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English

Operating manual

Thermal microclimate

HD32.3TC

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1 INTRODUCTION

HD32.3TC is a portable instrument indicated for the microclimate and Indoor Air Quality (IAQ) analysis.

Depending on the probes connected, the instrument measures:

- **T** dry bulb temperature
- $\mathbf{T_{nw}}$ natural ventilation wet bulb temperature
- $\mathbf{T_g}$ globe thermometer temperature
- **RH** relative humidity
- $\mathbf{V_a}$ air speed
- $\mathbf{CO_2}$ carbon dioxide
- $\mathbf{P_{atm}}$ atmospheric pressure
- **PM1.0**, **PM2.5**, **PM10** particulate matter

and calculates:

- **WBGT indoor** (Wet Bulb Globe Temperature) index in absence of solar irradiation
- **WBGT outdoor** (Wet Bulb Globe Temperature) index in presence of solar irradiation
- Mean radiant temperature **Tr**
- **PMV** (Predicted Mean Vote) index
- **PPD** (Predicted Percentage of Dissatisfied) index
- **TU** (Turbolence) index
- **DR** (Draft Rate) index

Instrument main features:

- Data logger with large memory capacity for long measuring cycles.
- Rechargeable battery that guarantees an operating autonomy of at least 24 hours.
- Backlit Color 4” graphic LCD (active area 52x87 mm, 800x480 pixel) with capacitive touch.
- Data immediately available via "cloud" application accessible remotely via Wi-Fi connection.
- Three inputs for probes with SICRAM module, which keeps memory of the probe calibration data. The probes can be inserted in any of the inputs: they are automatically recognized when the instrument is turned on.
- RS485 serial port to which auxiliary probes can be connected: for example the **HD32PMB4W** probe for measuring fine particles, CO_2, and atmospheric pressure.
- OTG Mini-USB port for PC connection and battery charging.

Microclimate applications:

- In **moderate environment** (in compliance with ISO 7730 and ASHRAE 55 standards):
  - Measurement of the **PMV**, **PPD** and $\mathbf{T_r}$ global comfort indices.
  - Measurement of the **DR** local discomfort index.
- In **severe hot environment** (in compliance with ISO 7243 standard):
  - Measurement of the **WBGT** index.

IAQ applications:

- Measurement of comfort conditions and indoor air quality, for example in schools, offices, factories, etc.
- Sick building syndrome analysis.
- Verification of the efficiency of Heating, Ventilation and Air Conditioning (HVAC) systems.
- Building Automation.

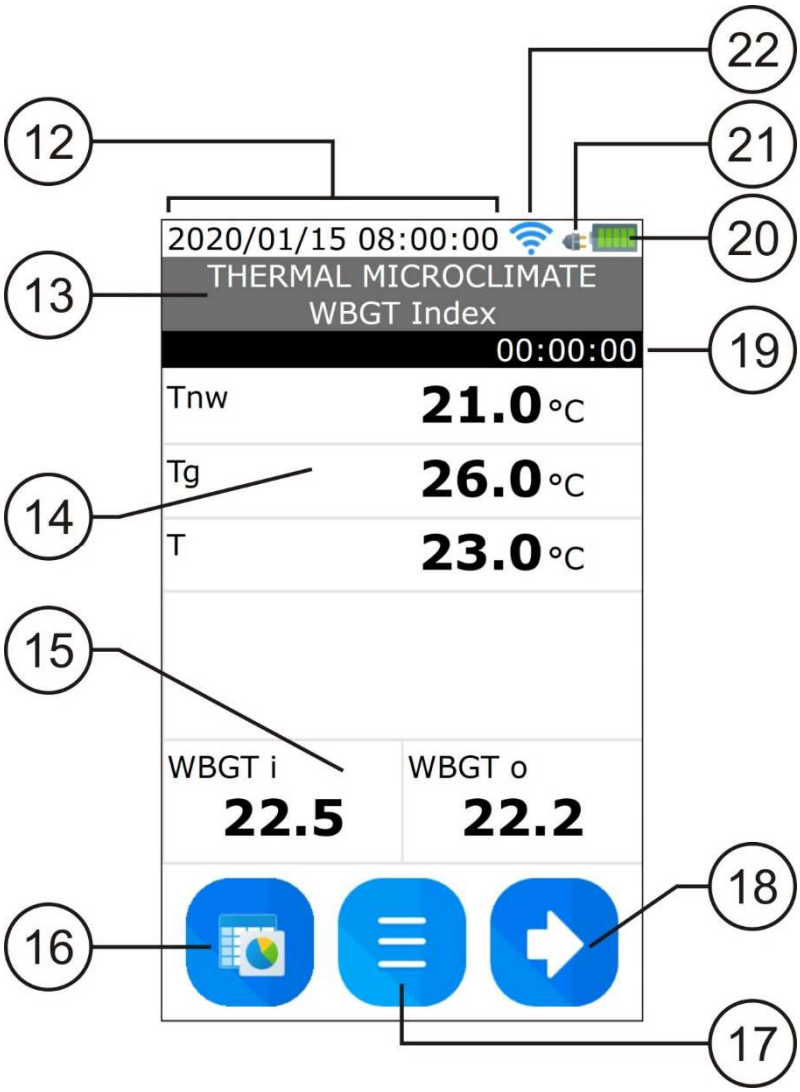
Reference standards:

- **ISO 7726** Ergonomics of the thermal environment - Instruments for measuring physical quantities.
- **ISO 7730** Ergonomics of the thermal environment - Analytical determination and interpretation of thermal comfort using calculation of the PMV and PPD indices and local thermal comfort criteria.
- **ISO 7243** Ergonomics of the thermal environment - Assessment of heat stress using the WBGT (wet bulb globe temperature) index.
- **ASHRAE Standard 55** Thermal Environmental Conditions for Human Occupancy.
- **ASHRAE Standard 62.1-2019** Ventilation for Acceptable Indoor Air Quality.
- **ASHRAE Standard 62.1-2019** Ventilation for Acceptable Indoor Air Quality.

2 DESCRIPTION

1. Input for **SICRAM** probes.
2. OTG mini-USB input for power supply, battery charging, PC connection.
3. Three-color (RGB) LED: indicates logging and battery status. It blinks green if the logging is not active; It blinks blue if the logging is active; it blinks red if the battery is almost discharged.
4. Microphone.
5. Graphic backlit LCD display with capacitive touch.
6. **BACKLIGHT** key: turns the display backlight on and off.
7. **REC** key: starts and stops the data logging.
8. **ON/OFF** key: switches the instrument on and off.
9. Tripod fixing.
10. Camera.
11. RS485 serial port for the connection of auxiliary probes.

Display



12. Date and time.
13. Type of measurement.
14. Physical quantities measured by the connected probes.
15. Calculated indices.
16. Key for viewing the graphs.
17. Key for entering the menu.
18. Key to view the next page (the scrolling is cyclic).
19. Duration of the current logging session (the counter is updated with each acquisition) or of the last logging session, if logging has been stopped.
20. Battery charge level.
21. Indicator of the presence of the external power supply.
22. Status of the Wi-Fi connection.

3 THERMAL MICROCLIMATE

Thermal Microclimate refers to the environmental parameters that influence the thermal exchanges between an individual and the environment in confined places, and that determine the so-called "thermal well-being".

The micro-environmental climatic factors, together with the type of work done, condition the worker in a series of biologic responses linked to well-being situations (Comfort) or thermal uneasiness (Discomfort). In fact, the human body tries to keep the thermal balance in equilibrium conditions in order to keep the body temperature on optimal values.

The instrument detects the following quantities:

In **WBGT index** visualization:

- **T_{nw}**: natural ventilation wet bulb temperature probe
- **T_g**: globe thermometer temperature
- **T_a**: ambient temperature

In **PMV - PPD index** visualization:

- **V_a**: air speed
- **T_g**: globe thermometer temperature
- **T_a**: ambient temperature
- **RH**: relative humidity

In **Turbolence** visualization:

- **V_a**: air speed
- **T_a**: ambient temperature

In addition to the direct measurements made with the probes connected, the instrument calculates and displays:

- In **WBGT index** visualization: the **WBGT index** in presence or absence of solar radiation.
- In **PMV index** visualization: the medium radiant temperature **T_r**, the Predicted Mean Vote PMV and Predicted Percentage of Dissatisfied **PPD**.
- In **Turbolence** visualization: the local Turbulence intensity **TU** and the Draft Rate **DR**.

3.1 WBGT INDEX

WBGT (Wet Bulb Globe Temperature) is one of the indices used for determining the thermal stress to which is submitted an individual in a warm environment. It represents the value, with reference to the metabolic waste associated with a particular activity, beyond which the individual is in a thermal stress condition. WBGT index combines the natural ventilation wet bulb temperature measurement **T_{nw}** with the Globe thermometer temperature **T_g** and, in some situations, with the air temperature **T_a**. The formula for the calculation is the following, and refers to an individual with reference cotton work clothing (I_{cl} = 0.6 and i_m = 0.38):

- inside and outside the buildings in **absence of solar irradiation**:

$$\mathbf{WBGT_{close\ environments} = 0.7\ T_{nw} + 0.3\ T_g}$$

- outside the building in **presence of solar irradiation**:

$$\mathbf{WBGT_{external\ environments} = 0.7\ T_{nw} + 0.2\ T_g + 0.1\ T_a}$$

where:
T_{nw} = natural ventilation wet bulb temperature
T_g = globe thermometer temperature
T_a = air temperature

The detected data must be compared with the limit values established by the standard; if they are exceeded, it is necessary to:

- directly reduce the thermal stress in the workplace under consideration;
- proceed with a detailed analysis of the thermal stress.

Table 3.1: limit values of the thermal stress WBGT indicated in the ISO 7243 standard

METABOLIC RATE CLASS	METABOLIC RATE, M		WBGT LIMIT VALUE			
	RELATIVE TO A UNIT AREA OF SKIN SURFACE (W/m^2)	TOTAL (FOR AN AVERAGE AREA OF SKIN SURFACE OF 1.8 m^2) (W)	INDIVIDUAL ACCLIMATED TO HEAT (°C)		INDIVIDUAL NON- ACCLIMATED TO HEAT (°C)	
0 (RESTING)	M ≤ 65	M ≤ 117	33		32	
1	65 < M ≤ 130	117 < M ≤ 234	30		29	
2	130 < M ≤ 200	234 < M ≤ 360	28		26	
3	200 < M ≤ 260	360 < M ≤ 468	STAGNANT AIR 25	NON- STAG-NANT AIR 26	STAGNANT AIR 22	NON-STAG-NANT AIR 23
4	M > 260	M > 468	23	25	18	20
NOTE: THE VALUES HAVE BEEN ESTABLISHED TAKING AS A REFERENCE A MAXIMUM RECTAL TEMPERATURE OF 38 °C.						

