0.22
15	11.30 ± 0.35	33.30 ± 0.21	75.61 ± 0.18
20	11.31 ± 0.31	33.07 ± 0.18	75.47 ± 0.14
25	11.30 ± 0.27	32.78 ± 0.16	75.29 ± 0.12
30	11.28 ± 0.24	32.44 ± 0.14	75.09 ± 0.11
35	11.25 ± 0.22	32.05 ± 0.13	74.87 ± 0.12
40	11.21 ± 0.21	31.60 ± 0.13	74.68 ± 0.13
45	11.16 ± 0.21	31.10 ± 0.13	74.52 ± 0.16
50	11.10 ± 0.22	30.54 ± 0.14	74.43 ± 0.19
55	11.03 ± 0.23	29.93 ± 0.16	74.41 ± 0.24
60	10.95 ± 0.26	29.26 ± 0.18	74.50 ± 0.30
65	10.86 ± 0.29	28.54 ± 0.21	74.71 ± 0.37
70	10.75 ± 0.33	27.77 ± 0.25	75.06 ± 0.45
75	10.64 ± 0.38	26.94 ± 0.29	75.58 ± 0.55
80	10.51 ± 0.44	26.05 ± 0.34	76.29 ± 0.65
85	10.38 ± 0.51	25.11 ± 0.39	
90	10.23 ± 0.59	24.12 ± 0.46	
95	10.07 ± 0.67	23.07 ± 0.52	
100	9.90 ± 0.77	21.97 ± 0.60	

6.2.5 *Wind speed measurement*

The instrument works with hot-wire and vane probes fitted with the SICRAM module.

The SICRAM module acts as an interface between the sensor on the probe and the instrument. There is a microprocessor circuit with a permanent memory inside the module that enables the instrument to recognize the type of probe connected and to read its calibration information.

Note: The vane probes can be exclusively connected to input 8.

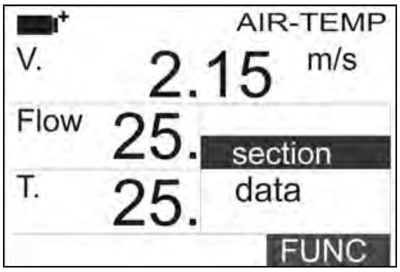
The probe is detected during turn on, and this cannot be performed when the instrument is already on, therefore if a probe is connected and the instrument is on, it is necessary to turn it off and on.

The AP471 and AP472 series probes measure the incident wind speed and flow rate; some also measure air temperature. The hot-wire measurement principle is used for the AP471 series and the vane principle for the AP472 series. On request, the probes of the AP471 series can be fitted with a telescopic rod that eases measurements in areas difficult to reach (for example vents).
The typical applications are wind speed and flow rate checks in air conditioning, heating and cooling systems, or environmental comfort determination, etc.
In addition, the measured fluid temperature must be considered: the probes measure air flows at 80 °C maximum temperature.

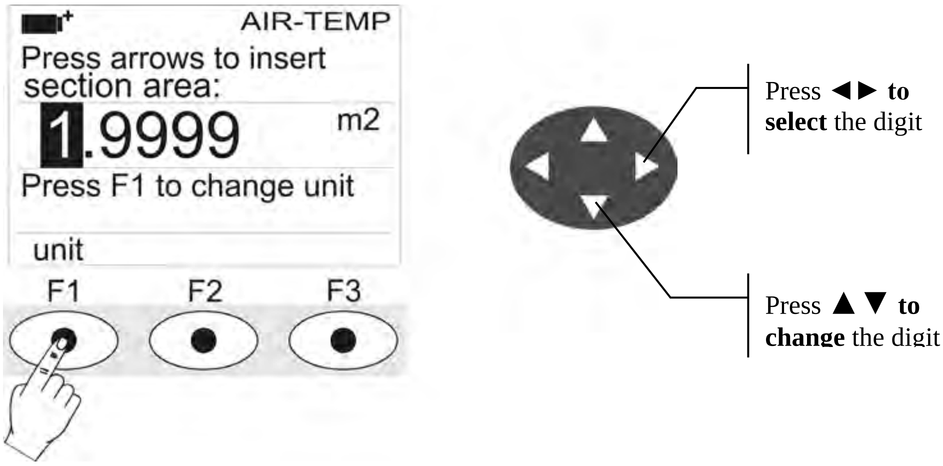
The measurements provided by the instrument using the probes are: wind speed, flow rate, and air temperature.
The following units of measurement are available:

- for wind speed: m/s - km/h - ft/min - mph (miles/hour) - knots;
- for air temperature: °C and °F;
- for flow rate: l/s (liters/s) - m^3/s - m^3/min - m^3/h - ft^3/s - ft^3/min

The flow rate measurement requires knowledge of the duct or vent area orthogonal to the flow: the menu item "**SECT**" define the section area **m²** or **inch²**. In order to set this section, you have to open the Shortcut menu by pressing **SHIFT FNC.** The Shortcut menu will appear:



Use the ▲▼ navigation keys to select **section** and press **Enter.** The following screen will appear:



Use the ◄► navigation keys to highlight the digits in the section. Use the ▲▼ navigation keys to modify the highlighted digit.

The area comprised must be between 0.0001 m^2 (1 cm^2) and 1.9999 m^2.

Pressing **F1** toggles the display between **m2** and **inch2**;

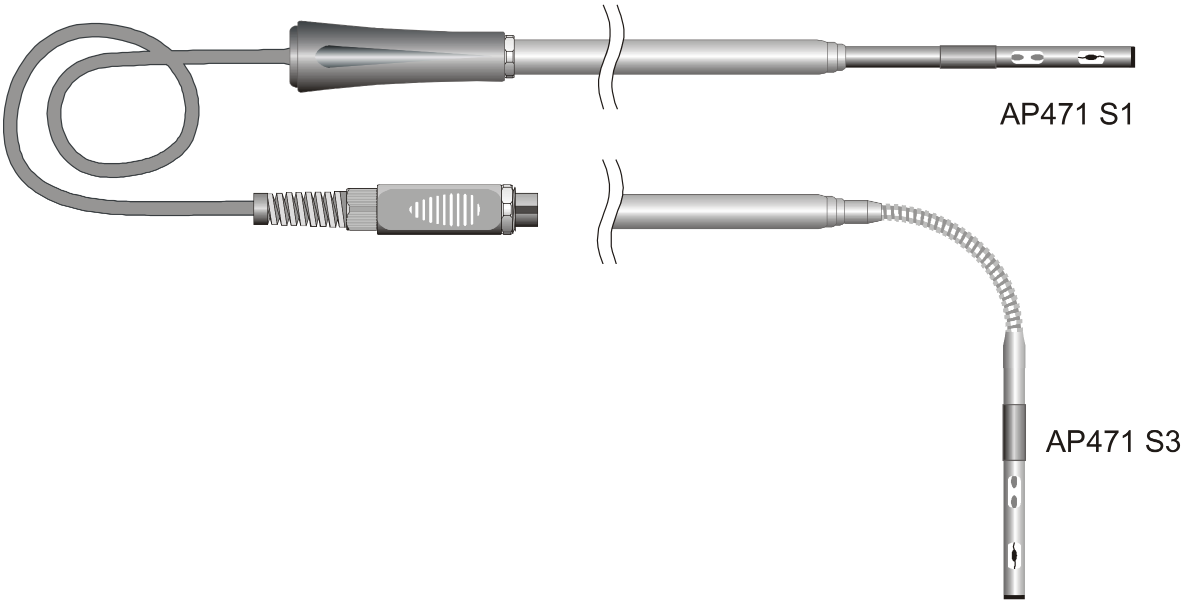
Press **Enter** to confirm the information and exit from the section setting.

6.2.6 AP471S… Hot-wire wind speed measurement probes complete with SICRAM module

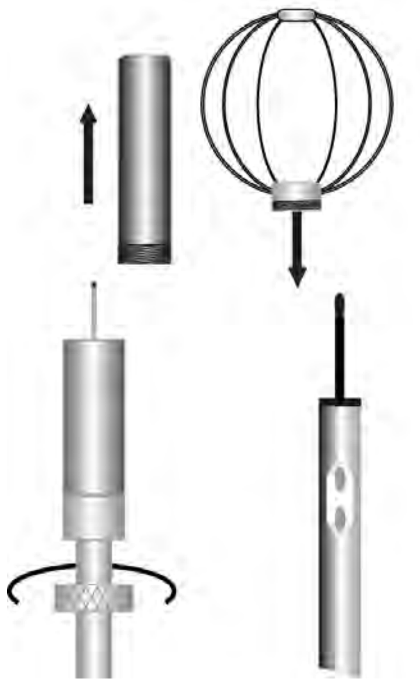
The AP471S1 and AP471S3 probes measure incident air flows up to 40 m/s. The AP471S2 and AP471S4 probes are fitted with an omni directional sensor allowing measurement of speeds up to 5 m/s in any direction of the air flow incident on the probe. The AP471S4 probe is fitted with support base and sensor protection. The wind speed measurement is temperature compensated within the range 0…+80 °C.

The AP471S1, AP471S2 and AP471S3 probes measure the environment temperature in the range -25…+80 °C; the AP471S4 probe in the range 0…+80 °C.

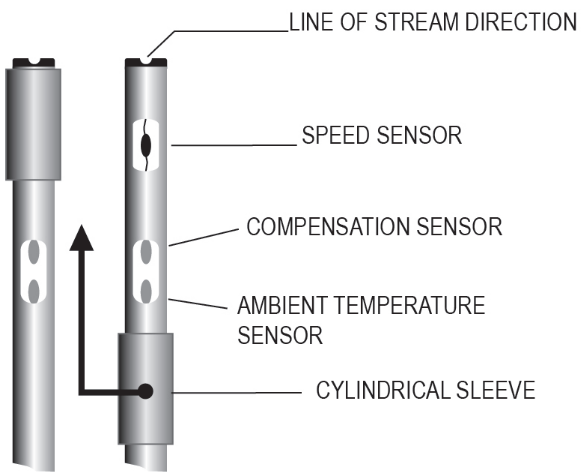
The AP471S... modules are calibrated in the factory; no calibration is required by the user.



The AP471S1 and S3 probes are fitted with a cylindrical protection screen that can slide longitudinally over a groove. The screen has two end-of-travel positions that block it in measurement condition (completely low) or rest condition (completely high). To reduce the space occupied when not used, the AP471S2 and AP471S4 are supplied with a protection cylinder that can be screwed on the probe's head.



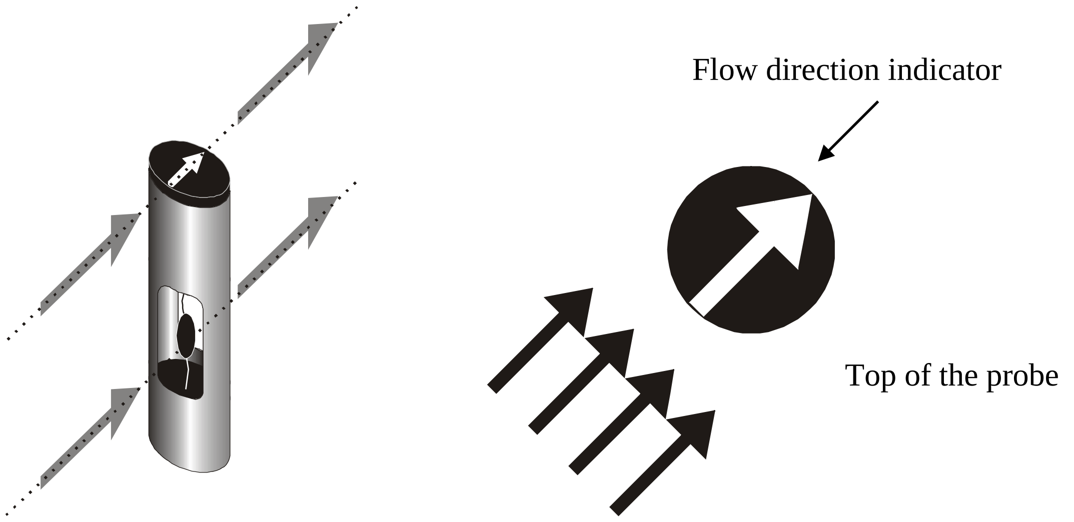
AP471S4 – AP471S2



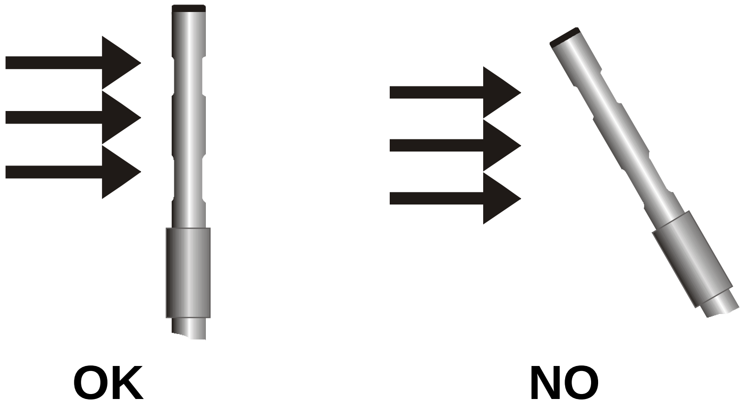
AP471S1 - AP471S3

Operation

Extend the telescopic rod to the necessary length **paying attention to the cable so that it can slide freely and without strain**.
Uncover the sensor and introduce the probe in the air flow being measured, maintaining the arrow at the top of the probe parallel to the flow, as indicated in the figures.



