

English

Operating manual

Multifunction Data Logger HD31



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1 INTRODUCTION

HD31 is a portable multifunction and data logger instrument. It has a large (43 x 58 mm) color graphic LCD display.

It is equipped with 3 independent inputs. Each input can be connected to individual and combined SICRAM probes (intelligent and interchangeable probes capable to store calibration data into memory) for the measurement of several physical qualities:

- Temperature
- Relative humidity
- Barometric and differential pressure
- Air speed
- Illuminance (lux) and Irradiance
- Carbon dioxide (CO₂)
- Direct voltage and current

The type of probes connected to the different inputs is automatically recognized by the instrument. The probes are supplied factory- calibrated and are interchangeable.

By connecting a combined relative-humidity and temperature probe, the instrument calculates the derived humidity quantities: dew-point temperature, wet-bulb temperature, absolute humidity, mixing ratio, partial vapor pressure, saturated steam pressure, enthalpy. The DI (Discomfort Index) and the NET (Net Effective Temperature) indexes are calculated as well.

The instrument's inputs can also be connected to non SICRAM probes, by using the relevant interface modules between instrument and probe.

The display can show up to 36 quantities, three of which can be displayed simultaneously in numeric format. A real-time measured quantity graph is shown in the display.

The measuring unit can be selected according to the measured physical quantity.

Data logging function with data storage in CSV format directly into the SD-type Memory Card, for a long logging time (for example, with a 4 GB SD-type card, the logging lasts several months even when recording several quantities with the minimum logging interval of 1 second). User-configurable storage interval. Manual or programmed logging start/stop. Logging date/time storage of each sample (automatically creates measurement reports in PDF format in the memory card). Manual RECORD function (acquires the current measurement by simply pressing a button) or automatic RECORD function (acquires the current measurement once per second) for the calculation of minimum, mean and maximum values of the measured quantities.

HOLD function (holds current measurements on the display), REL function (difference with regard to a stored value) and DIFF function (difference between two homogeneous measurements, e.g., between the measurements of two temperature probes).

Functions reserved through user password. USB port with mini-USB connector for PC connection, for configuration and download of the acquired data. **DeltaLog9** application software supplied with the instrument.

It is provided with MSD (Mass Storage Device) mode, in which the instrument is seen by the PC as a SD card reader, thus allowing direct access to the memory card for displaying, copying or deleting the logging files.

Serial output for the print of the displayed measurements on a RS232C input printer. The Baud Rate can be set from 1200 to 115200.

Lithium ion rechargeable battery. Automatic switch-off (may be disabled) after user-configurable downtime (2, 5, 10, 15, 20 or 30 minutes) for preserving the battery life. External power supply through USB input (with mini-USB connector) by connecting a 5 Vdc power supply unit or a PC USB port (500 mA at least). With an external power supply unit connected, the battery is recharged and the automatic switch-off is automatically disabled.