To calculate the WBGT index, the following probes must be connected:

- **HP3201.2**, **HP3201** or **TP3204S** natural ventilation wet bulb temperature probe.
- **TP3276.2** or **TP3275** globe thermometer probe.
- **TP3207.2** or **TP3207** dry bulb temperature probe if the detection is made in presence of solar irradiation.

For the measurement of the WBGT index, reference is made to the standards:

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

3.2 PREDICTED MEAN VOTE PMV AND PREDICTED PERCENTAGE OF DISSATISFIED PPD

The thermal comfort is defined by ASHRAE (American Society of Heating, Refrigerating and Air Conditioning Engineers INC) as a condition of psycho-physical well-being of the individual with reference to the environment in which he lives and works.

The evaluation of such subjective state can be objectified and calculated using integrated indices that consider the ambient microclimatic parameters (Ta, Tr, Va, RH), the energetic waste (metabolic waste MET) associated with the working activity and the clothing typology (thermal insulation CLO) usually used.

The index that more accurately reflects the influence of the physical and physiological variables is the **PMV** (Predicted Mean Vote) index.

In summary, it comes from the equation of thermal balance whose result is related with a psycho-physical well-being scale and expresses the mean vote (predicted mean vote) on the thermal sensations of a sample of individuals that are in the same environment.

From the PMV index is derived a second index called **PPD** (Predicted Percentage of Dissatisfied) which quantifies in percentage the "dissatisfied" individuals in relation to certain microclimatic conditions.

ISO 7730 standard suggests the PMV index use in presence of the following ranges of variations of the variables influencing the thermal balance:

- Energetic waste = 1 ÷ 4 met
- Clothing thermal impedance = 0 ÷ 2 clo
- Wet bulb temperature = 10 ÷ 30 °C
- Mean radiant temperature = 10 ÷ 40 °C
- Air speed = 0 ÷ 1 m/s
- Vapour pressure = 0 ÷ 2.7 kPa

The PMV index is therefore an index particularly suitable for the evaluation of **working environments with moderate microclimate**, such as houses, schools, offices, laboratories, hospitals, etc.; it is useful in detecting limited degrees of thermal discomfort in residents of such environments.

ISO 7730 standard suggests PMV values between +0.5 and -0.5 for the thermal comfort, which corresponds to a percentage of dissatisfied with the thermal conditions (PPD) less than 10% (see the following table).

Table 3.2: thermal sensation scale

PMV	PPD (%)	THERMAL SENSATION
+3	100	Very Hot
+2	75.7	Hot
+1	26.4	A little bit warm
+0.85	20	Acceptable thermal environment
-0.5…+0.5	< 10	Thermal well-being
-0.85	20	Acceptable thermal environment
-1	26.8	A little bit cold
-2	76.4	Cold
-3	100	Very Cold

For the calculation of PMV and PPD indices it is necessary to know:

- The working charge (energetic waste);
- The thermal impedance of clothing.

The working charge can be quantified using the following units of measurement:

- **kcal/h (1 kcal/h = 1.163 W):** with this unit it is expressed the average power per hour supplied by an individual during the working activity;
- **MET (1 MET = 58.15 W/m²):** with this unit it is expressed the total power per hour supplied by an individual during the working activity divided by the body surface of the individual.

Clothing thermal impedance:

The clothing thermal impedance is measured in CLO.

1 CLO = thermal gradient of 0.18 °C on a 1 m^2 area crossed by 1 kcal/h thermal flow.

The following tables can help to establish the thermal impedance values of the clothing and the working charge (metabolism).

Table 3.3: thermal impedance values of some typical clothes combinations (ISO 9920)

Clothing	CLO	m^2 K/W
Work clothing		
Pants, overalls, socks, shoes	0.70	0.110
Pants, shirt, pants, socks, shoes	0.75	0.115
Pants, shirt, overalls, socks, shoes	0.80	0.125
Pants, shirt, pants, jacket, socks, shoes	0.85	0.135
Pants, shirt, pants, aprons, socks, shoes	0.90	0.140
Lingerie with short sleeves and legs, shirt, pants, jacket, socks, shoes	1.00	0.155
Lingerie with short sleeves and legs, shirt, pants, overalls, socks, shoes	1.10	0.170
Lingerie with long sleeves and legs, thermal jacket, socks, shoes	1.20	0.185
Lingerie with short sleeves and legs, shirt, pants, jacket, thermal jacket, socks, shoes	1.25	0.190
Lingerie with short sleeves and legs, overalls, thermal jacket and trousers, socks, shoes	1.40	0.220
Lingerie with short sleeves and legs, shirt, pants, jacket, thermal jacket and trousers, socks, shoes	1.55	0.225
Lingerie with short sleeves and legs, shirt, pants, jacket, padded jacket with heavy overalls, socks, shoes	1.85	0.285
Lingerie with short sleeves and legs, shirt, pants, jacket, heavy jacket and track suit, socks, shoes, cap, gloves	2.00	0.310
Lingerie with long sleeves and legs, thermal jacket and pants, thermal outer jacket and trousers, socks, shoes	2.20	0.340
Lingerie with long sleeves and legs, thermal jacket and pants, parka with heavy padding, padding with heavy overalls, socks, shoes, cap, gloves	2.55	0.395
Daily clothing		
Pants, shirt, shorts, light socks, sandals	0.30	0.050
Slip, slip, stockings, dress with light sleeves, sandals	0.45	0.070
Pants, shirt with short sleeves, light trousers, light socks, shoes	0.50	0.080
Panties, stockings, short-sleeve shirt, skirt, sandals	0.55	0.085
Pants, shirt, light trousers, socks, shoes	0.60	0.095
Slip, slip, stockings, dress, shoes	0.70	0.105
Underwear, shirts, trousers, socks, shoes	0.70	0.110
Underwear, complete racing (shirt and trousers), long socks, running shoes	0.75	0.115
Slip, slip, blouse, skirt, thick knee socks, shoes	0.80	0.120
Pants, shirt, skirt, a sweater necklace, thick knee socks, shoes	0.90	0.140
Pants, blouses with short sleeves, pants, sweater with a V-neck, socks, shoes	0.95	0.145
Pants, shirt, pants, jacket, socks, shoes	1.00	0.155
Panties, socks, shirt, skirt, vest, jacket	1.00	0.155
Panties, stockings, blouse, long skirt, jacket, shoes	1.10	0.170
Underwear, blouses with short sleeves, shirt, pants, jacket, socks, shoes	1.10	0.170
Underwear, short sleeve blouses, shirts, trousers, waistcoats, jackets, socks, shoes	1.15	0.180
Lingerie with long sleeves and legs, shirt, pants, sweater with a V-neck, jacket, socks, shoes	1.30	0.200
Lingerie with long sleeves and legs, shirt, pants, vest, jacket, coat, socks, shoes	1.50	0.230
Knitted underwear		
Panties	0.30	0.047
Long Panties	0.10	0.016
Blouse	0.04	0.006
Short-sleeve shirt	0.09	0.014
Long-sleeve shirt	0.12	0.019
Panties and bra	0.03	0.005
Jerseys - blouses		
Short-sleeve	0.15	0.023

Clothing	CLO	m^2 K/W
Light, with long sleeves	0.20	0.031
Normal, with long sleeves	0.25	0.039
In flannel, with long sleeves	0.30	0.047
Light blouse, with long sleeves	0.15	0.023
Trousers		
Short	0.06	0.009
Light	0.20	0.031
Normal	0.25	0.039
In flannel	0.28	0.043
Clothes- skirts		
Light skirt (summer)	0.15	0.023
Heavy skirt (winter)	0.25	0.039
Light dress, with short sleeves	0.20	0.031
Winter dress, with long sleeves	0.40	0.062
Overall	0.55	0.085
Sweaters		
Gilet	0.12	0.019
Light sweater	0.20	0.031
Sweater	0.28	0.043
Heavy sweater	0.35	0.054
Jackets		
Light , summer jacket	0.25	0.039
Jacket	0.35	0.054
Apron	0.30	0.047
High thermal insulation, synthetic fur padding		
Suit	0.90	0.140
Trousers	0.35	0.054
Jacket	0.40	0.062
Waistcoat	0.20	0.031
Outdoor clothing		
Coat	0.60	0.093
Under-jacket	0.55	0.085
Parka	0.70	0.109
Suit	0.55	0.085
Accessories		
Socks	0.02	0.003
Heavy ankle socks	0.05	0.008
Heavy long socks	0.10	0.016
Nylon socks	0.03	0.005
Shoes (thin soles)	0.02	0.003
Shoes (thick soles)	0.04	0.006
Boots	0.10	0.016
Gloves	0.05	0.008

Table 3.4: metabolic rate – classification according to the job

Job		**Metabolism** (W/m^2)
Craftsman	Bricklayer	110 ÷ 160
	Carpenter	110 ÷ 175
	Glazier	90 ÷ 125
	Painter	100 ÷ 130
	Baker	110 ÷ 140
	Butcher	105 ÷ 140
	Watchmaker	55 ÷ 70
Mining	Trasporter worker	70 ÷ 85
	Coal miner	110
	Coke oven worker	115 ÷ 175
Steel industry	Blastfurnace worker	170 ÷ 220
	Electrical oven worker	125 ÷ 145
	Trainer by hand	140 ÷ 240
	Trainer by machine	105 ÷ 165
	Melter	140 ÷ 240
Metallurgical industry	Blacksmith	90 ÷ 200
	Welder	75 ÷ 125
	Turner	75 ÷ 125
	Milled operator	80 ÷ 140
	Precision mechanic	70 ÷ 110
Graphical jobs	Composer by hand	70 ÷ 95
	Bookbinder	75 ÷ 100
Agriculture	Gardener	115 ÷ 190
	Tractor Conducer	85 ÷ 110
Traffic	Car Conducer	70 ÷ 100
	Bus Conducer	75 ÷ 125
	Tram Conducer	80 ÷ 115
	Crane Conducer	65 ÷ 145
Different jobs	Laboratory assistant	85 ÷ 100
	Teacher	85 ÷ 100
	Sales assistance	100 ÷ 120
	Secretary	70 ÷ 85