The probe should be maintained orthogonal to the flow and not tilted in relation to it:



Proceed with measurement following the instructions provided in this chapter.

6.2.7 Technical information on Hot-wire wind speed measurement and temperature probes using SICRAM module

AP471S1 - AP471S2 - AP471S3 - AP471S4

	AP471S1 - AP471 S3	AP471S2	AP471S4
Type of measurements	Air speed, calculated flow rate, air temperature		
Type of sensor			
Speed	NTC thermistor	Omni directional NTC thermistor	
Temperature	NTC thermistor	NTC thermistor	
Measurement range			
Speed	0.02…40 m/s	0.02…5 m/s	
Temperature	-25…+80 °C	-25…+80 °C	0…80 °C
Air temperature compensation	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 (0.10…0.99 m/s) ±0.4 m/s (1.00…9.99 m/s) ±0.8 m/s (10.00…40.00 m/s)	±0.05 m/s (0.10…0.99 m/s) ±0.15 m/s (1.00…5.00 m/s)	
Temperature	±0.8 °C (-10…+80 °C)	±0.8 °C (-10…+80 °C)	
Minimum speed	0.02 m/s		

Care and maintenance of the probes

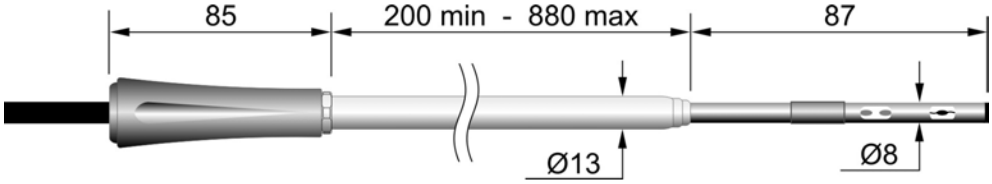
The speed sensor of the AP471S… probes is heated and, **in the presence of gas vapors, could trigger a fire or explosion. Do not use the probe in the presence of inflammable gases. Ensure that no gas or explosive vapor leakage is present in the measurement environments**.

The probe is very delicate and should be handled with extreme care. Even a simple collision, especially of the omni directional probes that have an uncovered sensor, could render the probe unusable. After measurement, the sensor set on the probe head must be protected with the supplied metallic screen or threaded cylinder. During use, the AP471S4 omni directional probe must be protected with the special metallic grid. During transportation, the sensor must be closed into a cylinder screwed on the end part of the probe.

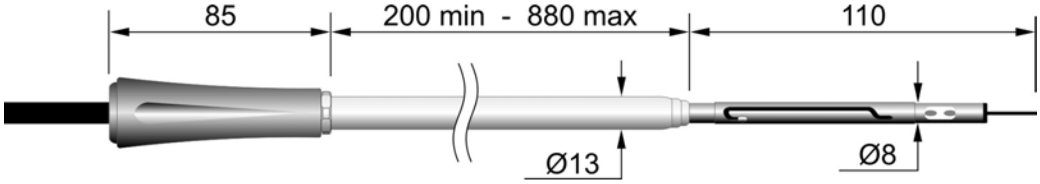
Do not let fingers touch the sensors. Use only distilled water to clean the probe.

Dimensions

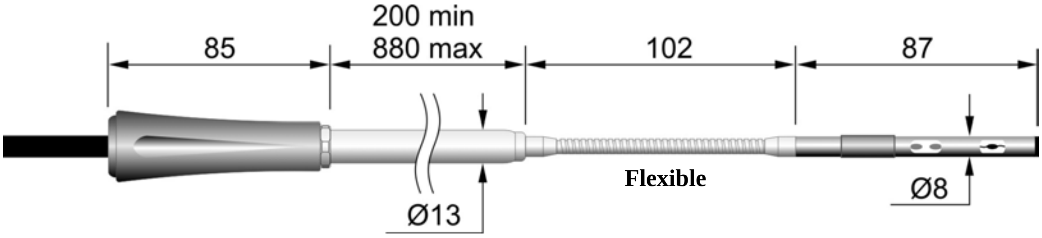
AP471S1



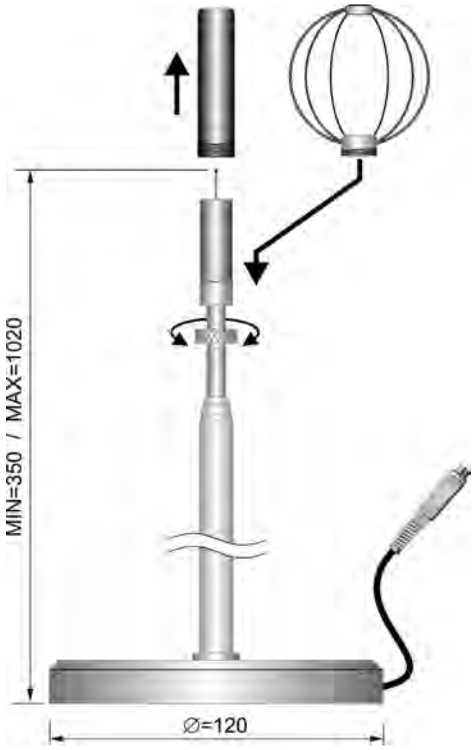
AP471S2



AP471S3



AP471S4



6.2.8 AP472S… Vane wind speed measurement probes complete with SICRAM module

The AP472S1 and AP472S2 vane probes measure the incident wind speed and flow rate. The probe AP472S1 measures also the temperature using a thermocouple of type K. On request, they can be fitted with a telescopic rod that eases measurements in areas difficult to reach (for example vents). The probes' speed and temperature measurement ranges are outlined in the table below:

	Speed (m/s)	**Temperature (°C)**	**Temperature sensor**	**Diameter (mm)**
AP472S1	0.6…25	-25…+80	Thermocouple K	100
AP472S2	0.5…20	-25…+80	----	60

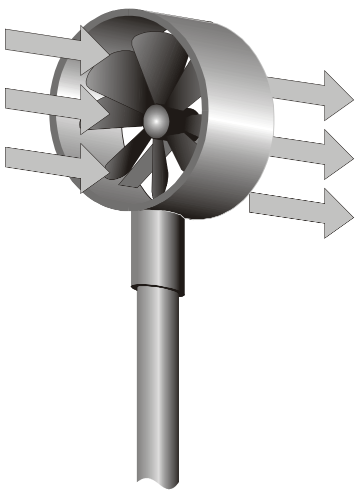
Greater diameters are suitable for flow measurements in the presence of turbulence with medium-low air speeds (i.e. at the exit of the ducts). Lower diameters are suitable in applications where the probe surface must be much slower than the duct cross section within which the measurement is carried out, i.e. ventilation ducts.

Calibrations

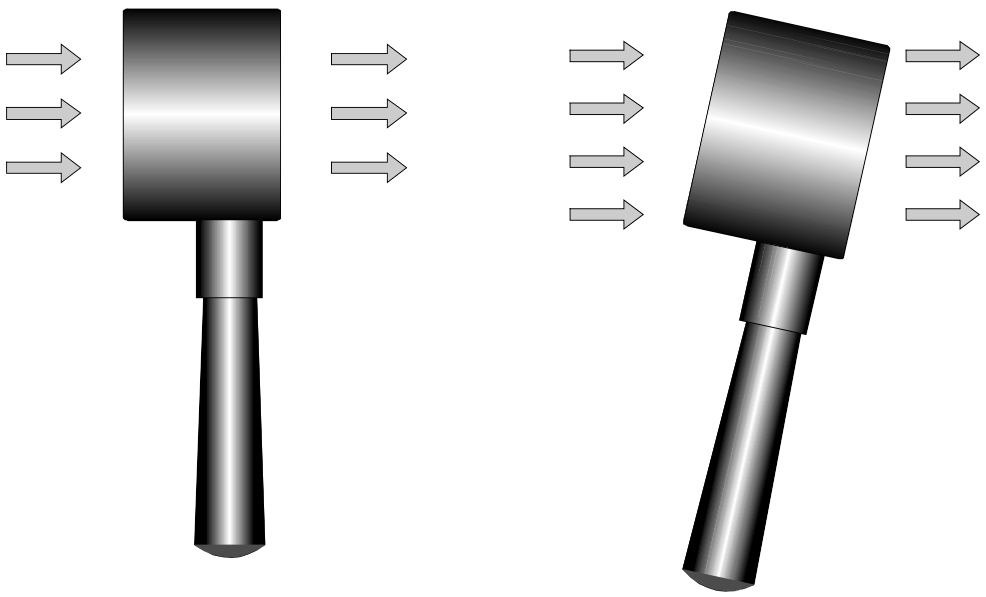
The AP472S1 and AP472S2 probes are calibrated in the factory; no calibration is required by the user.

Operation

Where present, extend the telescopic rod to the necessary length **paying attention to the cable so that it can slide freely and without strain**.
Introduce the probe in the air flow being measured, maintaining the arrow at the top of the probe parallel to the flow as indicated in the following figure.



The probe should be maintained orthogonal to the flow and not tilted in relation to it:



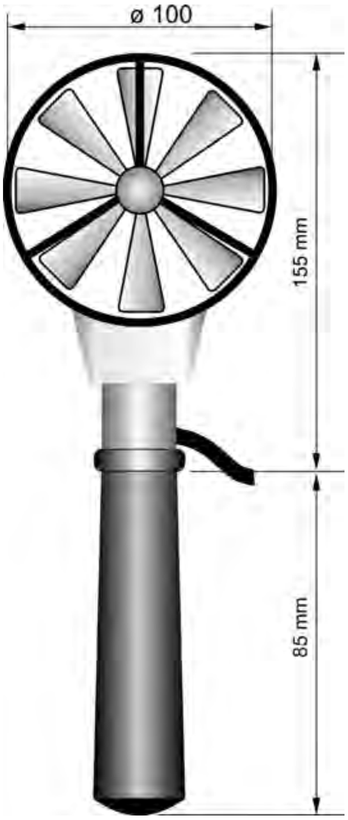
OK **NO**

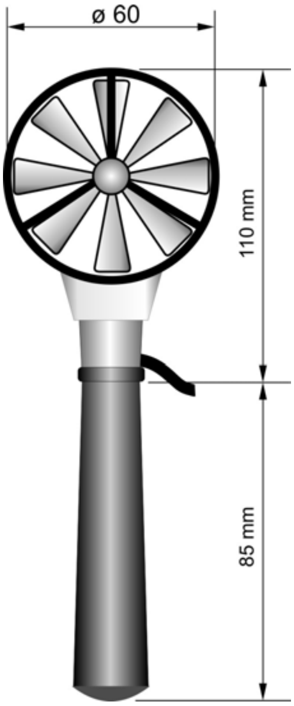
The probe is correctly positioned in relation to the air-flow when the value measured is the maximum possible.
Proceed with measurement following the instructions provided in this chapter.