2 DESCRIPTION

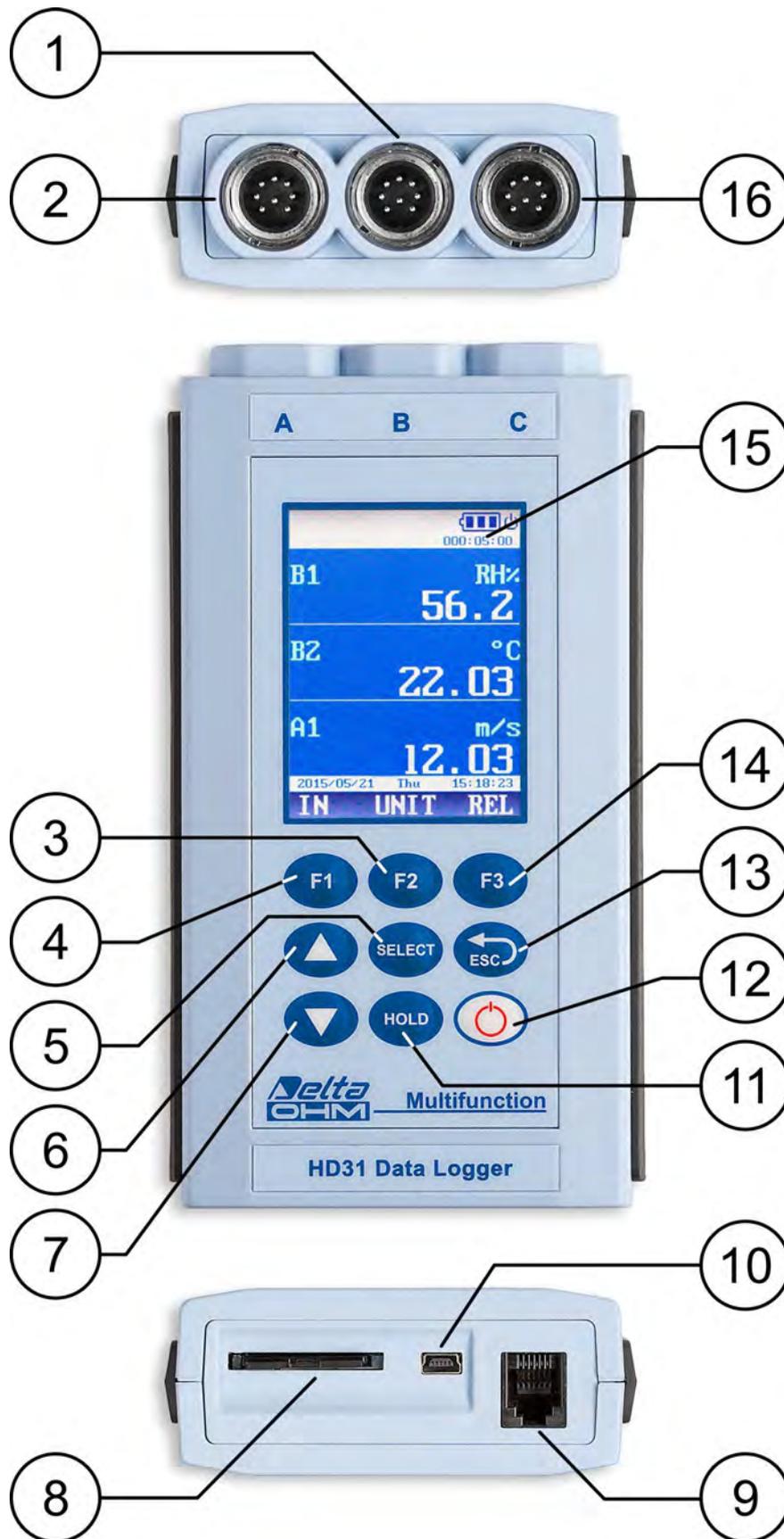


Fig. 2.1: instrument description

1. **Input B**, 8-pole DIN45326 connector.
2. **Input A**, 8-pole DIN45326 connector.
3. **F2** function key: activates the central command in the command bar.
4. **F1** function key: activates the left command in the command bar.
5. **SELECT** key: scrolls cyclically forward the main commands in the command bar.
6. **▲** key: in "Measure" mode, scrolls cyclically upwards the measurements on the display; in the menu, it scrolls through the available options.
7. **▼** key: in "Measure" mode, scrolls cyclically downwards the measurements on the display; in the menu, it scrolls through the available options.
8. **SD card** housing. To introduce the card, push it into the slot until it clicks into place, which ensures the correct insertion. To remove the card, push it until you hear the release click.
CAUTION: to avoid data loss, do not remove the card if logging is active. Stop logging before removing the card.
9. RS232C serial output with RJ12 (6P6C) connector for connecting the printer.
10. USB port with mini-USB for connecting a PC or external power supply device.
11. **HOLD** key: holds the measurement to the current value.
12. **ON/OFF** key: turns the instrument on/off.
13. **ESC** key: in "Measure" mode, scrolls cyclically backward the main commands in the command bar; in the menu, it allows returning to the higher menu level; cancels the current operation without modifying the instrument parameters.
14. **F3** function key: activates the right command in the command bar.
15. Color graphic LCD display.
16. **Input C**, 8-pole DIN45326 connector.