Table 3.5: Metabolic rate – classification by category

Class	M variation range		Examples
	W/m^2	W	
0 At rest	65 (55 ÷ 70)	115 (100 ÷ 125)	Rest
1 Low metabolic rate	100 (70 ÷ 130)	180 (125 ÷ 235)	**Comfortable seated**: light manual work (writing, typing, drawing, cutting, accounting), working with hands and arms (small tools, inspection, assembly or sorting of material), with arms and legs (driving a vehicle under normal conditions, operation of a pedal or a switch with the feet). **Standing**: work with drill (small pieces), milling machine (small pieces), winding bobbins, winding small armatures, work with low power machines, walk (speed up to 3.5 km/h).
2 Moderate metabolic rate	165 (130 ÷ 200)	295 (235 ÷ 360)	Moderate work with hands and arms: (hammering nails, filing), work with arms and legs (driving off-road trucks, tractors or building machinery), work with arms and trunk (with jackhammer, tractor assembly, plastering, intermittent handling of moderately heavy materials, weeding, hoeing, picking fruits and vegetables), push or pull light wagons or wheelbarrows, walk at speeds between 3.5 and 5.5 km/h; forging.
3 High metabolic rate	230 (200 ÷ 260)	415 (360 ÷ 465)	Intense work with arms and bust, bringing heavy material, digging with shovel; working with hammer, saw, chisel or plane hardwood; shearing the grass by hand, digging, walking at a speed between 5.5 and 7 km/h. Pushing or pulling wagons and wheelbarrows with heavy loads; debarring castings; placing cement blocks.
4 Very high metabolic rate	290 (> 260)	520 (>465)	Very intense work at a fast to maximum pace; working with the ax, digging so intense, climbing the stairs, ramps, walking quickly in small steps, running, walking at speeds greater than 7 km/h.

Table 3.6: metabolic rate – classification by specific activity

Activity	W/m²
Flat walk along the path	
At 2 km/h	110
At 3 km/h	140
At 4 km/h	165
At 5 km/h	200
Walking uphill at 3 km/h	
Slope of 5°	195
Sope of 10°	275
Slope of 15°	390
Walking downhill at 5 km/h	
Slope of 5°	130
Slope of 10°	115
Slope of 15°	120
Climb a ladder (0.172 m/step)	
80 steps per minute	440
Down a scale (0.172 m/step)	
80 steps per minute	155
Carry a cargo at 4 km/h	
Mass 10 kg	185
Mass 30 kg	250
Mass 50 kg	360
Relaxing	
Sleeping	41
Standing	46
Sitting relaxed	58
Relaxing	65
Standing relaxed	79
Various	
Sedentary activity (office, home, lab, light ind.)	70
Light standing activity (shopping, lab, light ind.)	93
standing moderate activity (shop assistant, housework, work on machine)	116
Jobs – Building industry	
Laying bricks (building a uniform wall)	
Full brick (mass 3.8 kg)	150
Hollow brick (mass 4.2 kg)	140
Hollow brick (mass 15.3 kg)	125
Hollow brick (mass 23.4 kg)	135
Prefabrication of concrete elements	
Mounting and unmounting formworks (prestressed concrete)	180
Inserting steel rods	130
Pouring concrete (prestressed concrete)	180
Construction of houses	
Mixing cement	155
Pouring concrete for foundations	275
Compacting concrete by vibration	220
Mounting formworks	180
Load the wheelbarrow with stones and lime	275

Activity	W/m²
Jobs – Steel industry	
Blastfurnace	
Preparing the casting channel	340
Tapping	430
Forming (by hand)	
Forming medium size pieces	285
Hammering with jackhammer	175
Forming small pieces	140
Forming (by machine)	
Pouring castings	125
Forming, ladle with one operator	220
Forming, ladle with two operators	210
Forming from a ladle suspended to a crane	190
Finishing	
Working with jackhammer	175
Grinding. Cutting.	175
Jobs – Forestry industry	
Transportation and working with ax	
Walking and carrying (7 kg) in a forest, 4 km/h	285
Carrying an electric saw (18 kg) by hand, 4 km/h	385
Working with an ax (2 kg, 33 strokes/min)	500
Cutting roots with the ax	375
Chopping down (fir)	415
Sawing - cutting with circular saw operated by two people	
60 double strokes/min, 20 cm^2 per double stroke	415
40 double strokes/min, 20 cm^2 per double stroke	240
Sawing - cutting with electric saw	
Saw operated by a person	235
Saw operated by two people	205
Sawing – cutting	
Saw operated by a person	205
Saw operated by two people	190
Sawing - removing the bark	
Summer average	225
Winter average	390
Job – Agricolture	
Various jobs	
Digging (24 strokes / min)	380
Plowing with horses	235
Plowing with a tractor	170
Hoeing (mass of the hoe 1.25 kg)	170
Fertilizing a field	
Sowing by hand	280
Sowing with spreaders pulled by horses	250
Sowing with tractor	95
Jobs - Sport	
Running	
9 km/h	435
12 km/h	485
15 km/h	550

Activity	W/m²
Skiing - in plan with good snow	
7 km/h	350
9 km/h	405
12 km/h	510
Ice Skating	
12 km/h	225
15 km/h	285
18 km/h	360
Jobs – Home jobs	
Various jobs	
Cleaning	100 ÷ 200
Cooking	100 ÷ 200
Cleaning dishes, standing	145
Hand washing and ironing	120 ÷ 220
Shaving, washing and dressing	100

To calculate the PMV and PPD indices, the following probes must be connected:

- **TP3276.2** or **TP3275** globe thermometer probe.
- **HP3217.2R** or **HP3217R** combined relative humidity and temperature probe.
- **AP3203.2** or **AP3203** hot wire air speed probe.

For the measurement of the PMV and PPD indices, reference is made to the standards:

- **ISO 7726**
- **ISO 7730:2005**

3.3 MEAN RADIANT TEMPERATURE

The medium radiant temperature $\mathbf{T_r}$ is defined as the uniform temperature of a fictitious black cavity in which an individual would exchange the same amount of radiant thermal energy that it exchanges in the real non-uniform environment.

To evaluate the mean radiant temperature, we must detect: the globe thermometer temperature, the air temperature and the air speed measured close to the globe thermometer.

The formula for calculating the mean radiant temperature is the following:

- In case of **natural convection**:

$$\mathbf{T_r} = \left[\left(\mathbf{T_g} + 273\right)^4 + \frac{0.25 \times 10^8}{\varepsilon_{\mathbf{g}}} \left(\frac{\left|\mathbf{T_g} - \mathbf{T_a}\right|}{\mathbf{D}} \right)^{1/4} \times \left(\mathbf{T_g} - \mathbf{T_a}\right) \right]^{1/4} - 273$$

- In case of **forced convection**:

$$\mathbf{T_r} = \left[\left(\mathbf{T_g} + 273\right)^4 + \frac{1.1 \times 10^8 \times \mathbf{V_a}^{0.6}}{\varepsilon_{\mathbf{g}} \times \mathbf{D}^{0.4}} \left(\mathbf{T_g} - \mathbf{T_a}\right) \right]^{1/4} - 273$$

where:

D = globe thermometer diameter
ε_g = 0.95 globe thermometer presumed emissivity
T_g = globe thermometer temperature
T_a = air temperature
V_a = air speed

The mean radiant temperature does not coincide with the air temperature: if within a room there are areas which have a temperature much higher than that of the air (think, for example, of the flame of a fireplace), the mean radiant temperature is an average significantly affected by the presence of this very hot area.

The mean radiant temperature is detected with the globe thermometer, which is a temperature probe consisting of a copper sphere painted with matt black, with emissivity **ε_g** equal to 0.95 (as required by ISO 7726), with a Pt100 sensor inside.

The temperature of globe thermometer may be significantly higher than the air temperature, as in the case of a mountain hut, where the air is 0 °C, but where the presence of a fireplace produces a medium radiant temperature of 40 °C, ensuring a comfort situation.

Under normal conditions, maintaining a mean radiant temperature significantly higher than the air temperature is an advantage in terms of environmental quality. In homes, where fireplaces or stoves no longer exist, usually the mean radiant temperature coincides with the air temperature, or it is even lower. These situations (the main case is represented by buildings with large glazed surfaces) are not particularly healthy as the warm and wet air facilitates the development of pathogens. From this point of view, the heating with lamps or radiant panels is much healthier. It is more hygienic to ensure the comfort conditions with a mean radiant temperature greater than the air temperature. The legislation erroneously establishes the air temperature rather than the mean radiant temperature as the evaluation parameter for heating systems.

To calculate the mean radiant temperature, the following probes must be connected:

- **TP3276.2** or **TP3275** globe thermometer probe.
- **HP3217.2R** or **HP3217R** combined relative humidity and temperature probe.
- **AP3203.2** or **AP3203** hot wire air speed probe.

To calculate the mean radiant temperature, reference is made to the **ISO 7726** standard.

3.4 TURBULENCE INTENSITY TU AND DRAFT RATE DR

The local turbulence intensity, in percentage, is defined as the ratio between the local air speed standard deviation and the local average air speed (ISO 7726):

$$\mathbf{TU} = \frac{\mathbf{SD}}{\mathbf{V_a}} \times 100$$

where:

$\mathbf{V_a}$ = average local wind speed

SD = local wind speed standard deviation

$$\mathbf{SD} = \sqrt{\frac{1}{\mathbf{n}-1} \cdot \sum_{\mathbf{i}=1}^{\mathbf{n}} \left(\mathbf{V_{a_i}} - \mathbf{V_a}\right)^2}$$

From the turbulence calculation, knowing the average values of the local wind speed and ambient temperature, the Draft Rate **DR** is obtained, according to ISO 7730:

$$\mathbf{DR} = (34 - \mathbf{T_a}) \cdot (\mathbf{V_a} - 0.05)^{0,62} \cdot (0.37 \cdot \mathbf{V_a} \cdot \mathbf{TU} + 3.14)$$

The air current discomfort is defined as an undesired local cooling of the body due to air motion. The Draft Rate DR indicates the percentage of people who are dissatisfied due to the air current.

The DR index is calculated when the temperature is between 20 and 26 °C and the average air speed is less than 0.5 m/s.

To calculate the turbulence intensity, the **AP3203.2** or **AP3203** hot wire air speed probe must be connected.

To calculate the turbulence intensity TU and the Draft Rate DR, reference is made to the standards:

- **ISO 7726**
- **ISO 7730**

4 OPERATION

Before switching the instrument on, connect the probes to the inputs.