Care and maintenance of the probes

The probe performance, mainly at low speeds, largely depends on the very slow friction of the vane on its own axis. In order not to compromise this characteristic, it is recommended that forcing is avoided, as well as blocking or rotating the vane with the fingers, and if possible, avoid inserting it in air flows that could soil the probe.

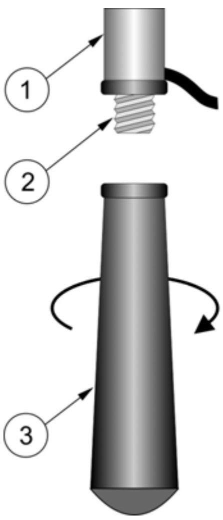
Dimensions

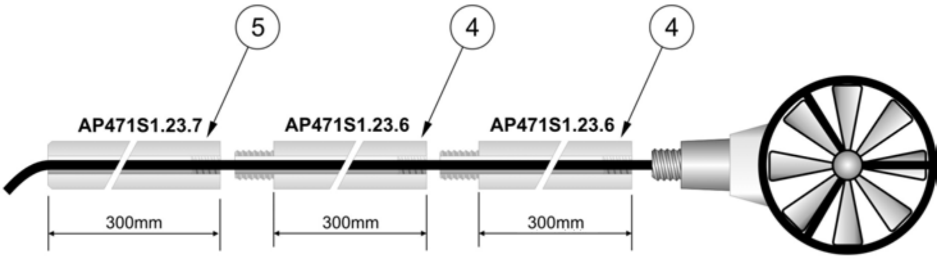




AP472S1 **AP472S2**

Unscrew the handle (3) holding the probe body still in the point (1).





The **AP472S1 - AP472S2** probes, in addition to the telescopic rod with swivel head can use the rigid telescopic rod ∅16 mm. Unscrew the handle (3) holding the probe body still in the point (1). Screw the rod end **AP471S1.23.6** (4) on the screw (2). You can add more telescopic rods **AP471S1.23.6**. The last element can be the handle (3) or the telescopic rod **AP471S1.23.7** (5).

6.2.9 Technical information on Vane wind speed measurement probes using SICRAM module

	AP472S1	AP472S2
Type of Measurements	Wind speed, calculated flow rate, air temperature	Wind speed, calculated flow rate
Diameter	100 mm	60 mm
Type of Measurement		
Speed	Vane	Vane
Temperature	K thermocouple	----
Measuring Range		
Speed	0.6…25 m/s	0.5…20 m/s
Temperature	-25…+80	-25…+80
Resolution		
Speed	0.01 m/s - 0.1 km/h - 1 ft/min - 0.1 mph - 0.1 knots	
Temperature	0.1°C	----
Accuracy		
Speed	±(0.4 m/s + 1.5% f.s.)	±(0.4 m/s + 1.5% f.s.)
Temperature	±0.8 °C	----
Min. Speed	0.6 m/s	0.5 m/s

6.2.10 Light measurement

The instrument works with probes of the LP471… series: these are photometric and radiometric probes that measure **illuminance** (LP471PHOT), **irradiance** (LP471RAD, LP471UVA, LP471UVB, LP471UVBC and LP471UVC), **PAR** (LP471PAR), **luminance** (LP471LUM2) and **total effective irradiance in the blue light** spectral range (LP471BLUE) . All the probes, except the LUM2, are provided with a diffuser for cosine correction.
Upon turning on the instrument automatically detects the probe connected to the input: It is sufficient to connect it. If the instrument is already on, turn it off and back on again in order for the probe to be detected. The unit of measurement is determined according to the probe connected to the input: In cases where more than one unit of measurement is provided for the same probe, use the UNIT key to select the one desired.
All probes are calibrated in the factory; no calibration is required by the user.

The probe is detected during turn on, and this cannot be performed when the instrument is already on, therefore if a probe is connected and the instrument is on, it is necessary to turn it off and on.

6.2.11 Technical characteristics of photometric and radiometric probes complete with SICRAM module to be connected with the instruments on line

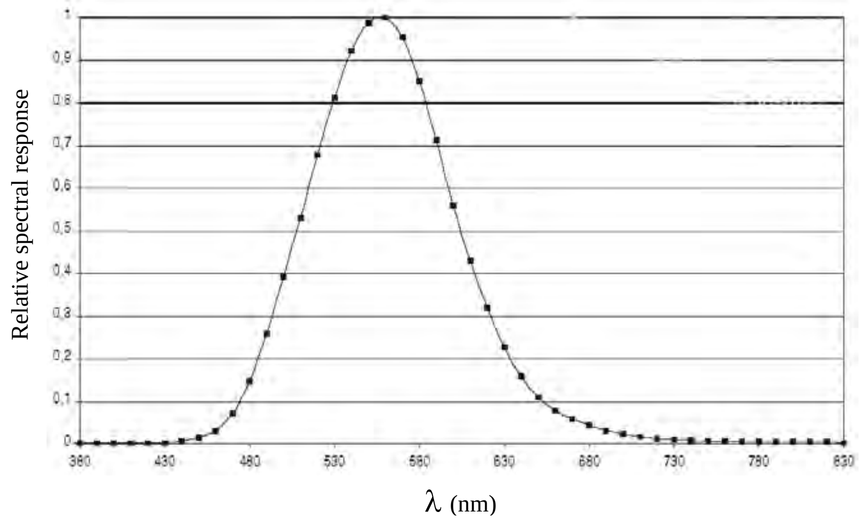
LP471PHOT - Probe for the measurement of illuminance, with SICRAM module.

Measurement range (lux):	0.10…199.99	…1999.9	…19999	…199.99·10^3
Resolution (lux):	0.01	0.1	1	0.01·10^3
Spectral range	in accordance with standard photopic curve V(λ)			
α (temperature coefficient) f6(T)	<0.05% K			
Calibration uncertainty	<4%			
f'1 (accordance with photopic response V(λ))	<6%			
f2 (response as law of cosines)	<3%			
f3 (linearity)	<1%			
f4 (error in instrument reading)	<0.5%			
f5 (fatigue)	<0.5%			
Class	B			
1 year drift	<1%			
Operating temperature	0…50 °C			
Reference standard	CIE n°69 – UNI 11142			

LP471LUM2 - Probe for the measurement of luminance, with SICRAM module.

Measuring range (cd/m2)	1…1999.9	…19999	…199.99x10^3	…1999.9x10^3
Resolution(cd/m2)	0.1	1	0.01 x 10^3	0.1 x 10^3
Angle of view	2°			
Spectral range	in accordance with standard photopic curve V(λ)			
α (temperature coefficient) f6(T)	<0.05% K			
Calibration uncertainty	<5%			
f'1 (accordance with photopic response V(λ)	<8%			
f3 (linearity)	<1%			
f4 (error in instrument reading)	<0.5%			
f5 (fatigue)	<0.5%			
Class	C			
1 year drift	<1%			
Operating temperature	0…50 °C			
Reference standard	CIE n°69 – UNI 11142			

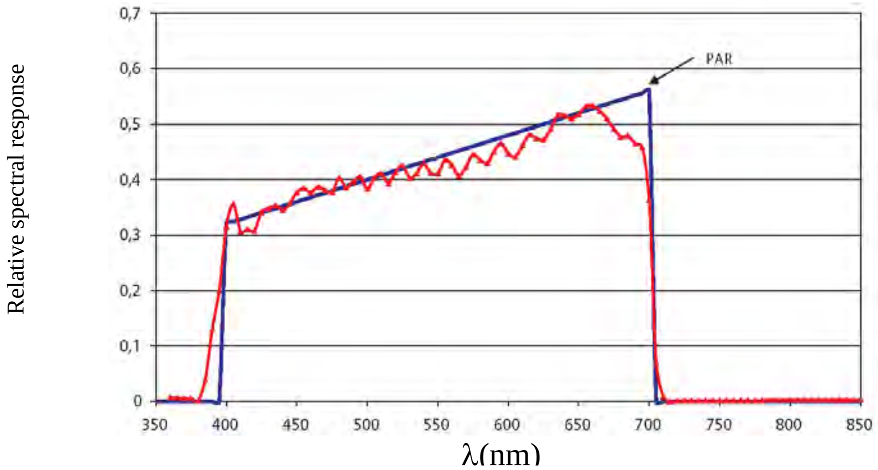
Typical response curve of **LP471PHOT** and **LP471LUM2** probes:



LP471PAR - Quantum-radiometric probe for the measurement of photon flux in the PAR chlorophyll field, with SICRAM module.

Measurement range (μmol/m²s):	0.1… 199.99	200.0…1999.9	2000…10000
Resolution (μmol/m²s):	0.01	0.1	1
Spectral range	400 nm…700 nm		
Calibration uncertainty	<5%		
f_2 (response as law of cosines)	<6%		
f_3 (linearity)	<1%		
f_4 (error in instrument reading)	±1digit		
f_5 (fatigue)	<0.5%		
1 year drift	<1%		
Operating temperature	0…50°C		

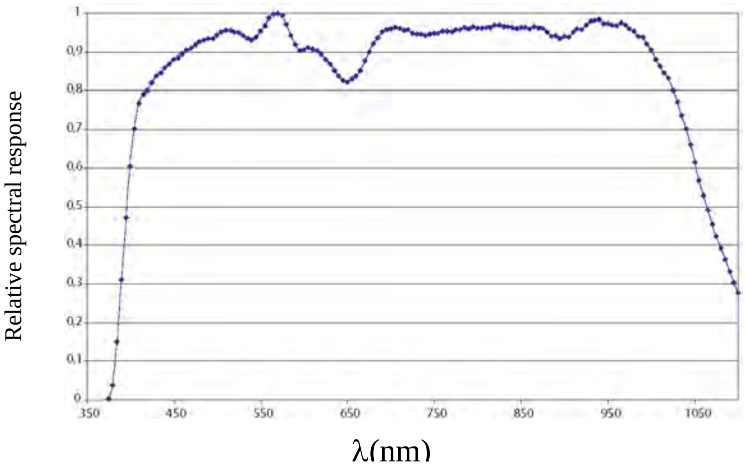
Typical response curve of probe **LP471PAR**:



LP471RAD Probe for the measurement of **irradiance**, with SICRAM module.

Measuring range (W/m²)	$1x10^{-3}…999.9x10^{-3}$	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution(W/m²)	$0.1x10^{-3}$	0.001	0.01	0.1
Spectral range	400 nm…1050 nm			
Calibration uncertainty	<5%			
f_2 (response as law of cosines)	<6%			
f_3 (linearity)	<1%			
f_4 (error in instrument reading)	±1digit			
f_5 (fatigue)	<0.5%			
1 year drift	<1%			
Operating temperature	0…50 °C			

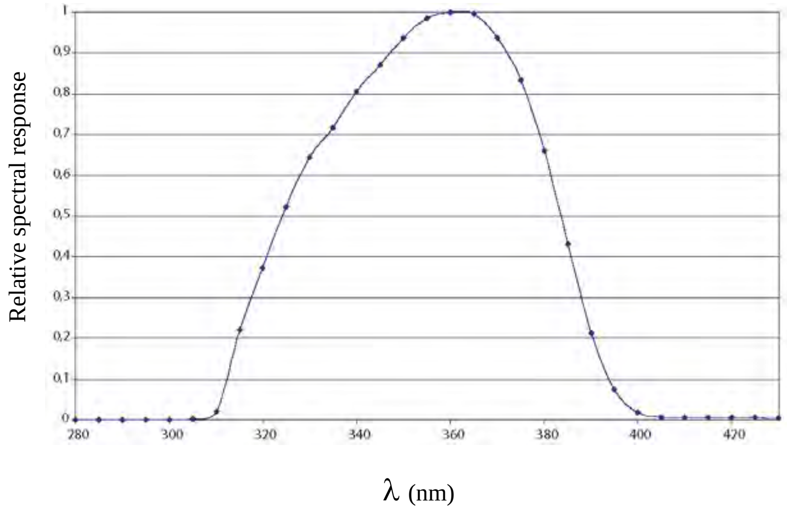
Typical response curve of **LP471RAD** probe:



LP471UVA Probe for the measurement of **UVA irradiance**, with SICRAM module.