2.1 DISPLAY DESCRIPTION

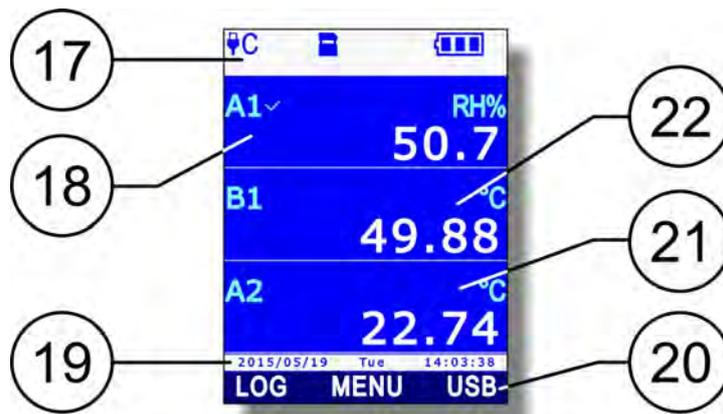


Fig. 2.1.1:display description

17. Status bar: shows information about logging state, battery charge level, presence of SD card, USB connection state, etc.
18. Display of the first measurement.
19. Date and time. During execution of the commands the line shows information messages.
20. Command bar (indications vary according to the function enabled).
21. Display of the third measurement.
22. Display of the second measurement.

2.2 KEY TO THE SYMBOLS IN THE STATUS BAR

	Instrument connected to a USB port on your PC
	Instrument connected to a USB port on your PC and communicating
	Instrument connected to the external power supply unit
	Instrument in MSD mode (Mass Storage Device): connected to the PC, it works as an SD card reader
	SD card inserted in the instrument
	Logging session enabled. The logging interval, in the case of automatic recording, or the MANL indication, in the case of manual recording, is shown under the symbol; the interval background turns light blue during acquisition time.
	Auto-off between two logging instants activated
	Start and stop logging instants programmed by the user
	Only the logging start time is programmed
	Only the logging stop time is programmed
	"Monitor" function active (enabled by DeltaLog9 software)
	The reduced level of brightness for the display is set
	Reduced brightness level temporarily suspended following the push of a key (the level will return to its "reduced" state after a few moments of inactivity)
	Auto-off function activated (*)
	Auto-off function disabled or temporarily suspended (for example, following the activation of the logging) (*)
	Power supply activated for hot-wire air speed probes or CO ₂ probes
	Battery charge between 67% and 100% (**)
	Battery charge between 34% and 66% (**)
	Battery charge between 4% and 33% (**)
	Battery charge less than 4% (**)

(*) The symbol is off if the instrument is connected to the external power supply unit or to the USB port of the PC.

(**) The symbol flashes when the battery is charging.

2.3 OVERVIEW OF THE FUNCTIONS IN THE COMMAND BAR

F1, **F2** and **F3** keys allow selecting the functions indicated in the display command bar. Press the **SELECT** key to scroll cyclically through the main functions available in the command bar (or alternatively the ESC key to scroll the functions in the opposite direction).

Some features include sub-functions (displayed in the command bar when you select the main function by pressing the corresponding function key) or opening a menu. The scheme in Fig. 2.3.1 illustrates the functions listed using the SELECT key and the corresponding sub-functions.