- For the measurement of the **WBGT** index, connect the following SICRAM probes:
  - **TP3207.2** or **TP3207** dry bulb temperature probe.
  - **TP3276.2** or **TP3275** globe thermometer probe.
  - **HP3201.2** or **HP3201** or **TP3204S** natural ventilation wet bulb temperature probe.
- For the measurement of the **PMV/PPD** indices and mean radiant temperature $\mathbf{T_r}$, connect the following SICRAM probes:
  - **HP3217.2R** or **HP3217R** temperature and relative humidity combined probe.
  - **AP3203.2** or **AP3203** omnidirectional hot wire air speed probe.
  - **TP3276.2** or **TP3275** globe thermometer probe, one of the following:
- For the measurement of the **TU/DR** indices, connect the **AP3203.2** or **AP3203** omnidirectional hot wire air speed SICRAM probe.
- For the measurement of the $\mathbf{CO_2}$ carbon dioxide, connect the **HP3217B4** SICRAM probe or connect to the RS485 port the **PMBsense-M** probe.
- For the measurement of the PM1.0 - PM2.5 - PM10 particulate matter, connect to the RS485 port the **PM[B]sense-M** probe.

Notes:

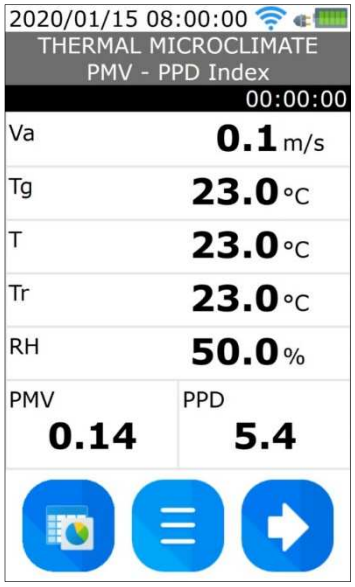
1) **The probes must be connected when the instrument is off. If a probe is connected when the instrument is already on, it is not recognized: it is necessary to switch the instrument off and on again.**
2) If a probe is disconnected when the instrument is on, an acoustic alarm will be heard (a beep per second) and the "LOST" message will be displayed in correspondence of the disconnected physical quantity.
3) If more probes of the same type are connected, it will be considered only the first recognized probe: the scan of the probes, for their recognition, starts from input A.

To switch the instrument on and off, press the **ON/OFF** key.

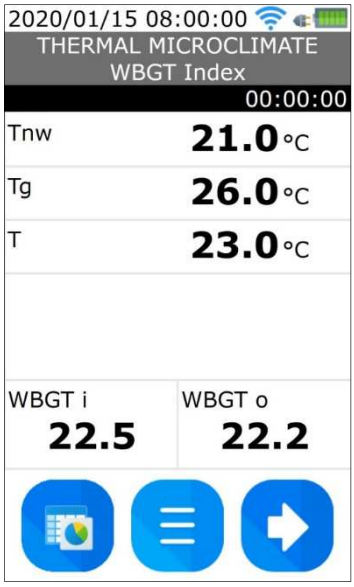
When the instrument is switched on, the instrument model and the firmware revision (at the bottom left) will be displayed for some seconds, then the measurements are displayed.

If multiple measurement screens are available, use the "left arrow" key on the display to switch from one screen to another. The scrolling is cyclic.

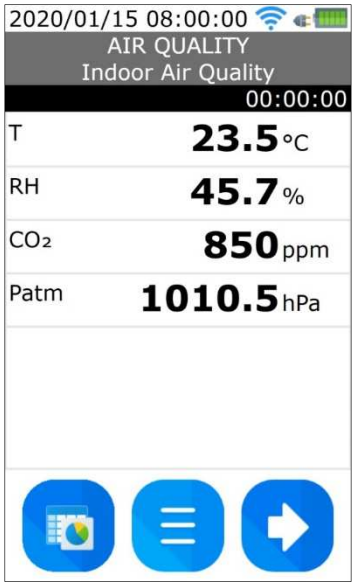
The various measurement screens are illustrated below (the screens actually visible depend on the instrument measurement settings, see the MENU chapter).



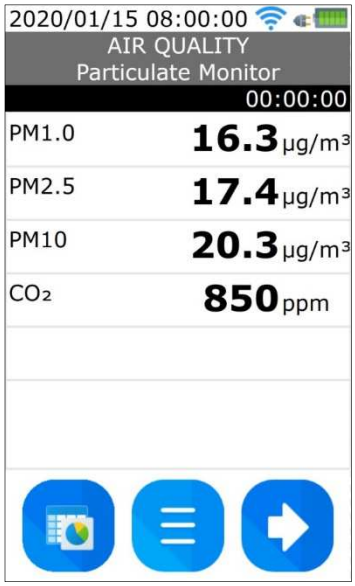
Thermal microclimate PMV – PPD indices



Thermal microclimate WBGT index



Indoor Air Quality



Indoor Air Quality Particulate Matter

Thermal microclimate DR – TU indices

Measured quantities:

CO_2 = Carbon dioxide
T = Environmental temperature (dry bulb)
Tg = Globe thermometer temperature
Patm = Atmospheric pressure
PM1.0 - PM2.5 - PM10 = Particulate Matter
RH = Relative humidity
Tnw = Wet bulb temperature
Va = Air speed

Calculated indices:

DR = Draft Rate
PMV = Predicted Mean Vote
PPD = Predicted Percentage of Dissatisfied
Tr = Mean radiant temperature
TU = Turbolence
WBGT = Wet Bulb Globe Temperature

DR and TU indices calculation

To start the calculation of the TU and DR indices press the **START** key in the measurement screen. The calculation is updated every second and stops automatically after 3 minutes (at the top right, above the measurements, there is a timer). The final measurement is an average value over the 3 minutes.

The calculation can be paused before the 3 minutes have elapsed and restarted by pressing the same key.

Note: if a logging session is in progress, the START key is disabled. In this case, stop logging, calculate the indices and at the end run the logging.

If 10% < DR < 30%, the instrument emits a short beep per second. If DR > 30%, the instrument emits a prolonged beep per second.

LOGGING

To start a logging session, press the **REC** key. The frequency with which the data are stored is set with the "LOGGING >> INTERVAL" menu item. The data stored between a start and a subsequent stop represent a measurement block.

The instrument front LED changes from blinking green to blinking blue when data logging starts.

To stop the logging, press the **REC** key again. It is possible to set a logging duration in the "LOGGING >> INTERVAL" menu.

The data are stored in the folder corresponding to the selected project. Before starting the logging, select a project in the "LOGGING >> PROJECT" menu. If there are no user-defined projects, the data are stored in the default folder.

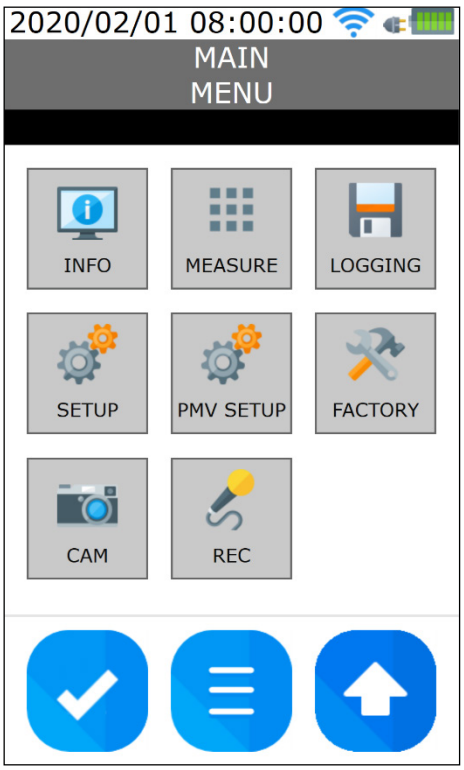
Once the logging is finished, the data files can be retrieved by connecting the instrument to the PC, directly via USB or via a local Wi-Fi network. The instrument is seen as a disk drive containing the various folders corresponding to the projects. The data files can be read with the **DeltaLog10** software.

It is possible to send the data files of a project via FTP directly from the instrument via the "LOGGING >> FILES >> FTP" menu.

It is also possible to insert images and audio recordings into the project using the "CAM" (camera) and "REC" (audio recording) menus.

5 THE MENU

To enter the menu, press MENU key (central key) on the display:



INFO: instrument and connected probes general information.

MEASURE: setting of the type of measurements displayed.

LOGGING: setting of the logging interval, viewing of recorded files and definition of projects.

SETUP: setting of the Wi-Fi and FTP connections, date and time, language and auto-off of the display backlight.

PMV SETUP: setting of the parameters for the PMV index calculation.

FACTORY: advanced system functions for the technical maintenance of the instrument.

CAM: allows taking photos.

REC: allows making audio recordings.

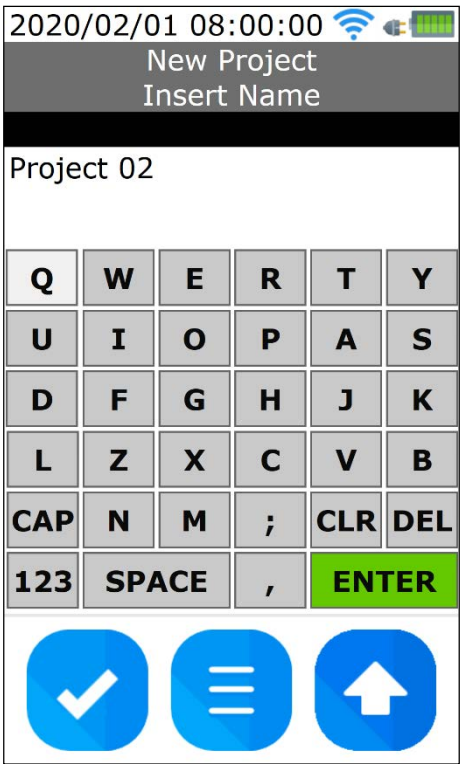
To exit the menu, press the MENU key again.

To go back up a level within a sub-menu, press the "arrow up" key.

To confirm a setting, press the "check" key.

Virtual keyboard:

Some settings require entering a string. In this case, a virtual keyboard appears on the instrument display, as shown in the following image.



- **CAP**: upper case ⇔ lower case.
- **CLR**: clears the string.
- **DEL**: deletes the last character.
- **123**: alphabetic characters ⇔ numbers/symbols.
- **ENTER**: confirms the entered string.