Measuring range (W/m^2)	1x10^{-3}… 999.9x10^{-3}	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution(W/m^2)	0.1x10^{-3}	0.001	0.01	0.1
Spectral range	315 nm…400 nm (Peak 360 nm)			
Calibration uncertainty	<5%			
f_3 (linearity)	<1%			
f_4 (error in instrument reading)	±1digit			
f_5 (fatigue)	<0.5%			
1 year drift	<2%			
Operating temperature	0…50 °C			

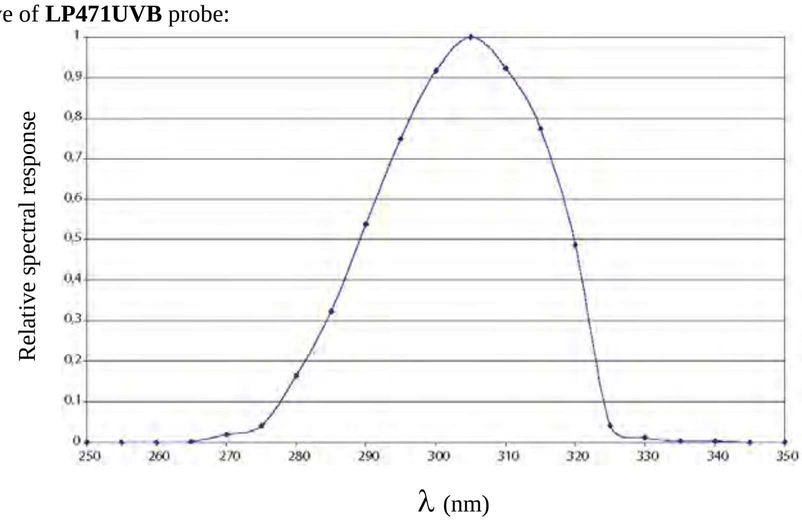
Typical response curve of **LP471UVA**:



LP471UVB Probe for the measurement of **UVB irradiance**, with SICRAM module.

Measuring range (W/m^2)	1x10^{-3}…999.9x10^{-3}	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution(W/m^2)	0.1x10^{-3}	0.001	0.01	0.1
Spectral range	280 nm…315 nm (Peak 305 nm)			
Calibration uncertainty	<5%			
f_3 (linearity)	<2%			
f_4 (error in instrument reading)	±1digit			
f_5 (fatigue)	<0.5%			
1 year drift	<2%			
Operating temperature	0…50 °C			

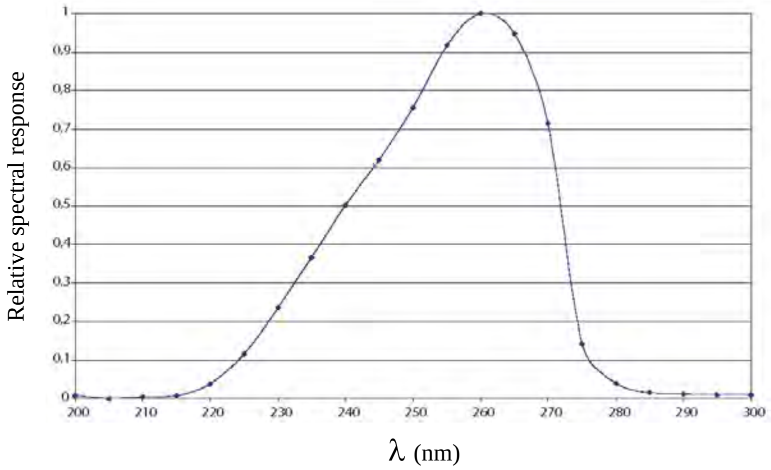
Typical response curve of **LP471UVB** probe:



LP471UVC Probe for the measurement of **UVC irradiance**, with SICRAM module.

Measuring range (W/m^2)	1x10^{-3}…999.9x10^{-3}	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution(W/m^2)	0.1x10^{-3}	0.001	0.01	0.1
Spectral range	220 nm…280 nm (Peak 260 nm)			
Calibration uncertainty	<5%			
f_3 (linearity)	<1%			
f_4 (error in instrument reading)	±1digit			
f_5 (fatigue)	<0.5%			
1 year drift	<2%			
Operating temperature	0…50 °C			

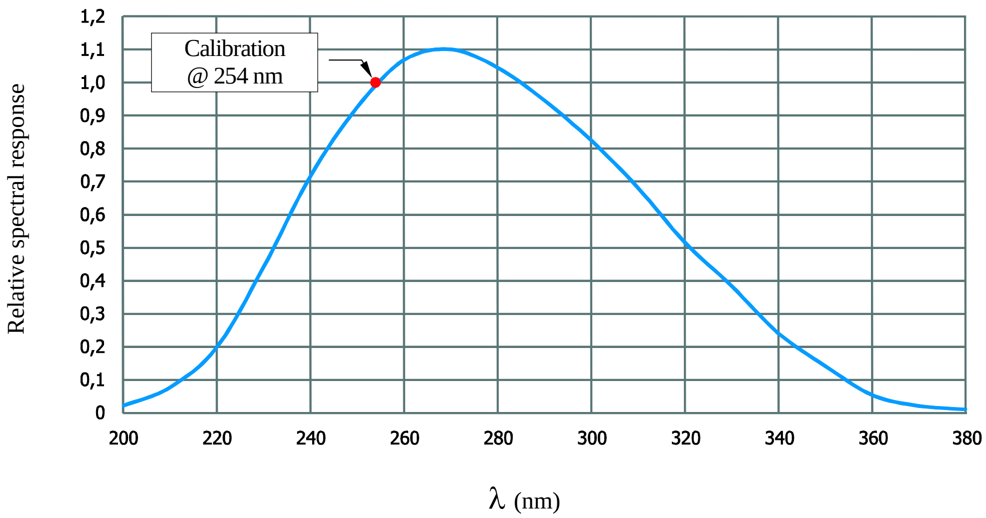
Typical response curve of **LP471UVC** probe:



LP471UVBC Probe for the measurement of **UVBC irradiance**, with SICRAM module.

Measuring range (W/m^2)	1x10^{-3}…999.9x10^{-3}	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution(W/m^2)	0.1x10^{-3}	0.001	0.01	0.1
Spectral range	210 nm…355 nm (Peak 265 nm)			
Calibration uncertainty	<7% (calibration @ 254 nm)			
f_3 (linearity)	<2%			
f_4 (error in instrument reading)	±1digit			
f_5 (fatigue)	<0.5%			
1 year drift	<2%			
Operating temperature	0…50 °C			

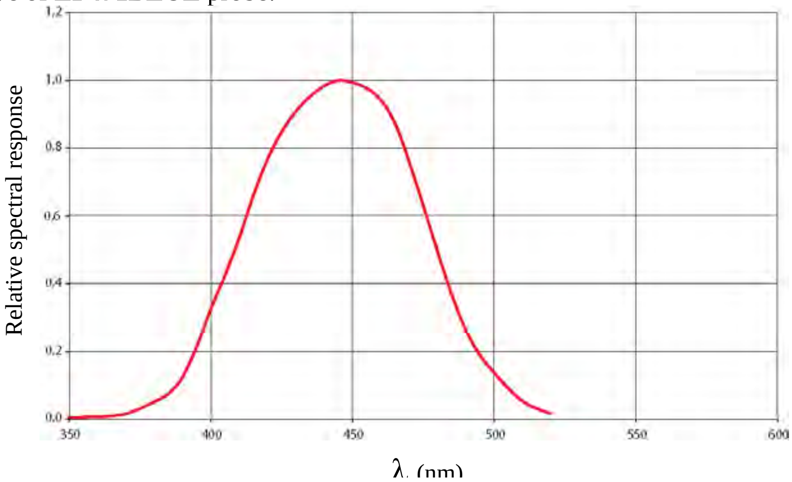
Typical response curve of **LP471UVBC** probe:



LP471BLUE Probe for the measurement of **effective irradiance in blue light spectral band**, with SICRAM module.

Measuring range (W/m^2)	1x10^{-3}…999.9x10^{-3}	1.000…19.999	20.00…199.99	200.0…1999.9
Resolution(W/m^2)	0.1x10^{-3}	0.001	0.01	0.1
Spectral range	380 nm…550 nm. action curve for blue-light induced damage B(λ)			
Calibration uncertainty	<10%			
f_2 (response as law of cosines)	<6%			
f_3 (linearity)	<3%			
f_4 (error in instrument reading)	±1digit			
f_5 (fatigue)	<0.5%			
1 year drift	<2%			
Operating temperature	0…50 °C			

Typical response curve of **LP471BLUE** probe:



LP471BLUE radiometric probe measures irradiance (W/m^2) in the Blue Light spectral band. The probe consists in a photodiode plus a suitable filter and is provided with diffuser for proper measurement according to the cosine law. The spectral response curve of the probe allows the effective irradiance for blue-light induced damage (B(λ)curve according to ACGIH/ICNIRP standards) to be measured in the spectral range from 380 nm to 550 nm. Optical radiations in this portion of spectrum can cause photochemical damage to the retina. Another field of use of the probe is the monitoring of blue light irradiance in neonatal jaundice therapies.

6.2.12 HD320A2 probe for the measurement of CO Carbon monoxide

HD320A2 probe measures the carbon monoxide concentration in air. It's a colorless, odorless gas, lighter than the air and it can cause explosions or fires. It is poisonous even in low quantities: indeed, it's sufficient a concentration of 10-30ppm of carbon monoxide in air to produce symptoms of poisoning and about 2000ppm are fatal in less than 30 minutes.
Carbon monoxide is formed when substances containing carbon are burned in absence of oxygen, or when, although the amount of oxygen is sufficient, the combustion occurs at high temperature, e.g. in car engines.
Carbon monoxide is one of the major pollutant agents in urban areas. Moreover, being odorless, is an insidious poison.
Together with the HD320B2 probe, the HD320A2 probe allows analyzing and monitoring the air quality in internal environments and detecting any loss of CO.

The sensor for the measurement of CO consists of an electro - chemical cell with two electrodes.

CO probe calibration

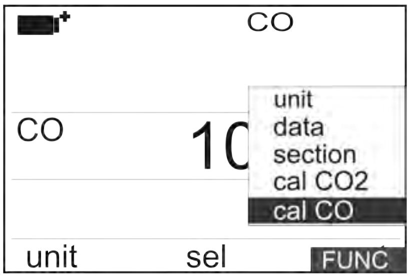
The probe is calibrated by the company and, usually, doesn't request any intervention by the user.

However, there is the possibility to make a new calibration that corrects the sensor zero:

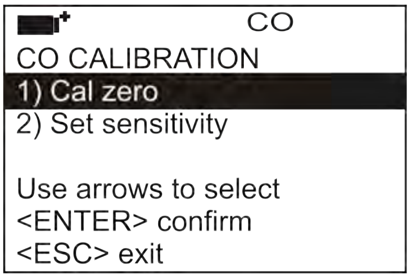
- in clean air (outside the CO concentration is less than 0,1 ppm)
- With the help of nitrogen cylinders

CO zero calibration in clean air:

1. Place the instrument in an environment with clean air (outside, far from the companies or the streets, the CO concentration is less than 0.1 ppm), switch the instrument on and wait at least 15 minutes till the measurements becomes stable.
2. Press **SHIFT FNC** key: the shortcut window appears. With ▲▼ arrows select "cal CO" and confirm with ENTER.

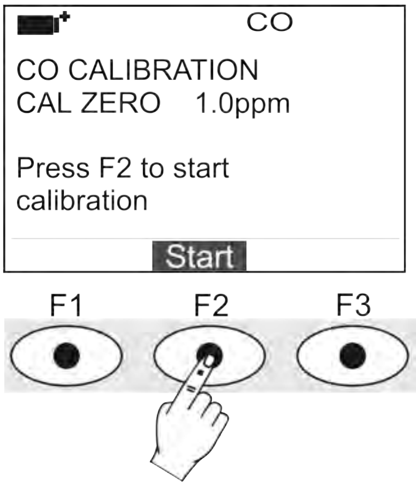


3. The screen for the operation to do on the sensor appears (calibration or replacement):



4. With Up and Down arrows, select "Cal zero" and confirm with ENTER. The screen for the calibration of CO sensor appears.