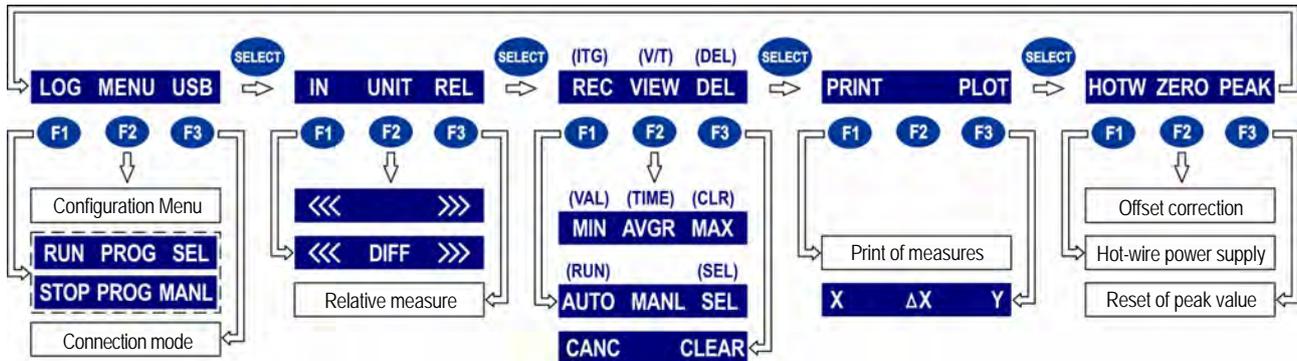


Fig. 2.3.1: functions in the command bar

The commands shown in the scheme are briefly outlined below. For a detailed description, please refer to the sections in the manual for the respective functions.

- LOG** (logging): logging on and off. If logging is not enabled, the following sub-functions appear:
 - **RUN**: manual start of the logging.
 - **PROG** (program): setting the programmed start and stop of the logging.
 - **SEL** (select): selects the measurement line indicated by the cursor on the display for logging. If the measurement line has been already selected, the selection is canceled.
 If logging is enabled, the following sub-functions appear instead of RUN and SEL:
 - **STOP**: manual stop of the logging.
 - **MANL** (manual): manual acquisition of a sample (function enabled only if the setting of the logging interval is MANUAL).
- MENU**: opens the configuration menu of the instrument.
- USB**: activation and deactivation of the MSD (Mass Storage Device) to read the SD card from the PC (see paragraph 14.1 at page 110).
- IN** (input): selection of the quantities to be displayed. The following sub-functions are shown:
 - <<<>>>: scrolls backward the available quantities in the display line indicated by the cursor.
 - **DIFF**: displays the difference between the quantity currently indicated by the cursor and an equivalent quantity, if available. If there are several equivalent quantities, press repeatedly F2 until the desired quantity is selected.
 - >>>>: scrolls forward the quantities available in the display line indicated by the cursor.
- UNIT**: selects the measurement unit. The following sub-functions are shown:
 - <<<>>>: scrolls backwards the measurement units available for the quantity shown in the display line indicated by the cursor.
 - >>>>: scrolls forward the measurement unit available for the quantity shown in the display line indicated by the cursor.
- REL**: displays the relative measurement, that is the difference between the current value and the one stored when the key was pressed, in the display line indicated by the cursor.

7. **REC** (record): calculation of minimum, average and maximum values. The following sub-functions appear:
- **AUTO**: starts the automatic update, once per second, of the minimum, average and maximum values.
 - **MANL** (manual): updates the minimum, average and maximum values taking into account the measurement at the time when the command is selected.
 - **SEL** (select): selects the measurement line indicated by the cursor on the display for the REC function. If the measurement line is already selected, the selection is cancelled.

If an integral measurement is selected, (with illuminance or irradiance measurements), REC function is replaced by ITG function.

ITG (integral): calculation of the integral. The following sub-functions appear:

- **RUN**: starts the calculation of the integral.
 - **SEL** (select): selects the measurement line indicated by the cursor on the display for the ITG function. If the measurement line is already selected, the selection is cancelled.
8. **VIEW**: views the minimum, average and maximum values (calculated with the REC function) of the selected quantity. The following sub-functions appear:
- **MIN**: displays the quantity minimum value in the display line indicated by the cursor. Press the function key again to return to the current measurement value.
 - **AVRG** (average): displays the quantity average value in the display line indicated by the cursor. Press the function key again to return to the current measurement value.
 - **MAX**: displays the quantity maximum value in the display line indicated by the cursor. Press the function key again to return to the current measurement value.

If an integral measurement is selected (with illuminance or irradiance measurements), the VIEW function is replaced by the V/T function.