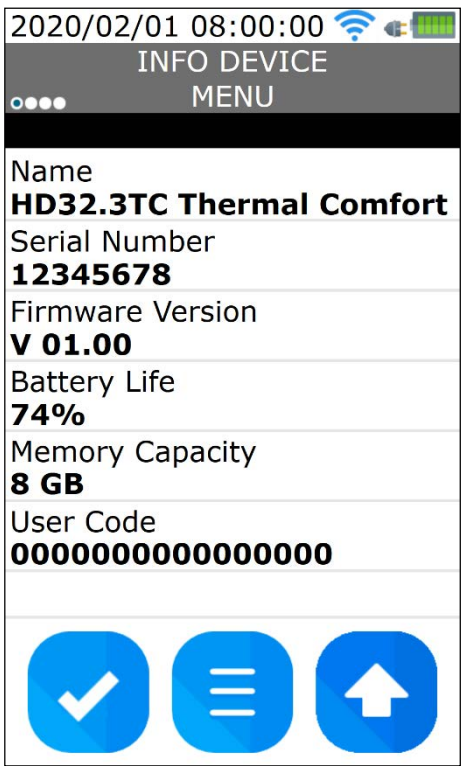
5.1 INFO MENU

The INFO Menu shows the instrument and connected probes general information.

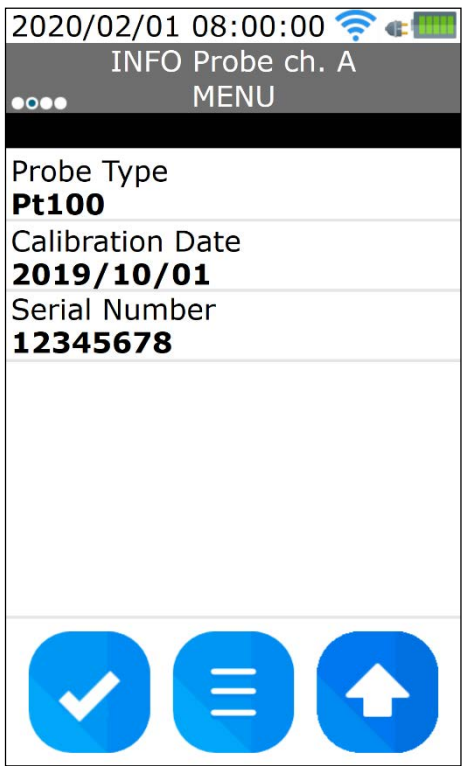
In order to scroll through the information pages, swipe horizontally on the display. The page you are viewing is indicated in the third row of the display, on the left.

Instrument information: model, serial number, firmware version, battery charge, memory capacity and user code.

Probes information: probe type, calibration date and serial number.



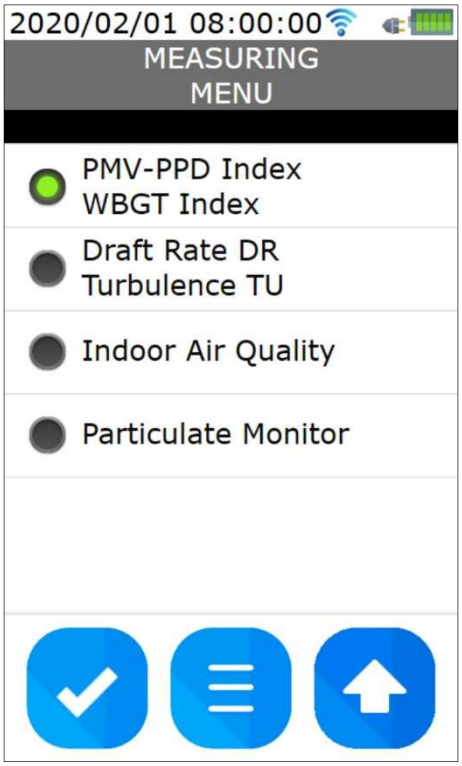
Instrument info



Probes info

5.2 MEASURE MENU

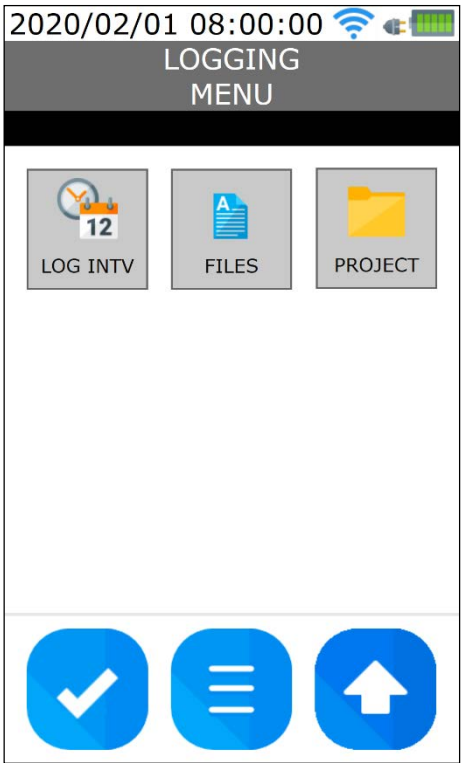
The MEASURE menu allows choosing the measurement screens to be displayed.



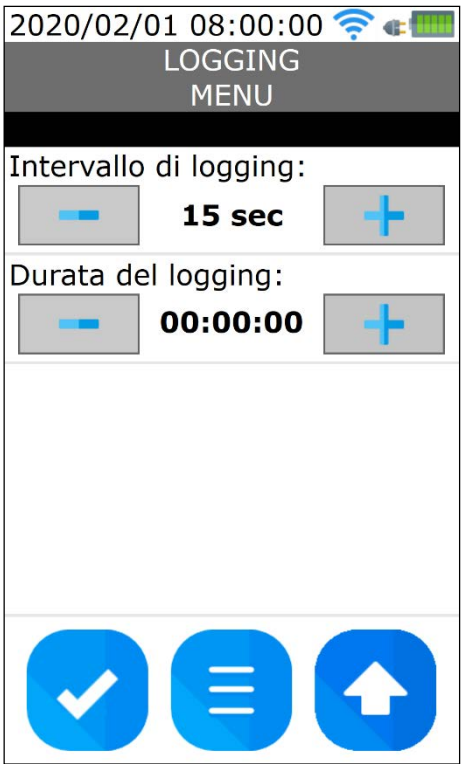
To save the setting, press the "check" key, a message will appear asking to confirm the save.

5.3 LOGGING MENU

The LOGGING menu allows setting the logging interval, viewing the data files list and defining and selecting projects (folders).



In order to set the logging interval, press LOG INTV. Use the +/- keys to change the interval an to set any logging duration.



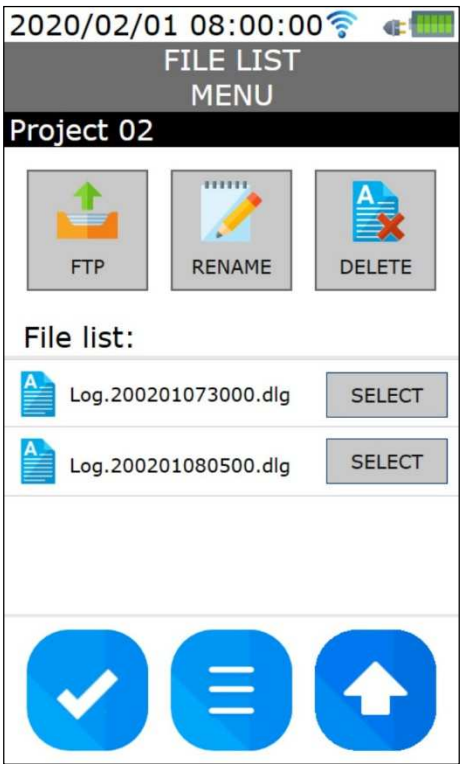
The interval can be set from 1 second to 1 hour.

If the logging duration is "00:00:00", the logging stops when the **REC** key is pressed.

If the logging duration is different from "00:00:00", the storage ends when the set time expires (from the start of logging with the **REC** key). The logging can be stopped manually before the set time has elapsed by pressing the **REC** key.

To save the setting, press the "check" key, a message will appear asking to confirm the save.

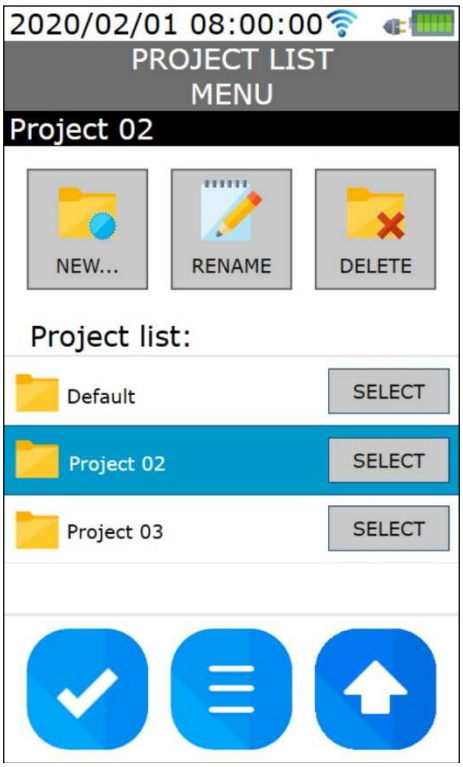
To view the recorded data files of the selected project, press FILES in the LOGGING menu.



- **FTP**: sends all the files of the project via FTP.
- **RENAME**: renames the selected file.
- **DELETE**: deletes the selected file.

To select a file, press the SELECT key next to the file name.

To manage the projects, press PROJECT in the LOGGING menu.

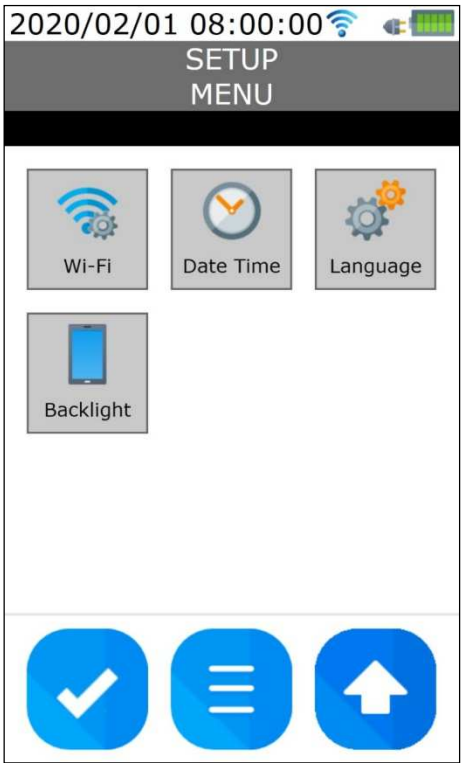


- **NEW...**: creates a new project.
- **RENAME**: renames the selected project.
- **DELETE**: deletes the selected project.