5. Press F2= START to start the calibration:

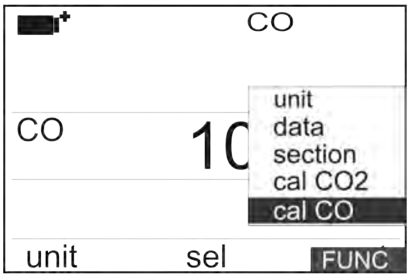


Next to "CAL ZERO" writing is indicated the CO concentration value measured by the instrument.

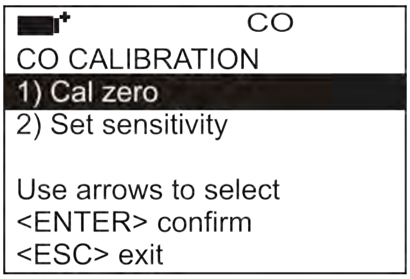
6. During the calibration "*Zero CO in progress*" message appears. Wait for some minutes to execute the process without modifying the working conditions.
7. At the end, the instrument gives an acoustic signal out and visualized "Calibration completed" message. Press F2=Exit for coming to the measurement.
8. The process is finished.

Zero CO calibration with nitrogen cylinder:

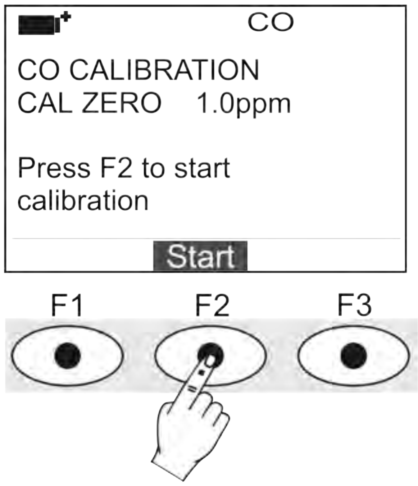
1. Switch the instrument on and wait at least 15 minutes till the measurements becomes stable.
2. Connect the pipe coming from the nitrogen cylinder with the rubber cowling on the CO sensor head.
3. Press **SHIFT FNC** key: the shortcut window appears. With ▲▼ arrows select "cal CO" and confirm with ENTER.



4. The screen for the operation to execute on the sensor appear (calibration or replacement):



5. With Up and Down arrows select “Cal zero” and confirm with ENTER. The screen for CO sensor calibration appears.
6. Supply the gas adjusting the fluxmeter of the cylinder in order to have a constant fluid between 0.1 and 0.2 l/min.
7. Press F2= START to start calibrating:

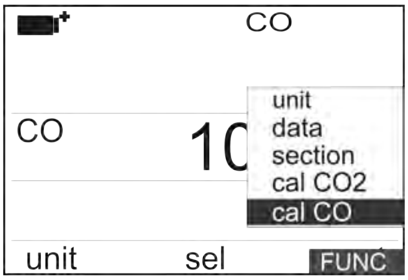


Next to “CAL ZERO” writing is indicated the CO concentration value measured by the instrument.

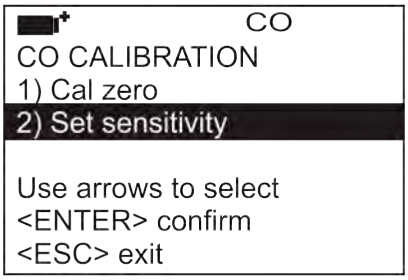
8. During the calibration “*Zero CO in progress*” message appears. Wait for some minutes to execute the process without modifying the working conditions.
9. At the end, the instrument gives an acoustic signal out and visualized “Calibration completed” message. Close the cylinder tap and remove the CO sensor cowling.
9. Press F2=Exit for coming back to calibrate.
10. Insert the protection.
11. The process is finished.

Replacement of CO sensor:
In normal conditions of use, CO sensor has an average expected life up to 5 years. If it’s necessary to replace CO sensor, proceed as indicated below:

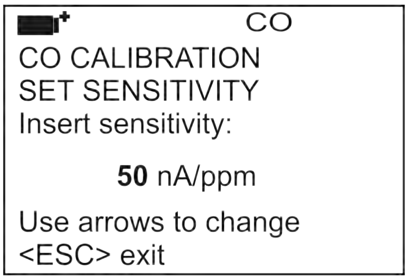
1. Disconnect the probe from the instrument.
2. Unscrew the head of the probe and extract the sensor of void CO.
3. Take note of the number written on the edge of the sensor that indicates the sensibility in nA/ppm.
4. Insert the new sensor electrodes into the contacts.
5. Screw the cap with the probe filter.
6. Connect the probe and switch the instrument on. Press Shift Fnc key: the shortcut window appears. With ▲▼ arrows select “Cal CO” and confirm with ENTER.



7. The screen for the operation to done on the sensor appears (calibration or replacement):



8. With Up and Down arrows select “Set sensitivity” and confirm with ENTER. The screen for the replacement of CO sensor appears.



9. With Up and Down arrows set the sensor sensibility value. Press ENTER to confirm: the instrument comes back to the previous screen.
10. If necessary, calibrate the zero of the CO new sensor.
11. Press ESC to come back in measurement.
12. The process is finished.

6.2.13 HD320B2 probe for the measurement of CO_2 carbon dioxide concentration

HD320B2 probe measures the carbon dioxide concentration in air. It’s indicated for checking and monitoring the indoor air quality.

Typical applications are the check of the air quality in all the buildings where there is a crowd of people (schools, hospitals, auditoria, canteens, etc.), in the working places to optimize the comfort.

CO_2 measurement is obtained with an infrared special sensor (NDIR technology: Non-Dispersive Infrared Technology) that, thanks to the use of a double filter and a special measurement technique, warranties precise, stable and long-term measurements. The air to check is spread inside the measurement chamber through the protection membrane placed at the top of the probe.

CO_2 probe calibration

The probe is calibrated by the company and usually doesn't request any intervention by the user.

However, there is the possibility to execute a new calibration that corrects the sensor offset:

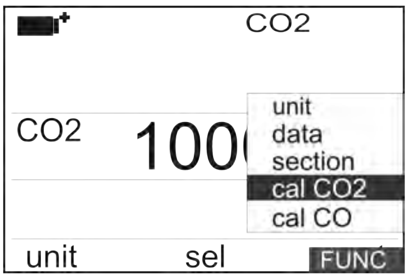
- at 400 ppm in clean air
- at 0 ppm with the help of nitrogen cylinder.

The instrument can automatically recognize the mode of the started calibration: if 400 ppm or 0 ppm. The calibration has to be done on one point: each new calibration cancels the previous one.

The concentration of carbon dioxide in air is influenced by different factors: the human activities (companies, pollution, combustion, etc.) cause an increase of this percentage in air. The calibration value is equal to 400 ppm and it’s in clean air, for example in the country far from the more polluted areas.

Go on as indicated below:

1. If you want to calibrate around 400 ppm, make sure to apply clean air to the instrument through a membrane placed on the head of the probe.
2. For the calibration at 0ppm, remove the cap placed at the base of the probe in order to discover the plug of the calibration gas inlet and connect the tube coming from the nitrogen cylinder. Adjust the fluxmeter of the cylinder on the flow from 0.3 to 0.5l/min.
3. Switch the instrument on and wait for at least 15 minutes before going on.
4. Press **SHIFT FNC** key: the shortcut window appears. With ▲▼ arrows select “**cal CO2**” and confirm with ENTER.



5. Supply CO_2 for at least 2 minutes in order that the measurement becomes stable.
6. Going on supplying CO_2 to the probe, press **F2 = CAL CO2** function key: the calibration, **which lasts three minutes**, starts. In this phase the instrument measures CO_2 and calibrates itself to a value next to 0ppm if you are using the nitrogen cylinder, at 400ppm if you are calibrating it in clean air.

7. Wait for three minutes necessary for the calibration without modifying the working conditions.
8. If the timer reaches the zero, the instrument gives an acoustic signal out that confirms that the calibration is finished.

Note: the instrument rejects the calibration values that exceed ±150ppm from the theoretic value.

7. SERIAL INTERFACE AND USB

The **HD32.1** is fitted with an electrically isolated RS-232C serial interface, and an USB 2.0 interface. Optionally, they can be connected using a serial cable with sub D 9-pole female connectors (code **9CPRS232**) and a cable with USB 2.0 connectors (code **CP22**).
The USB connection requires the previous installation of a driver included in the DeltaLog10 software package. **Install the driver before connecting the USB cable to the PC** (follow the instructions included in the software package).

Standard parameters of the instrument RS232 serial transmission are:

- Baud rate 38400 baud
- Parity None
- N. bit 8
- Stop bit 1
- Protocol Xon/Xoff

It is possible to change the RS232C serial port baud rate by setting the "*Selection of the serial transmission speed (Baud Rate)*" parameter in the menu (please see the menu on chapter ***5.3.1 The Baud Rate***). The possible values are: 38400, 19200, 9600, 4800, 2400, 1200. The other transmission parameters are fixed.
The USB 2.0 connection does not require the setting of parameters (Baud rate = 460800 fixed).

The selection of the port is carried out directly by the instrument: If the USB port is connected to a PC, the RS232 serial port is automatically disabled, and vice versa.

The instruments are provided with a complete set of commands and data queries to be sent via the PC.

All the commands transferred to the instrument must have the following structure:
XXCR where: **XX** is the command code and **CR** is the Carriage Return (ASCII 0D)
The XX command characters are exclusively upper case characters. Once a correct command is entered, the instrument responds with "&"; when any wrong combination of characters is entered, the instrument responds with "?".
The instrument response strings end with the sending of the CR command (Carriage Return) and LF (Line Feed).
Before sending commands to the instrument via the serial port, locking the keyboard to avoid functioning conflicts is recommended: Use the P0 command. When complete, restore the keyboard with the P1 command.

7.1 THE OPERATING PROGRAM A: MICROCLIMATE ANALYSIS

Command	Response	Description
P0	&	Ping (locks the instrument keyboard for 70 seconds)
P1	&	Unlocks the instrument keyboard
S0		
G0	`Model HD32.1 prog.A`	Instrument model
G1	`M=THERMAL MICROCLIMATE`	Model description
G2	`SN=12345678`	Instrument serial number
G3	`Firm.Ver.=01.00`	Firmware version
G4	`Firm.Date=2005/10/12`	Firmware date
G5	`cal 0000/00/00 00:00:00`	Calibration date and time
C1		Probe 1 type, serial number, calibration date
C2		Probe 2 type, serial number, calibration date

Command	Response	Description
C3		Probe 3 type, serial number, calibration date
C4		Probe 4 type, serial number, calibration date
C5		Probe 5 type, serial number, calibration date
C6		Probe 6 type, serial number, calibration date
C7		Probe 7 type, serial number, calibration date
C8		Probe 8 type, serial number, calibration date
GC		Print instrument's heading
GB	User ID=0000000000000000	User code (set with T2xxxxxxxxxxxxxxxx)
H0	Tw= 19.5 øC	Print wet bulb temperature
H1	Tg= 22.0 øC	Print globe thermometer temperature
H2	Ta= 21.6 øC	Print air temperature (dry bulb);
H3	Pr= 1018.1 hPa	Print atmospheric pressure
H4	RH= 50.5 %RH	Print relative humidity
H5	Va= 0.20 m/s	Print wind speed
H6	Tr= 18.5 øC	Print average radiation temperature
H7	WBGT(i)= 23.0 øC	Print indoor WGBT (without solar radiation)
H8	WBGT(o)= 24.0 øC	Print outdoor WGBT (with solar radiation)
H9	WCI=_ERROR_ øC	Print WCI
HA		Print date, time, Tw, Tg, Ta, Pr, RH, Va, Tr, WBGT(i), WBGT(o), WCI
LN	A00 -A01 -B02 -B03 - .. - .. - .. - .. - .. - .. - .. - .. - .. - .. - .. - .. -	Print instrument memory map: If a section is allocated a number is displayed, if it is free 2 points (..) are displayed.
LFn	!Log n.= 0!started on:!2006/01/01 00:37:32	Print memory n section status. The number, the storage start date and time are displayed. (n= hexadecimal number 0-F). If the section is empty:“-->No Log Data<--“
LDn		Print data stored in section n. If the section is empty: “-->No Log Data<--“
LEn	&	Cancel data stored in section n.
LEX	&	Cancel data stored in all sections.
K1	&	Immediate printing of data
K0	&	Stop printing data
K4	&	Start logging data
K5	&	Stop logging data
KP	&	Auto-power-off function=ENABLE
KQ	&	Auto-power-off function=DISABLE
WC0	&	Setting SELF off
WC1	&	Setting SELF on
RA	Sample print = 0sec	Reading of PRINT interval set
RL	Sample log = 30sec	Reading of LOG interval set
WA#	&	Setting PRINT interval. # is a hexadecimal number 0…D that represents the position of the interval in the list 0, 1, 5, 10, …, 3600 seconds.
WL#	&	Setting LOG interval. # is a hexadecimal number 1…D that represents the position of the interval in the list 15, …, 3600 seconds.