V/T (Value/Time): setting integration limits. The following sub-functions appear:

- **VAL** (value): sets the threshold for the stoping of the integral calculation.
 - **TIME**: sets the integration time limit.
 - **CLR** (clear): sets to zero the integration time and threshold limit.
9. **DEL**: deletes minimum, average and maximum values (or the integral calculation, with ITG function). The following sub-functions appear:
- **CANC** (cancel): disables the REC function (or ITG) and deletes the minimum, average and maximum values (or the integral calculation, in the case of ITG function).
 - **CLR** (clear): resets the minimum, average and maximum value calculation (or the integral calculation, in the case of ITG function).
10. **PRINT**: sends the three measurements displayed when the key is pressed to the printer connected with the RS232C output. Also the information about the connected probes (type of probe, serial number, type of calibration used) are printed.
11. **PLOT**: displays the real-time graphics of the measurement indicated by the cursor on the display. The following sub-functions appear:
- **X**: displays the vertical cursors.
 - **ΔX**: sets the scale of abscissae.
 - **Y**: displays the horizontal cursors and the zoom functions of the axis of ordinates.
12. **HOTW** (hot-wire): supplies or removes power to the hot-wire air speed probe.
13. **ZERO**: corrects the offset of the probes provided with this function.
14. **PEAK**: resets the peak value of the pressure probes.

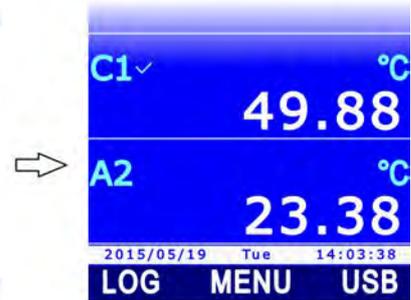
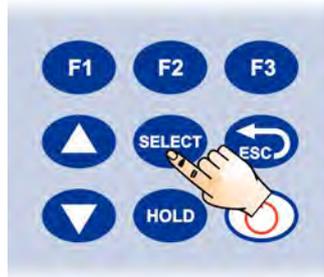
Note: some functions may appear disabled (grayed out) according to the selected quantity and the instrument state.

2.4 HELP FUNCTION

The instrument is provided with a quick HELP function that briefly describes the meaning of the symbol appearing in the display status bar and the function of the commands available through the SELECT key.

To access the HELP function:

1. Press the **SELECT** key to display the **MENU** command in the command bar.
2. Select the **MENU** command by pressing the **F2** key.



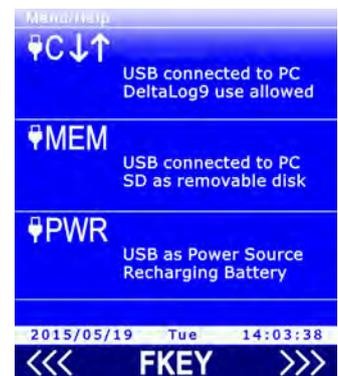
3. If necessary, select the **HELP** item using **▲** and **▼** keys, then press **F3** key (OK command) to confirm.



4. The HELP of the commands available with the SELECT key appears. To cycle through the list of commands, select repeatedly "**<<<**" (**F1** key) or "**>>>**" (**F3** key)



5. To display the help of the symbols appearing in the display status bar, select the **ICON** command by pressing **F2** key.
6. To cyclically scroll the symbols' list, repeatedly select "**<<<**" (**F1** key) or "**>>>**" (**F3** key). To return to the Help of the commands, select the **FKEY** command by pressing the **F2** key.



7. Press **ESC** key twice to exit the menu and return to the measurement mode.

3 MEASUREMENT MODE

Switching on and off the instrument is obtained by pressing the ON/OFF key.

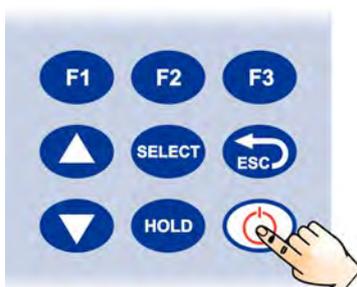


Fig. 3.1: ON/OFF key

At startup, the instrument checks for the probes connected to inputs and, after a few seconds, goes to the standard measurement mode, displaying the measured quantities. The instrument displays three measurement lines at the same time.