To select a project, press the SELECT key next to the project name.

5.4 SETUP MENU

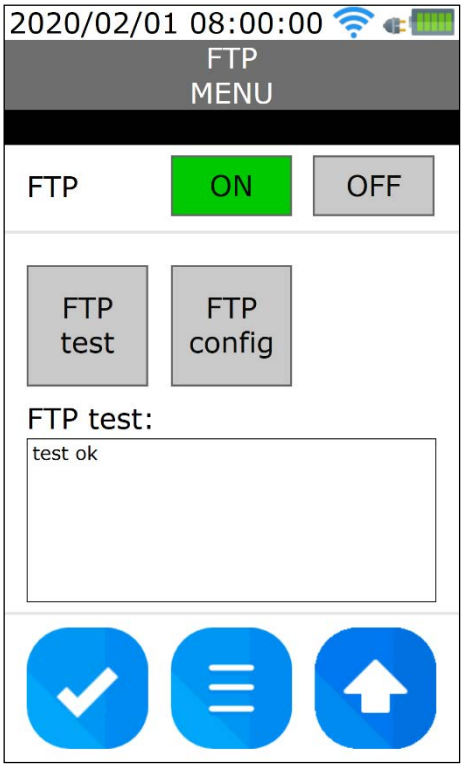
The SETUP menu allows setting the Wi-Fi and FTP connections ("Wi-Fi" key), the instrument date and time ("Date Time" key), the instrument language ("Language" key) and the auto-off of the display backlight ("Backlight" key).



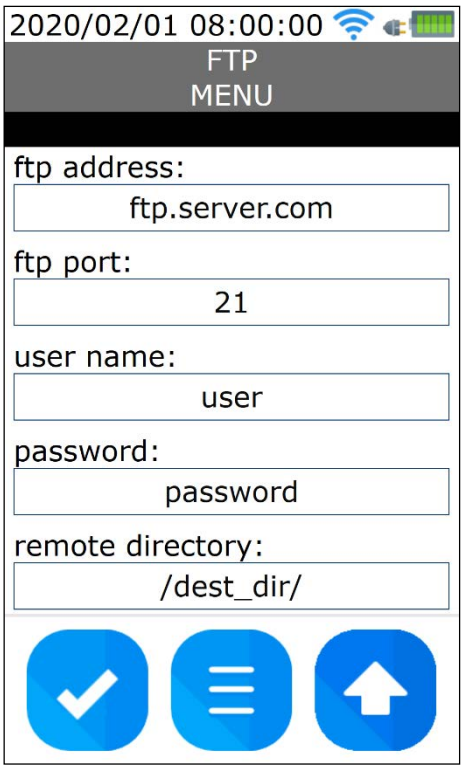
By selecting Wi-Fi you can activate (ON) or deactivate (OFF) the Wi-Fi connection and enter the SSID and password of the Wi-Fi network.

By selecting the SSID or PASS fields, the virtual keyboard for entering the network identifier or the access password appears.

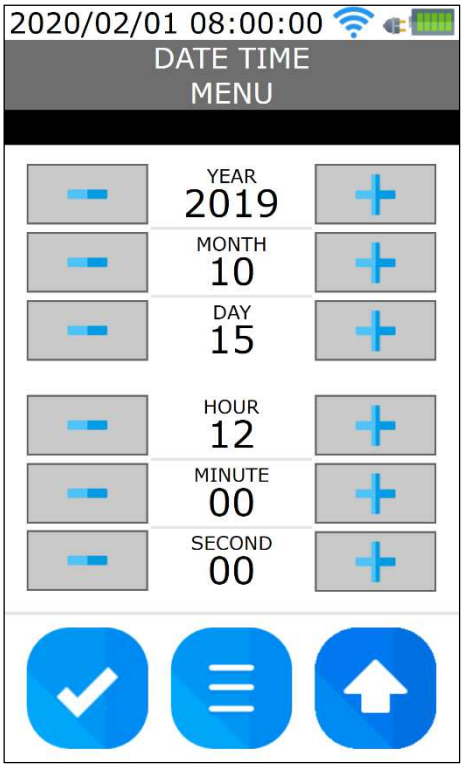
Selecting FTP SETUP you can activate (ON) or deactivate (OFF) the data files sending via FTP.



Select "FTP test" to check the correct sending of data via FTP. Select "FTP Config" to configure the sending of data via FTP: FTP address, port number, user name, password and data destination folder.

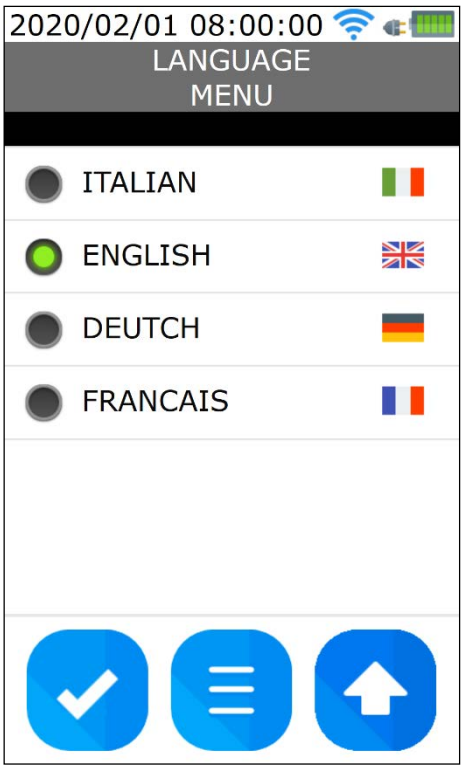


In order to set the instrument date and time, press “Date Time” in the SETUP menu.

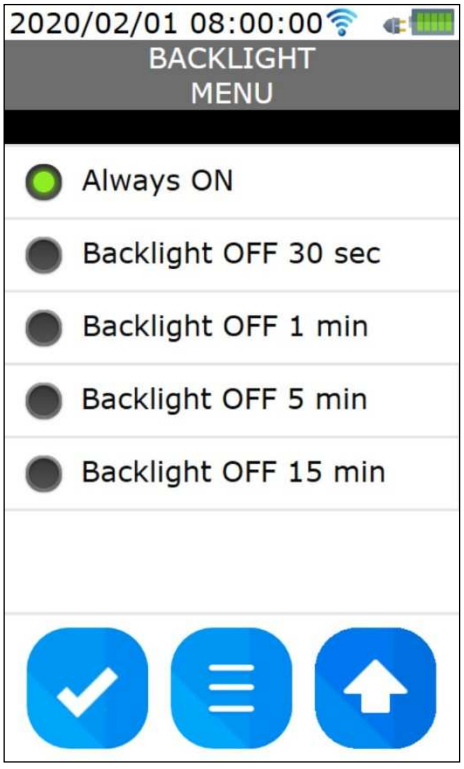


Set YEAR, MONTH, DAY, HOUR, MINUTE and SECOND by using the +/- keys. Press the "check" key to confirm.

In order to change the instrument language, press “Language” in the SETUP menu, then select the language and press the "check" key to confirm.



In order to change setting of the auto-off of the display backlight, press “Backlight” in the SETUP menu.



Select “Always ON” to disable the auto-off.

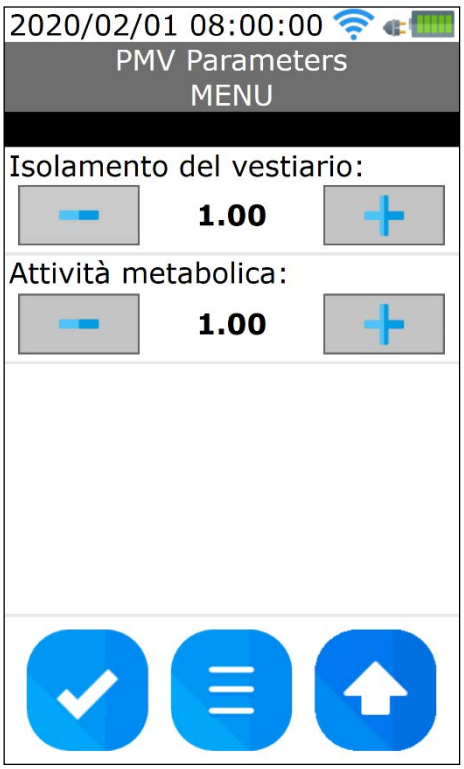
To set the auto-off after 30 s, 1 min, 5 min or 15 min of inactivity, select the corresponding "Backlight OFF ..." item.

Press the "check" key to confirm.

The display backlight can be turned off and on manually with the BACKLIGHT key on the instrument (key at the bottom right).

5.5 PMV SETUP MENU

The PMV SETUP menu allows setting the parameters for the PMV index calculation.



Set the clothing insulation (in CLO) and the metabolic rate (in MET) by using the +/- keys.

For the values to set, see paragraph 3.2 “Predicted Mean Vote PMV and Predicted Percentage of Dissatisfied PPD”.

Press the "check" key to confirm.

5.6 FACTORY MENU

The FACTORY menu includes advanced system functions for the technical maintenance of the instrument and is accessible after entering a numeric password.