7.2 THE OPERATING PROGRAM B: DISCOMFORT ANALYSIS

Command	Response	Description
P0	&	Ping (locks the instrument keyboard for 70 seconds)
P1	&	Unlocks the instrument keyboard
S0		
G0	`Model HD32.1 prog.B`	Instrument model
G1	`M=THERMAL MICROCLIMATE`	Model description
G2	`SN=12345678`	Instrument serial number
G3	`Firm.Ver.=01.00`	Firmware version
G4	`Firm.Date=2005/10/12`	Firmware date
G5	`cal 0000/00/00 00:00:00`	Calibration date and time
C1		Probe 1 type, serial number, calibration date
C2		Probe 2 type, serial number, calibration date
C3		Probe 3 type, serial number, calibration date
C4		Probe 4 type, serial number, calibration date
C5		Probe 5 type, serial number, calibration date
C6		Probe 6 type, serial number, calibration date
C7		Probe 7 type, serial number, calibration date
C8		Probe 8 type, serial number, calibration date
GC		Print instrument's heading
GB	`User ID=0000000000000000`	User code (set with T2xxxxxxxxxxxxxxxx)
H0	`Th= 19.5 øC`	Print temperature at head height
H1	`Tb= 22.0 øC`	Print temperature at body height
H2	`Tn= 21.6 øC`	Print temperature of the net radiometer
H3	`Tk= 19.5 øC`	Print temperature at ankles height
H4	`Tf= 19.5 øC`	Print temperature of the floor
H5	`Pt= 0.0 W/m2`	Print power of net radiometer
H6	`Dt= 0.0 øC`	Print asymmetrical radiant temperature of the net radiometer
HA		Print date, time, Th, Tb, Tn,Tk, Tf, Pt, Dt
LN	`A00 -A01 -B02 -B03 - .. - .. - .. - .. - .. - .. - .. - .. - .. - .. - .. -`	Print instrument memory map: If a section is allocated a number is displayed, if it is free 2 points (..) are displayed.
LFn	`!Log n.= 0!started on:!2006/01/01 00:37:32`	Print memory n section status. The number, and storage start date and time are displayed. (n= hexadecimal number 0-F). If the section is empty:“-->No Log Data<--“
LDn		Print data stored in section n. If the section is empty: “-->No Log Data<--“
LEn	&	Cancel data stored in section n.
LEX	&	Cancel data stored in all sections.
K1	&	Immediate printing of data
K0	&	Stop printing data
K4	&	Start logging data
K5	&	Stop logging data
KP	&	Auto-power-off function=ENABLE
KQ	&	Auto-power-off function=DISABLE
WC0	&	Setting SELF off
WC1	&	Setting SELF on
RA	`Sample print = 0sec`	Reading of PRINT interval set

Command	Response	Description
RL	`Sample log =   30sec`	Reading of LOG interval set
WA#	&	Setting PRINT interval. # is a hexadecimal number 0…D that represents the position of the interval in the list 0, 1, 5, 10, …, 3600 seconds.
WL#	&	Setting LOG interval. # is a hexadecimal number 1…D that represents the position of the interval in the list 15, …, 3600 seconds.

7.3 THE OPERATING PROGRAM C: PHYSICAL QUANTITIES

Command	Response	Description
P0	&	Ping (locks the instrument keyboard for 70 seconds)
P1	&	Unlocks the instrument keyboard
S0		
G0	`Model HD32.1 prog.C`	Instrument model
G1	`M=THERMAL MICROCLIMATE`	Model description
G2	`SN=12345678`	Instrument serial number
G3	`Firm.Ver.=01.00`	Firmware version
G4	`Firm.Date=2005/10/12`	Firmware date
G5	`cal 0000/00/00 00:00:00`	Calibration date and time
C1		Probe 1 type, serial number, calibration date
C2		Probe 2 type, serial number, calibration date
C3		Probe 3 type, serial number, calibration date
C4		Probe 4 type, serial number, calibration date
C5		Probe 5 type, serial number, calibration date
C6		Probe 6 type, serial number, calibration date
C7		Probe 7 type, serial number, calibration date
C8		Probe 8 type, serial number, calibration date
GC		Print instrument's heading
GB	`User ID=0000000000000000`	User code (set with T2xxxxxxxxxxxxxxxx)
H0	`Tpt= 19.5 øC`	Print Pt100 temperature
H1	`RH= 50.0 %`	Print %RH
H2	`Trh= 21.6 øC`	Print temperature of the RH probe
H3	`Va= 0.25 m/s`	Print air speed
H4	`Fl= 1.5 l/s`	Print air flux of air speed probe
H5	`Tv= 20.5 øC`	Print temperature of air speed probe
H6	`Lux= 550.0 lux`	Print lux
HA		Print date, time, Tpt, RH, Trh, Va, Fl, Tv, Lux1, Lux2, CO_2, CO
LN	`A00 -A01 -B02 -B03 - .. - .. - .. - .. - .. - .. - .. - .. - .. - .. - .. - .. -`	Print instrument memory map: If a section is allocated a number is displayed, if it is free 2 points (..) are displayed.
LFn	`!Log   n.=     0!started on:!2006/01/01 00:37:32`	Print memory n section status. The number, and storage start date and time are displayed. (n= hexadecimal number 0-F). If the section is empty:“-->No Log Data<--“
LDn		Print data stored in section n. If the section is empty: “-->No Log Data<--“
LEn	&	Cancel data stored in section n.

Command	Response	Description
LEX	&	Cancel data stored in all sections.
K1	&	Immediate printing of data
K0	&	Stop printing data
K4	&	Start logging data
K5	&	Stop logging data
KP	&	Auto-power-off function=ENABLE
KQ	&	Auto-power-off function=DISABLE
WC0	&	Setting SELF off
WC1	&	Setting SELF on
RA	`Sample print =    0sec`	Reading of PRINT interval set
RL	`Sample log =   30sec`	Reading of LOG interval set
WA#	&	Setting PRINT interval. # is a hexadecimal number 0…D that represents the position of the interval in the list 0, 1, 5, 10, …, 3600 seconds.
WL#	&	Setting LOG interval. # is a hexadecimal number 1…D that represents the position of the interval in the list 15, …, 3600 seconds.

7.4 Storing and Transferring Data to a PC

The **HD32.1** instrument can be connected to a personal computer via an RS232C serial port or USB port, and exchange data and information through the DeltaLog10 software running in a Windows operating environment. It is possible to print the measured values on a 80 column printer (*PRINT* key) or store them in the internal memory using the *Logging* function (MEM key). If necessary, the data stored in the memory can be transferred to a PC later.

7.4.1 The Logging Function

The *Logging* function allows recording of the measurements registered by the probe connected to the inputs. The time interval between two consecutive measurements can be set from 15 seconds to 1 hour. The logging starts by pressing the **MEM** key and ends by pressing the same key again: The data memorized in this way form a continuous block of data.
See the description of the menu items on chapter "**5. MAIN MENU"**.
If the automatic turning off option between two recordings (see par. *5.2.2 Self Shut-off mode*) is enabled, upon pressing the **MEM** key the instrument logs the first data and turns off. 15 seconds before the next logging instant, it turns on again to capture the new sample, and then turns off.
The data stored in the memory can be transferred to a PC using a command (see par. 5.2.5 Log File Manager). During data transfer the display shows the message DUMP; to stop the data transfer press ESC on the instrument or on the PC.

7.4.2 The Erase Function: clearing the memory

To clear the memory use the Erase Log function (see par. *5.2.5 Log File Manager*). The instrument starts clearing the internal memory; at the end of the operation, it goes back to normal display.

NOTES:

- Data transfer does not cause the memory to be erased: The operation can be repeated as many times as required.
- The stored data remain in the memory independently of battery charge conditions.
- In order to print the data to a parallel interface printer, you must use a parallel-serial adaptor (not supplied).
- **The direct connection between instrument and printer via a USB connector does not work.**
- Some keys are disabled during *logging*. The following keys are enabled: **MEM**, **SETUP**, **ENTER** and **ESC**.
- Pressing the **MEM** and **SETUP** keys has no effect on the logged data if these keys are pressed **after** starting the recording, otherwise the following is valid.

7.4.3 The Print Function

Press **PRINT** to send the measured data directly to the RS232 or USB ports, in real time. Print data units of measurements are the same as those used on the display. The function is started by pressing **PRINT**. The time interval between two consecutive prints can be set from 15 second to 1 hour (please see the **Print interval** menu item at par. 5.3.2 The Print Interval). If the print interval is equal to 0, by pressing **PRINT** the single data is sent to the connected device. If the print interval is higher than 0, the data transfer continues until the operator stops it by pressing **PRINT** again. The "PN" message is displayed at the top of the display.

NOTE: When setting the baud-rate, check the printer speed.

8. INSTRUMENT SIGNALS AND FAULTS

The following table lists all error indications and information displayed by the instrument and supplied to the user in different operating situations:

Display indication	Explanation
---.--	This appears if the sensor relevant to the indicated physical quantity is not present or is faulty
OVFL	Overflow appears when the probe detects a value that exceeds the expected measurement range.
UFL	Underflow appears when the probe detects a lower value than the expected measurement range.
WARNING: **MEMORY FULL!!**	The instrument cannot store further data, the memory space is full.
PN	Blinking message. It appears on the first line of the display when the data transfer function is enabled (PRINT key).
LOG	Blinking message. It appears on the first line of the display and indicates a logging session.

9. BATTERY SYMBOL AND BATTERY REPLACEMENT – MAINS POWER SUPPLY

The battery symbol
on the display constantly shows the battery charge status. To the extent that batteries have discharged, the symbol "empties". When the charge decreases still further it starts blinking.

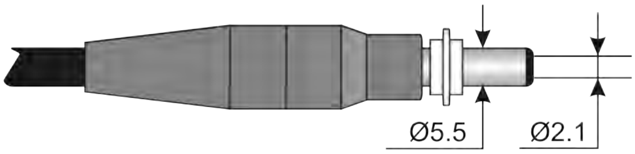
In this case, batteries should be replaced as soon as possible.
If you continue to use it, the instrument can no longer ensure correct measurement and turns off. Data stored on memory will remain.

The battery symbol becomes [~] when the external power supply is connected.

To replace the batteries, proceed as follows:
1. Switch the instrument off;
2. Disconnect the external power supply, if connected;
3. Unscrew the battery cover counter clockwise and take out the battery holder. **Do not pull the battery connection wires as they could break;**
4. Replace the batteries (4 1.5V alkaline batteries - C - BABY). Check that the battery polarity matches the indication on the battery holder;
5. Replace the battery holder and screw the cover on clockwise.




The instrument can be powered by the mains using, for example, the stabilized power supply SWD10 input 100÷240Vac output 12Vdc – 1000mA (the positive is in the middle).



The external diameter of power supply connector is 5.5 mm, the internal diameter is 2.1 mm.
Warning: The power supply cannot be used as battery charger. If the instrument is connected to the external power supply, the **[~]** symbol is displayed instead the battery symbol.

Malfunctioning upon turning on after battery replacement
After replacing the batteries, the instrument may not restart correctly; in this case, repeat the operation.
After disconnecting the batteries, wait a few minutes in order to allow circuit condensers to discharge completely; then reinsert the batteries.

9.1 WARNING ABOUT BATTERY USE

- Batteries should be removed when the instrument is not used for an extended time.
- Flat batteries must be replaced immediately.
- Avoid loss of liquid from batteries.
- Use waterproof and good-quality batteries, if possible alkaline. Sometimes on the market, it is possible to find new batteries with an insufficient charge capacity.