The quantities appearing on the display are identified by the letter (A, B or C) corresponding to the input channel connected to the probe measuring the quantity, followed by a sequential number helping to differentiate the various quantities measured by the same probe (combined probes) or any derived quantities.

When the instrument is first switched on, it lists the available quantities depending on the number and type of the connected probes, choosing among A1, B1, C1, A2, B2, C2, A3, B3, C3.... For instance, if input A is connected to a humidity/temperature combined probe, and input B to a Pt100 probe, the automatic configuration will organize the display as follows:

- First line (A1): relative humidity in %RH;
- Second line (B1): temperature of the Pt100 single probe;
- Third line (A2): temperature of the combined probe.

By default, derived quantities are not displayed; see paragraph 3.4. for their display.

If there are more than three quantities, use ▲ and ▼ keys to cyclically scroll upward or downward the list of the available quantities. During the scrolling operation, a small sequential number appears over the quantity identifier, marking the position of the measurement in the list.



Fig. 3.2: measurements display

With the next switch-on, the instrument displays the list of the quantities as it appears at switch-off.

Note: the recognition of the probes occurs when the instrument is on; if a probe is connected when the instrument is on, the instrument has to be turned off and on to display the new probe measures.

3.1 SELECTING A MEASUREMENT LINE

Some functions of the instrument have effect on the selected measurement line, indicated by a check mark next to the quantity identifier. Use the ▲ and ▼ keys to select a measurement line. The currently selected measurement line is highlighted with the first press of the ▲ or ▼ key: repeatedly press the ▲ or ▼ key until the desired measurement line is highlighted and wait some seconds for the checkmark to appear.

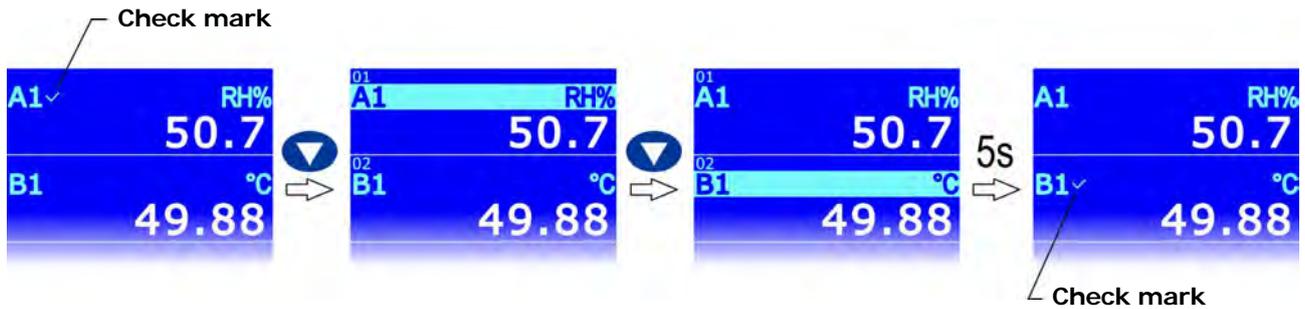


Fig. 3.1.1: selecting a measurement line

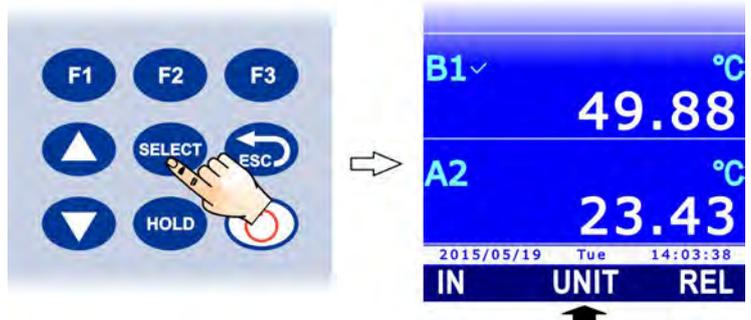
3.2 SELECTING THE MEASUREMENT UNIT

Several measurement units are available for some quantities (temperature, pressure, air speed, ...). To change the measurement unit of a quantity in a measurement line:

1. Select the desired measurement line using ▲ and ▼ keys.

2. Press **SELECT** until the **UNIT** command in the command bar is selected, then select the command by pressing **F2**.