6 PROBES PREPARATION AND MAINTENANCE

Probes necessary for **WBGT** index measurement:

Probes necessary for **PMV/PPD** indices measurement:

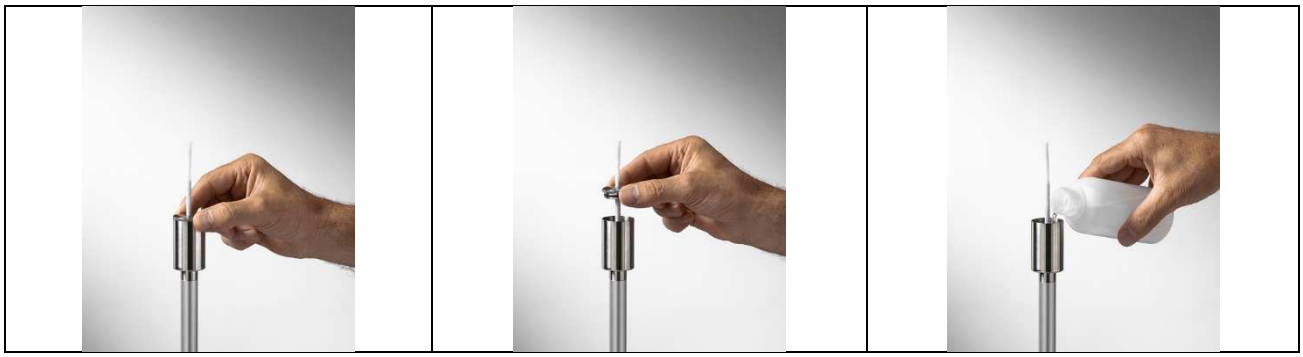
The probes are already factory calibrated. The calibration data are stored in the SICRAM module memory.

TP3575 and TP3276.2 globe thermometer probes

Screw the globe to probe stem.

HP3201.2 and HP3201 natural ventilation wet bulb probes

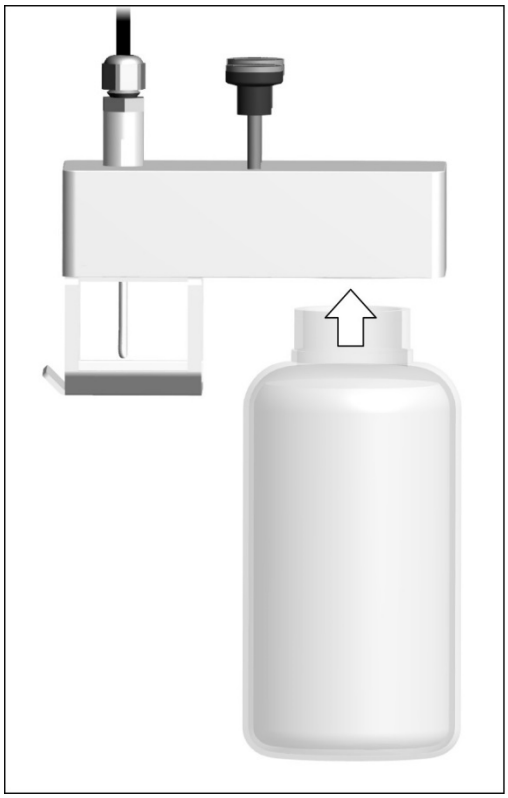
- Remove the sensor cap (the cap is not screwed).
- Insert the cotton wick, previously dipped with distilled water, into the temperature probe. The cotton wick must protrude from the probe for about 20 mm.
- Fill the reservoir up till ¾ with **distilled water**.
- Replace the cap.
- **Warning**: keep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

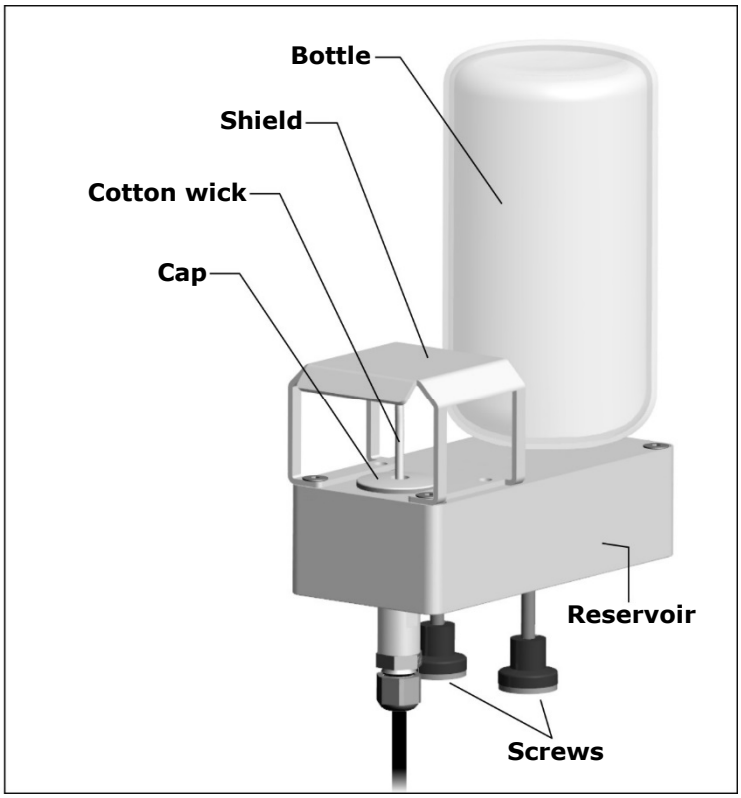


Note: over time the cotton wick tends to calcify (harden): it must be replaced periodically.

TP3204S natural ventilation wet bulb probe

- 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.





For measurements in presence of solar irradiation, use the protection shield from solar radiations.

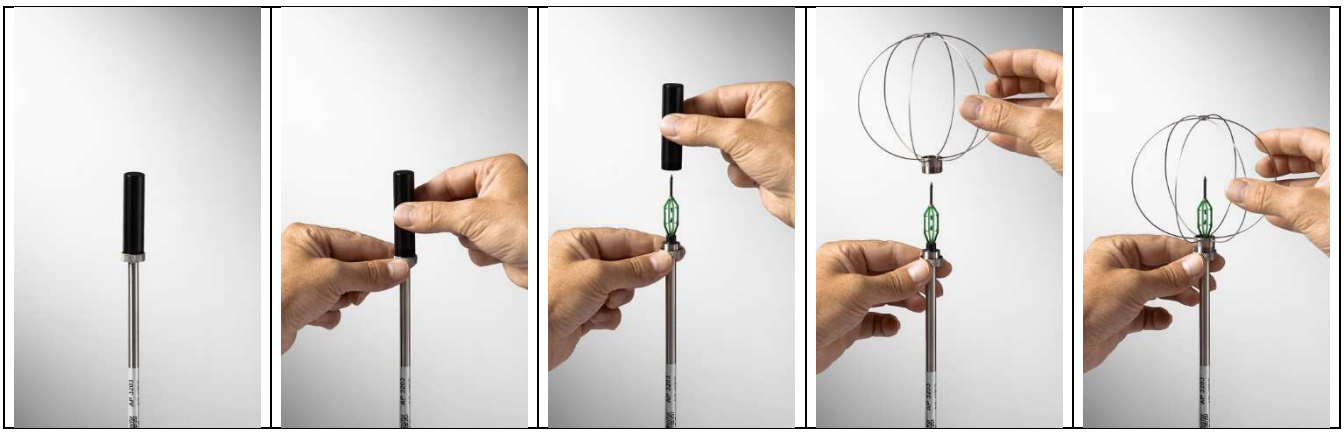
Note: over time the cotton wick tends to calcify (harden): it must be replaced periodically.

HP3217R and HP3217.2R combined relative humidity and temperature probes

- Do not touch the sensors with the hands; avoid dirtying them with oils, greases or resins.
- The sensors can be cleaned by the dust and pollution by using a very soft brush (e.g. badger) soaked in distilled water.
- To **check** the appropriateness of the relative humidity measurement, the saturated salt solutions **HD75** (75 %RH) and **HD33** (33 %RH) can be used.
- If the measurements are not appropriate, check that the sensors are not dirty, corroded, chipped or broken.

AP3203 and AP3203.2 omnidirectional hot wire air speed probes

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



- The sensor of AP3203 and AP3203.2 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.

General warnings

- Some sensors are not isolated from the outer sheath; take great care not to come into contact with live parts (above 48 V): it could be dangerous for the instrument and for the operator who could be electrocute.

- Do not expose the probes to gas or liquids that could corrode the probe material. After the measurement, clean accurately the probes.
- Respect the correct probes polarity.
- When inserting the probes connector into the instrument, do not fold or force the contacts.
- Do not bend, deform or drop the probes: they can be irreparably damaged.
- Use the probes suitable for the type of measurement to be performed.
- For a reliable measurement, avoid too rapid temperature variations.
- Avoid measuring in presence of high-frequency sources, microwave or high magnetic fields, as they would be unreliable.

7 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;
    - there are strong vibrations;
    - there are steams, salt or any corrosive gas.

8 SAFETY INSTRUCTIONS

General safety instructions

The instruments have been manufactured and tested in compliance with the safety standard EN61010-1:2010 "Safety requirements for electrical equipment for measurement, control and laboratory use" and left the factory in a safe and secure technical condition.

The proper operation and the operational safety of the instruments can be ensured only if all the regular security measures are observed as well as the specific measures described in this operational manual.

The proper operation and the operational safety of the instruments can be ensured only under the climatic conditions specified in this manual.

Do not use the instruments in places where there are:

- Rapid ambient temperature variations that may cause condensation.
- Corrosive or flammable gases.
- Direct vibrations, shocks to the instrument.
- High-intensity electromagnetic fields, static electricity.

If the instruments are moved from a cold environment to a hot one or vice versa, the formation of condensation might cause problems to their operation. In this case you need to wait for the instrument temperature to reach ambient temperature before operation.

User obligations

The user of the instruments must make sure that the following regulations and directives related to the handling of hazardous materials are fulfilled:

- European directives on safety and health at work.
- National regulations on safety and health at work.
- Accident prevention regulations.

Warnings on the use of the battery

In order to prolong the battery life, do not allow it to discharge excessively: recharge the battery when the battery symbol on the display reaches the minimum level.

Do not short-circuit the battery: it may explode with serious damage to persons. Additionally, to avoid any risk of explosion:

- Do not expose the battery to high temperature.
- Do not use charging devices different from those indicated.
- Do not overcharge the battery allowing it to charge for a long time after reaching the full charge status.

Disposal:

- Dispose of dead batteries in the dedicated bins or deliver them to authorized collection centers. Follow the relevant regulation.
- Do not dispose as household waste.
- Do not throw batteries into fire.