10. INSTRUMENT STORAGE

Instrument storage conditions:
- Temperature: -25…+65°C.
- Humidity: less than 90% RH without condensation.
- During storage avoid locations where:
  - humidity is high;
  - the instrument may be exposed to direct sunlight;
  - the instrument may be exposed to a source of high temperature;
  - the instrument may be exposed to strong vibrations;
  - the instrument may be exposed to steam, salt or any corrosive gas.

Some parts of the instrument are made of ABS plastic, polycarbonate: do not use any incompatible solvent for cleaning.

11. TECHNICAL CHARACTERISTICS

Instrument	
Dimensions (Length x Width x Height)	220 x 180 x 50 mm
Weight	1.100 g (batteries included)
Materials	ABS, polycarbonate and aluminum
Display	Backlit, Dot Matrix 128 x 64 points, visible area 56 x 38mm
Operating conditions	
Operating temperature	-5… 50 °C
Warehouse temperature	-25…65 °C
Working relative humidity	0…90 %RH without condensation
Protection degree	**IP64**
Instrument uncertainty	± 1 digit @ 20 °C
Barometric pressure measurement with internal sensor	
Measuring range	600…1100 hPa
Resolution	0.1 hPa
Accuracy	±0.5 hPa
Response time	1 s
Instrument temperature measurement with Pt100 probe	
Pt100 measuring range	-200…+650 °C
Resolution	0.01 °C in the range ±199.99 °C, 0.1 °C in the remaining range
Accuracy	±0.01 °C in the range ±199.99 °C, ±0.1 °C in the remaining range
Temperature drift @20°C	0.003%/°C
Drift after 1 year	0.1 °C/year
Instrument relative humidity measurement (capacitive sensor)	
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
Power	
Mains adapter (code SWD10)	12 Vdc/1A
Batteries	4 1.5V type C-BABY batteries
Autonomy	RH and temperature probes: 200 hours with 7800mAh alkaline batteries Hot-wire probe @ 5m/s: 100 hours with 7800 mAh alkaline batteries
Power absorbed with instrument off	< 45 μA
Security of stored data	Unlimited

Connections	
Input for probes with SICRAM module	8 x 8-pole male DIN45326 connector
RS232C serial interface	
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. 15 m
USB interface	
Type	1.1 – 2.0 electrically isolated
Memory	divided into 64 blocks.
Memory capacity	67600 recordings for 8 inputs each.
Storage interval	selectable among: 15, 30 seconds, 1, 2, 5, 10, 15, 20, 30 minutes and 1 hour.
Print interval	selectable among: 15, 30 seconds, 1, 2, 5, 10, 15, 20, 30 minutes and 1 hour.

12. EXPLANATORY TABLES ON THE MICROCLIMATE PROBES USAGE

DeltaLog10 Software	Operating Program	Main Calculated Indexes	Environments	Reference Standard
DeltaLog10BASIC	**Prog.A**	**t_a:** Air Temperature **t_r:** Average Radiation Temperature **PMV:** Expected Average Rating **PPD:** **DR:** Draught Risk **t_o:** Operating temperature **t_{eq}:** Equivalent temperature	Moderate	ISO 7730
DeltaLog10 Hot Environments	**Prog.A**	**WBGT:** **SW_p:** Sweat Rate **E_p:** Predicted Evaporative Heat Flow **PHS:** Predicted Heat Strain Model	Severe Hot	ISO 7243
DeltaLog10 Cold Environments	**Prog.A**	**IREQ:** Required Insulation **DLE:** Limit Exposure Time **RT:** Limit Exposure Time **WCI:** Wind Chill Index	Severe Cold	ISO 11079
DeltaLog10 Discomfort Analysis	**Prog.B**	**PD_v:** Unsatisfied with the vertical difference of temperature (head-ankles) **PD_f:** Unsatisfied with the floor temperature **PD_Δ:** Unsatisfied with the radiant asymmetry	Moderate	ISO 7730
DeltaLog10BASIC	**Prog.C**	**t_a:** Air Temperature **RH-t:** Humidity-temperature **V_a-t:** Wind speed-temperature **Lux:** Illuminance **cd/m^2:** Luminance **μW/m^2:** **W/m^2:** Irradiance **μmol/m^{2}s:** PAR **CO_2:** Bioxide carbonic concentration (ppm) **CO:** Monoxide carbonic concentration (ppm)	General use	

12.1 Diagram of the probes for HD32.1 Operating Program A: Microclimate Analysis

TP3207	Dry bulb temperature probe.
TP3275	Globe thermometer probe Ø 150 mm. (instead of TP3276)
TP3276	Globe thermometer probe Ø 50mm. (instead of TP3275)
AP3203	Omni directional hot-wire probe (0…+80 °C).
AP3203F	Omni directional hot-wire probe (-30…+30 °C).
HP3201	Natural ventilation wet bulb probe.
HP3217R	Relative humidity and temperature combined probe.
HP3217DM	Two-sensor probe for natural ventilation wet bulb temperature and dry bulb temperature measurement (instead of: HP3201/TP3204S and TP3207).

in the following table, each row represents a possible combination of probes that allows the calculation of the related indexes.

	TP3207	TP3275	TP3276	AP3203 AP3203F	HP3201	HP3217R	HP3217DM	TP3204S
DELTALOG 10 Basic								
t_r: Mean radiant temperature	•	•		•				
	•		•	•				
		•		•			•	
			•	•			•	
		•		•		•		
			•	•		•		
PMV: Predicted average rating **PPD**: Dissatisfied percentage	•	•		•		•		
	•		•	•		•		
		•		•		•	•	
			•	•		•	•	
		•		•		•		
			•	•		•		
DR: Draught risk	•			•				
				•			•	
				•		•		

DELTALOG 10 Hot Environments		TP3207	TP3275	TP3276	AP3203 AP3203F	HP3201	HP3217R	HP3217DM	TP3204S
WBGT Indoor: Wet bulb globe temperature			•			•			
			•						•
				•		•			
				•					•
WBGT Outdoor: Wet bulb globe temperature in presence of solar radiation		•	•			•			
		•	•						•
		•		•		•			
		•		•					•
			•					•	
				•				•	
			•			•	•		
			•				•		•
				•		•	•		
				•			•		•
SW_p: Sweat rate E_p: Predicted evaporative heat flow		•	•		•		•		
		•		•	•		•		
			•		•		•	•	
				•	•		•	•	
			•		•		•		
				•	•		•		
PHS	T_{re}: Predicted rectal temperature	•	•		•		•		
	Water loss: Water loss	•		•	•		•		
	$D_{lim\ tre}$: Maximum exposure time for thermal accumulation		•		•		•	•	
				•	•		•	•	
	$D_{limloss50}$: Maximum exposure time for water loss, standard person		•		•		•		
	$D_{limloss95}$: Maximum exposure time for water loss, 95% of the working population			•	•		•		

<table>
<tr><th></th><th>TP3207</th><th>TP3275</th><th>TP3276</th><th>AP3203
AP3203F</th><th>HP3201</th><th>HP3217R</th><th>HP3217DM</th><th>TP3204S</th></tr>
<tr><td colspan="9">DELTALOG 10 Cold Environments</td></tr>
<tr><td rowspan="8">IREQ: Required insulation
DLE: Exposure time limit
RT: Required recovery time
WCI: Wind Chill Index</td><td>•</td><td>•</td><td></td><td>•</td><td></td><td>•</td><td></td><td></td></tr>
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</table>

12.2 Diagram of the probes for HD32.1 Operating Program B: Discomfort Analysis

<table>
<tr><th></th><th>TP3227K</th><th>TP3227PC</th><th>TP3207P</th><th>TP3207R</th></tr>
<tr><td colspan="5">DELTALOG 10 Discomfort Analysis</td></tr>
<tr><td>PD$_v$: Percentage of dissatisfied with vertical temperature difference (head-ankles)</td><td>•</td><td>•</td><td></td><td></td></tr>
<tr><td rowspan="2">PD$_f$: Percentage of dissatisfied with floor temperature</td><td></td><td>•</td><td></td><td></td></tr>
<tr><td></td><td></td><td>•</td><td></td></tr>
<tr><td>PD$_\Delta$: Percentage of dissatisfied with radiant asymmetry</td><td></td><td></td><td></td><td>•</td></tr>
</table>

13. ORDERING CODES

HD32.1	**Thermal microclimate, datalogger multifunction instrument** to measure the microclimate in moderate, hot, severe hot, cold environments and the measure of physical quantities. It is provided with 8 inputs for probes equipped with SICRAM module and a back-lighted graphic display. The instrument is able to manage three operative programs (**progr. A – Microclimate Analysis, progr. B – Discomfort Analysis, progr. C – Physical Quantities**). Memory capacity from 15 seconds to 1 hour up to 650,000 single parameters. Functions: CLOCK, HOLD, RELATIVE, MINIMUM, MAXIMUM, MEAN MEASUREMENT. Simultaneous display of the measurements on eight inputs. Output for PC RS232C or USB. Power supply: 4 alkaline batteries type C, autonomy of about 200 hours (it depends on the kind and number of connected probes), 12 Vdc socket for mains voltage. The operative programs **A (Microclimatic Analysis for moderate environments), B (Discomfort Analysis) and C (Physical Quantities) are included**. Includes DeltaLog10 software downloadable from Delta OHM website. Supplied with: 4 alkaline C-type batteries, instruction manual. The carrying case, the probes and the cables have to be ordered separately.

Accessories:

9CPRS232	Sub D 9-pole Female/Female RS232 null-modem cable.
CP22	USB 2.0 connection cable, connector type A - type B.
BAG32	Carrying case made of strong aluminium for instrument HD32.1 and its accessories.
SWD10	100-240 Vac/12 Vdc-1 A stabilized mains power supply.
VTRAP32	Tripod equipped with 6 input head and 5 probe holders code HD3218K.
HD3218K	Clamp shaft for a further probe.
AM32	Two clamps shaft for two further probes.
AQC	200 cc distilled water.

13.1 A AND B OPERATING PROGRAMS PROBES
A: MICROCLIMATE ANALYSIS
B: DISCOMFORT ANALYSIS

TP3207 Pt100 sensor temperature probe. Probe stem Ø14 mm, length 140 mm. Cable length 2 meters. Complete with SICRAM module.
In combination with other probes, it is used for calculating the following indices: **IREQ, WCI, DLE, RT, PMV, PPD, WBGT, PHS**. Used for calculating **Mean radiant temperature.**

TP3275 Pt100 sensor globe thermometer probe, globe Ø150 mm.
Stem Ø14 mm, length 110 mm. Cable length 2 meters. Complete with SICRAM module.
In combination with other probes, it is used for measuring **Mean radiant temperature, WBGT.**

TP3276 Pt100 sensor globe thermometer probe, globe Ø50 mm.
Stem Ø8 mm, length 110 mm. Cable length 2 meters. Complete with SICRAM module.
In combination with other probes, it is used for measuring **Mean radiant temperature, WBGT.**

TP3227K Temperature probe composed of 2 standalone temperature probes, Pt100 sensor. Stem Ø14 mm, length 500 mm. Cable length 2 meters. Complete with dual SICRAM module and telescopic rod Ø14 mm, length 450 mm TP3227.2.
In combination with other probes, it is used for measuring **local discomfort due to vertical thermal gradient. It can be used for studying subjects standing or sitting. The height of one probe can be regulated.**

TP3227PC Temperature probe is composed of 2 standalone temperature probes, Pt100 sensor, one for floor level temperature measurement (Ø70 mm, height 30 mm), the other for temperature measurement at ankle height (Ø3 mm, height 100 mm). Cable length 2 meters. Complete with dual SICRAM module.
In combination with other probes, it is used for measuring **local discomfort due to vertical thermal gradient.**

TP3207P Pt100 sensor temperature probe for floor level temperature measurement (Ø70 mm, height 30 mm). Cable length 2 meters. Complete with SICRAM module.
In combination with other probes, it is used for the **evaluation of dissatisfied people due to radiant asymmetry.**

TP3207TR Probe for radiant temperature measurement. Probe stem Ø16 mm, length 250 mm. Cable length 2 meters. Complete with SICRAM module.
In combination with other probes, it is used for the **evaluation of dissatisfied people due to radiant asymmetry.**

AP3203 Omni directional hot-wire probe. Measurement range: Wind speed 0.02…5 m/s, temperature **0…+80 °C**. Probe stem Ø8 mm, length 230 mm. Cable length 2 meters. Complete with SICRAM module.
In combination with other probes, it is used for the following indexes calculation: **IREQ, WCI, DLE, RT, PMV, PPD, SR**. Used for the average radiation temperature calculation.

AP3203F Omni directional hot-wire probe. Measurement range: Wind speed 0.02…5 m/s, temperature **-30…+30 °C**. Probe stem Ø8 mm, length 230 mm. Cable length 2 meters. Complete with SICRAM module.
In combination with other probes, it is used for the following indexes calculation: **IREQ, WCI, DLE, RT, PMV, PPD, SR**. Used for the average radiation temperature calculation.

HP3201 Natural ventilation wet bulb probe. Pt100 sensor. Probe stem Ø 14 mm, length 110 mm. Cable length 2 meters. Complete with SICRAM module, cotton wick spare and container with 50 cc of distilled water.
In combination with other probes, it is used for measuring **WBGT**.

HP3217R Relative humidity and temperature combined probe. Capacity sensor for relative humidity, Pt100 temperature sensor. Probe stem Ø14 mm, length 110 mm. Cable length 2 meters. Complete with SICRAM module.
In combination with other probes, it is used for the following indexes calculation: **IREQ, WCI, DLE, RT, PMV, PPD, SR**.

HP3217DM Dual natural ventilation wet bulb and temperature probe (dry bulb). Probe stem Ø14 mm, length 110 mm. Cable length 2 meters. Complete with dual SICRAM module, braid spare and container with 50 cc of distilled water.

TP3204S Natural ventilation wet bulb probe for long-lasting measurements. Pt100 sensor. Probe stem Ø14 mm. Cable length 2 meters. Complete with SICRAM module, 500 cc bottle and two spare cotton wicks.
In combination with other probes, it is used for the measurement of: **WBGT**.

13.2 PROBES FOR THE OPERATING PROGRAM C: PHYSICAL QUANTITIES

13.2.1 Temperature probes complete with SICRAM module

TP472I Pt100 sensor immersion probe. Stem Ø 3 mm, length 300 mm. Cable length 2 meters.

TP472I.O Pt100 sensor immersion probe. Stem Ø 3 mm, length 230 mm. Cable length 2 meters.

TP473P.I Pt100 sensor penetration probe. Stem Ø 4 mm, length 150 mm. Cable length 2 meters.

TP473P.O Pt100 sensor penetration probe. Stem Ø 4 mm, length 150 mm. Cable length 2 meters.

TP474C.O Pt100 sensor contact probe. Stem Ø 4 mm, length 230 mm, contact surface Ø 5 mm. Cable length 2 meters.

TP475A.O Pt100 sensor air probe. Stem Ø 4 mm, length 230 mm. Cable length 2 meters.

TP472I.5 Pt100 sensor penetration probe. Stem Ø 6 mm, length 500 mm. Cable length 2 meters.

TP472I.10 Pt100 sensor penetration probe. Stem Ø 6 mm, length 1000 mm. Cable length 2 meters.

13.2.2 Relative Humidity and Temperature combined probes complete with SICRAM module

HP472ACR Combined probe %RH and temperature, dimensions Ø26 x 170 mm. Connection cable length 2 meters.

HP473ACR Combined probe %RH and temperature. Handle size Ø26 x 130 mm, probe Ø14 x 120 mm. Connection cable length 2 meters.

HP474ACR Combined probe %RH and temperature. Handle size Ø26 x 130 mm, probe Ø14 x 215 mm. Connection cable length 2 meters.

HP475ACR Combined probe %RH and temperature. Connection cable length 2 meters. Handle Ø26 x 110 mm. Stainless steel stem Ø12 x 560mm. Point Ø13.5 x 75 mm.

HP475AC1R Combined probe %RH and temperature. Stainless steel probe Ø14 x 480 mm with sintered stainless steel filter 20 µm. Handle 80 mm. Connection cable length 2 meters.

HP477DCR Combined sword probe %RH and temperature. Connection cable length 2 meters. Handle Ø26 x 110 mm. Probe's stem 18 x 4 mm, length 520 mm.

HP478ACR Combined probe %RH and temperature. Stainless steel probe stem Ø14 x 130 mm. Connection cable length 5 meters.

13.2.3 Wind Speed and Temperature combined probes complete with SICRAM module

HOT-WIRE PROBES

AP471S1 Hot-wire telescopic probe, measuring range: 0.02…40 m/s. Cable length 2 meters.

AP471S2 Omni directional hot-wire telescopic probe, measuring range: 0.02…5 m/s. Cable length 2 meters.

AP471S3 Hot-wire telescopic probe with terminal tip for easy position, measuring range: 0.02…40 m/s. Cable length 2 meters.

AP471S4 Omni directional hot-wire telescopic probe with base, measuring range: 0.02…5m/s. Cable length 2 meters.

VANE PROBES

AP472 S1 Vane probe with thermocouple K, Ø100 mm. Speed from 0.6 to 25 m/s; temperature from -25 to 80°C. Cable length 2 meters.

AP472 S2 Vane probe, Ø 60 mm. Measurement range: 0.5…20m/s. Cable length 2 meters.

13.2.4 Photometric/Radiometric probes for Light measurement complete with SICRAM module

LP471PHOT Photometric probe for **ILLUMINANCE** measurement complete with SICRAM module, spectral response in agreement with standard photopic vision, diffuser for cosine correction. Measurement range: 0.1 lux…$200 \cdot 10^3$ lux.

LP471LUM2 Photometric probe for **LUMINANCE** measurement complete with SICRAM module, spectral response in agreement with standard photonic vision, vision angle 2°. Measurement range: 0.1…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 400 nm…700 nm) complete with SICRAM, measurement in µmol/m^2s, diffuser for cosine correction. Measurement range: 0.01…10×10^3 µmol/m^2s.

LP471RAD Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module; in the 400 nm…1050 nm spectral range, diffuser for cosine correction. Measurement range: 0.1×10^{-3}…2000 W/m^2.

LP471UVA Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module; in the 315 nm…400 nm, peak 360 nm, **UVA** spectral range, quartz diffuser for cosine correction. Measurement range: 1×10^{-3}…2000 W/m^2.

LP471UVB Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module, in the 280 nm…315 nm, peak 305 nm, **UVB** spectral range, quartz diffuser for cosine correction. Measurement range: 1×10^{-3}…2000 W/m^2.

LP471UVC Radiometric probe for **IRRADIANCE** measurement complete with SICRAM module, in the 220 nm…280 nm, peak 260 nm, **UVC** spectral range, quartz diffuser for cosine correction. Measurement range: 1×10^{-3}…2000 W/m^2.

LP471UVBC Radiometric probe for the measurement of **irradiance** in the 210…355 nm **UVBC** spectral range, peak at 265 nm, complete with SICRAM module, quartz diffuser for cosine correction. Measuring range: 1×10^{-3}…2000 W/m^2.

LP471BLUE Radiometric probe for the measurement of effective irradiance in the Blue light spectral band, complete with SICRAM module. Spectral range 380…550 nm, diffuser for cosine correction. Measuring range: 0.1×10^{-3}…2000 W/m^2.

LP32F/R Support bracket for photometric-radiometric probes for Light measurement LP471...

13.2.5 Probes for CO_2 carbon dioxide measurement complete with SICRAM module

HD320B2 Probe for the measurement of CO_2 carbon dioxide complete with SICRAM module, with double source infrared sensor. Measurement range: 0…5000 ppm. Cable length 2 m equipped with SICRAM module.

HD37.37 Connection tube kit between instrument and nitrogen cylinder for CO_2 calibration.

13.2.6 Probes for the measurement of CO carbon monoxide complete with SICRAM module

HD320A2 Probe for the measurement of CO carbon monoxide complete with SICRAM module, with electro chemical sensor endowed with two electrodes. Measurement range: 0…5000 ppm. Cable length 2m equipped with SICRAM module.

HD320AS2 Magnetic support for fixing the probe HD320A2 to the housing of probe HD320B2.

HD37.36 Connection tube kit between instrument and nitrogen cylinder for CO calibration.

DELTA OHM metrology laboratories LAT N° 124 are ISO/IEC 17025 accredited by ACCREDIA for Temperature, Humidity, Pressure, Photometry / Radiometry, Acoustics and Air Velocity. They can supply calibration certificates for the accredited quantities.

DICHIARAZIONE DI CONFORMITÀ UE
EU DECLARATION OF CONFORMITY

Delta Ohm S.r.L. a socio unico – Via Marconi 5 – 35030 Caselle di Selvazzano – Padova – ITALY

Documento Nr. / Mese.Anno:
Document-No. / Month.Year: **5121 / 07.2019**

Si dichiara con la presente, in qualità di produttore e sotto la propria responsabilità esclusiva, che i seguenti prodotti sono conformi ai requisiti di protezione definiti nelle direttive del Consiglio Europeo:
We declare as manufacturer herewith under our sole responsibility that the following products are in compliance with the protection requirements defined in the European Council directives:

Codice prodotto:
Product identifier : **HD32.1**

Descrizione prodotto:
Product description : **Analizzatore di microclima**
Microclimate analyzer

I prodotti sono conformi alle seguenti Direttive Europee:
The products conform to following European Directives:

Direttive / *Directives*	
2014/30/EU	Direttiva EMC / *EMC Directive*
2014/35/EU	Direttiva bassa tensione / *Low Voltage Directive*
2011/65/EU - 2015/863/EU	RoHS / *RoHS*

Norme armonizzate applicate o riferimento a specifiche tecniche:
Applied harmonized standards or mentioned technical specifications:

Norme armonizzate / *Harmonized standards*	
EN 61010-1:2010	Requisiti di sicurezza elettrica / *Electrical safety requirements*
EN 61326-1:2013	Requisiti EMC / *EMC requirements*
EN 50581:2012	RoHS / *RoHS*

Il produttore è responsabile per la dichiarazione rilasciata da:
The manufacturer is responsible for the declaration released by:

Johannes Overhues

Amministratore delegato
Chief Executive Officer

Caselle di Selvazzano, 19/07/2019

Questa dichiarazione certifica l'accordo con la legislazione armonizzata menzionata, non costituisce tuttavia garanzia delle caratteristiche.
This declaration certifies the agreement with the harmonization legislation mentioned, contained however no warranty of characteristics.

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www.deltaohm.com | sales@deltaohm.com

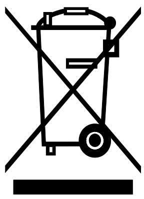
WARRANTY

Delta OHM is required to respond to the "factory warranty" only in those cases provided by Legislative Decree 6 September 2005 - n. 206. Each instrument is sold after rigorous inspections; if any manufacturing defect is found, it is necessary to contact the distributor where the instrument was purchased from. During the warranty period (24 months from the date of invoice) any manufacturing defects found will be repaired free of charge. Misuse, wear, neglect, lack or inefficient maintenance as well as theft and damage during transport are excluded. Warranty does not apply if changes, tampering or unauthorized repairs are made on the product. Solutions, probes, electrodes and microphones are not guaranteed as the improper use, even for a few minutes, may cause irreparable damages.
Delta OHM repairs the products that show defects of construction in accordance with the terms and conditions of warranty included in the manual of the product. For any dispute, the competent court is the Court of Padua. The Italian law and the “Convention on Contracts for the International Sales of Goods” apply.

TECHNICAL INFORMATION

The quality level of our instruments is the result of the continuous product development. This may lead to differences between the information reported in the manual and the instrument you have purchased. In case of discrepancies and/or inconsistencies, please write to sales@deltaohm.com.
Delta OHM reserves the right to change technical specifications and dimensions to fit the product requirements without prior notice.

DISPOSAL INFORMATION



Electrical and electronic equipment marked with specific symbol in compliance with 2012/19/EU Directive must be disposed of separately from household waste. European users can hand them over to the dealer or to the manufacturer when purchasing a new electrical and electronic equipment, or to a WEEE collection point designated by local authorities. Illegal disposal is punished by law.

Disposing of electrical and electronic equipment separately from normal waste helps to preserve natural resources and allows materials to be recycled in an environmentally friendly way without risks to human health.

CE RoHS

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03/2022