9 TECHNICAL CHARACTERISTICS

Power supply	**Rechargeable** lithium internal battery External power supply unit (**SWD05**), to be connected to the mini-USB connector of the instrument If connected to PC, it is powered by the computer USB port (500 mA at least)
Battery life	At least 24 hours of continuous operation (starting from a fully charged battery) with display always on
Logging interval	Configurable from 1 second to 1 hour
Storage capacity	8 GB
Inputs	3 inputs with 8-pole DIN45326 connector for probes with SICRAM module
Display	Backlit color graphic LCD with capacitive touch Active area 52x87 mm, 480x800 pixels
Connectivity	Wi-Fi and USB OTG, Host and Device The USB connection does not requires drivers installation
Uncertainty	± 1 digit @ 20 °C (only the instrument)
Operating conditions	-5…50 °C, 0…90 %RH no condensation
Storage Temperature	-25…65 °C
Materials	ABS, rubber protection band
Dimensions	185x90x40 mm
Weight	500 g
Degree of protection	IP 54

TP3275 AND **TP3276.2** TEMPERATURE PROBES

Sensor	Pt100
Accuracy:	1/3 DIN
Measuring range:	-30…120 °C
Resolution:	0.1 °C
Temperature drift @ 20 °C	0.003 %/°C
Long term stability	0.1 °C/year
Connection	8-pole female DIN45326 connector Cable L=2 m (only TP3275)
Globe dimensions	Ø=150 mm (TP3275), Ø=50 mm (TP3276.2)
Stem dimensions	Ø=14 mm, L=110 mm (TP3275) Ø=8 mm, L=170 mm (TP3276.2)
Response time T_{95} (*)	15 minutes

TP3207 AND **TP3207.2** TEMPERATURE PROBES

Sensor	Pt100
Accuracy:	1/3 DIN
Measuring range:	-40…100 °C
Resolution:	0.1 °C
Temperature drift @ 20 °C	0.003 %/°C
Long term stability	0.1 °C/year
Connection	8-pole female DIN45326 connector Cable L=2 m (only TP3207)
Dimensions	Ø=14 mm, L=140 mm (TP3207), L= 150 mm (TP3207.2)
Response time T_{95} (*)	15 minutes

HP3201 AND **HP3201.2** NATURAL VENTILATION WET BULB PROBES

Sensor	Pt100
Accuracy:	Class A
Measuring range:	4…80 °C
Resolution:	0.1 °C
Temperature drift @ 20 °C	0.003 %/°C
Long term stability	0.1 °C/year
Connection	8-pole female DIN45326 connector Cable L=2 m (only HP3201)
Stem dimensions	Ø=14 mm, L=110 mm (HP3201), L= 170 mm (HP3201.2)
Cotton wick length	10 cm approx.
Reservoir	Capacity 15 cc, autonomy 96 hours @ RH=50% and t=23 °C
Response time T_{95} (*)	15 minutes

TP3204S NATURAL VENTILATION WET BULB PROBE

Sensor	Pt100
Accuracy:	Class A
Measuring range:	4…80 °C
Resolution:	0.1 °C
Temperature drift @ 20 °C	0.003 %/°C
Long term stability	0.1 °C/year
Connection	8-pole female DIN45326 connector, cable L=2 m
Dimensions	L x W x H = 140 x 65 x 178,5 mm (reservoir + bottle)
Cotton wick length	10 cm approx.
Reservoir	Capacity 500 cc, autonomy 15 days @ t=40 °C
Response time T_{95} (*)	15 minutes

HP3217R AND **HP3217.2R** TEMPERATURE AND RELATIVE HUMIDITY COMBINED PROBES

Sensor	Temperature: Pt100 R.H.: capacitive
Accuracy:	Temperature: 1/3 DIN R.H.: ±1.5% (0…90%RH) / ±2% (90…100%RH) @ T=15…35 °C (1.5 + 1.5% measure)% @ T= remaining range
Measuring range:	Temperature: -40…100 °C R.H.: 0…100%
Resolution:	0.1 °C / 0.1 %RH
Temperature drift @ 20 °C	0.02 %RH/°C
Long term stability	0.1 %RH/year
Connection	8-pole female DIN45326 connector Cable L=2 m (only HP3217R)
Dimensions	Ø=14 mm, L=150 mm
Response time T_{95} (*)	15 minutes

AP3203 AND **AP3203.2** OMNIDIRECTIONAL HOT WIRE AIR SPEED PROBES

Sensor	NTC 10 kΩ
Accuracy:	± (0,05 + 0,5% measure) m/s
Measuring range:	0.05…5 m/s / 0…80 °C
Resolution:	0.01 m/s
Temperature drift @ 20 °C	0.06 %/°C
Long term stability	0.12 °C/year
Connection	8-pole female DIN45326 connector Cable L=2 m (only AP3203)
Stem dimensions	Ø=8 mm, L=230 mm
Protection dimensions	Ø=80 mm

(*) 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).

10 ORDERING CODES

HD32.3TC Data logger for thermal microclimate analysis. Three inputs for probes with SICRAM module. Color graphic touch display. USB and Wi-Fi connection. Lithium battery rechargeable via USB. Equipped with microphone and camera for recording vocal and visual comments.
Includes **DeltaLog 10** software downloadable from Delta OHM website. Supplied with: CP31 USB cable, SWD05 power supply and instruction manual. **The probes have to be ordered separately.**

Probes with SICRAM module for the measurement of microclimatic indices

The probes necessary for **WBGT** index measurement are:

- Dry bulb temperature probe, one of the following:
  - **TP3207.2** Ø 14mm, L=150 mm.
  - **TP3207** Ø 14mm, L=140 mm. Cable 2 m.
- Globe thermometer probe, one of the following:
  - **TP3276.2** Globe Ø 50 mm. Stem Ø 8 mm, L=170 mm.
  - **TP3275** Globe Ø 150 mm. Stem Ø 14 mm, L=110 mm. Cable 2 m.
- Natural ventilation wet bulb temperature probe, one of the following:
  - **HP3201.2** Stem Ø 14 mm, L=170 mm.
  - **HP3201** Stem Ø 14 mm, L=110 mm. Cable 2 m.
  - **TP3204S** For long-lasting measurements. 500 cc distilled water capacity. Cable 2 m.

The probes necessary for **PMV/PPD** indices measurement are:

- Temperature and relative humidity combined probe, one of the following:
  - **HP3217.2R** Stem Ø 14 mm, L=150mm.
  - **HP3217R** Stem Ø 14 mm, L=110mm. Cable 2 m.
- Omnidirectional hot wire air speed probe, one of the following:
  - **AP3203.2** Stem Ø 8 mm, L=230 mm.
  - **AP3203** Stem Ø 8 mm, L=230 mm. Cable 2 m.
- Globe thermometer probe, one of the following:
  - **TP3276.2** Globe Ø 50 mm. Stem Ø 8 mm, L=170 mm.
  - **TP3275** Globe Ø 150 mm. Stem Ø 14 mm, L=110 mm. Cable 2 m.

The probes necessary for **TU/DR** indices measurement are:

- Omnidirectional hot wire air speed probe, one of the following:
  - **AP3203.2** Stem Ø 8 mm, L=230 mm.
  - **AP3203** Stem Ø 8 mm, L=230 mm. Cable 2 m.

Probes for the measurement of CO_2 and Particulate Matter

HP3217B4 CO_2, temperature, relative humidity and atmospheric pressure probe with SICRAM module.

PMBsense-M PM1.0, PM2.5, PM10 and CO_2 probe with RS485 Modbus-RTU output.

PMsense-M PM1.0, PM2.5 and PM10 probe with RS485 Modbus-RTU output.

Accessories

VTRAP30	Tripod, maximum height 280 mm.
VTRAP32.2A.3A	Tripod for measurements with probes with cable.
HD32.2.7.1	Probes Support to be fixed to the **VTRAP32.2A.3A** tripod.
CP31	USB cable with male mini-USB connector on instrument side and male A type USB connector on PC side.
CP24A	PC connecting cable with built-in RS485/USB converter. 8-pole M12 connector on instrument side and A-type USB connector on PC side.
SWD05	100-240 Vac / 5 Vdc-1 A stabilized mains power supply. Output with A type USB connector.
BAT30	Spare rechargeable lithium battery.
AQC	200 cc of distilled water.

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.

NOTES

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DICHIARAZIONE DI CONFORMITÀ UE
EU DECLARATION OF CONFORMITY

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Documento Nr. / Mese.Anno:
Document-No. / Month.Year : **5147 / 01.2020**

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

Codice prodotto:
Product identifier : **HD32.3TC**

Descrizione prodotto:
Product description : **Datalogger di microclima termico**
Thermal microclimate data logger

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

Direttive / *Directives*	
2014/53/EU	Direttiva apparecchiature radio / *Radio Equipments Directive (RED)*
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 62479:2010	Esposizione umana a campi elettromagnetici / *Human exposure to EMF*
ETSI EN 300 328 V2.1.1	Dispositivi RF a banda larga / *RF wideband devices*
ETSI EN 301 489-1 V2.1.1	EMC per dispositivi radio / *EMC for radio equipments*
ETSI EN 301 489-17 V3.1.1	EMC per dispositivi RF a banda larga / *EMC for RF broadband devices*
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, 24/01/2020

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.

GUARANTEE

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TERMS OF GUARANTEE

All DELTA OHM instruments are subject to accurate testing, and are guaranteed for 24 months from the date of purchase. DELTA OHM will repair or replace free of charge the parts that, within the warranty period, shall be deemed non efficient according to its own judgement. Complete replacement is excluded and no damage claims are accepted. The DELTA OHM guarantee only covers instrument repair. The guarantee is void in case of incidental breakage during transport, negligence, misuse, connection to a different voltage than that required for the appliance by the operator. Finally, a product repaired or tampered by unauthorized third parties is excluded from the guarantee. The instrument shall be returned FREE OF SHIPMENT CHARGES to your dealer. The jurisdiction of Padua applies in any dispute.

The electrical and electronic equipment marked with this symbol cannot be disposed of in public landfills. According to the Directive 2011/65/EU, the european users of electrical and electronic equipment can return it to the dealer or manufacturer upon purchase of a new one. The illegal disposal of electrical and electronic equipment is punished with an administrative fine.

This guarantee must be sent together with the instrument to our service centre.

IMPORTANT: Guarantee is valid only if coupon has been correctly filled in all details.

Instrument Code: **HD32.3TC**

Serial Number _____

RENEWALS

Date _____	Date _____
Inspector _____	Inspector _____
Date _____	Date _____
Inspector _____	Inspector _____
Date _____	Date _____
Inspector _____	Inspector _____

CE

RoHS 2011/65/EU

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The quality level of our instruments is the result of the constant development of the product. This may produce some differences between the information written in this manual and the instrument you have purchased. We cannot completely exclude the possibility of errors in the manual, for which we apologize.

The data, images and descriptions included in this manual cannot be legally asserted. We reserve the right to make changes and corrections with no prior notice.

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