Note: if the quantity has no measurement unit available for selection or RECORD and/or LOG functions are enabled, the command is disabled.



3. Select "<<<" (F1 key) or ">>>" (F3 key) to cyclically scroll the available measurement units.



4. Press **ESC** to exit the **UNIT** command.

If several quantities of the same type (e.g. several temperatures) are shown in different measurement lines, you can set different measurement units for each measurement line.

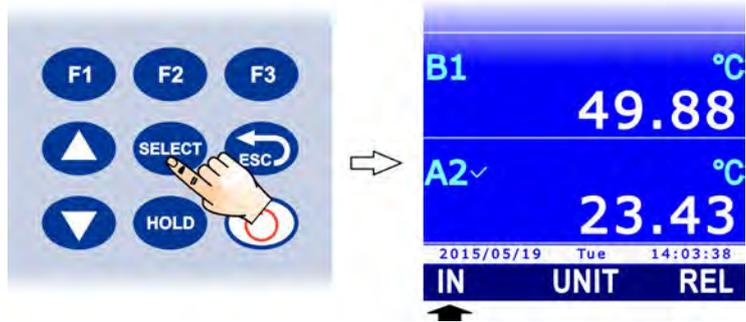
The measurement unit change affects the display and the immediate print of the measurements (PRINT command). **The data already stored in the SD card maintain the measurement units selected at storage.**

3.3 CHANGING THE QUANTITY VIEWED IN THE DISPLAY LINE

A quantity can be displayed in any measurement line of the display:

1. Select the desired line with ▲ and ▼ keys.

2. Press the **SELECT** key to display the **IN** command in the command bar, then select the command by pressing **F1** key.



3. Select “<<<” (F1) or “>>>” (F3) to cyclically scroll the available quantities.



If you don't want quantities to be displayed in the line, select “--”.



4. Press **ESC** to exit the IN command.

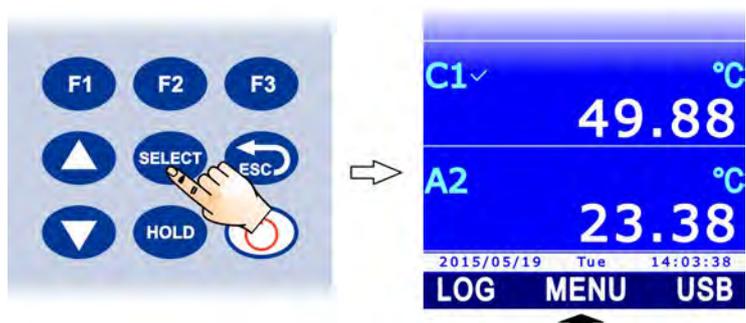
The same quantity can be displayed in several lines, e.g., for the simultaneous display of minimum and maximum values, or the current value and the average value, etc. (*note*: to display the minimum, average and maximum values of a quantity you need to activate the RECORD function, see chapter 5).

3.4 DERIVED QUANTITIES AND NUMBER OF MEASUREMENT LINES DISPLAYED

The number of measurement lines displayed can be configured. Up to 36 measurement lines can be displayed. The number of measurement lines displayed at the same time is always 3, further measurement lines can be seen by scrolling the list upward or downward using ▲ and ▼ keys.

By default, the instrument displays only the quantities measured by the probes and the main derived quantities. For instance, connecting a combined relative humidity and temperature probe displays only the temperature, the relative humidity and the dew point temperature, but not the other derived quantities: absolute humidity, mixing ratio, etc. To enable any other derived quantities as well, or to disable some of the visible quantities, proceed as follows:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing **F2**.



2. Select the **SETUP** item using ▲ and ▼, then press **F3 (OK command)** to confirm.



3. Select the **CHANNELS** item using ▲ and ▼, then press **F3 (OK command)** to confirm.



4. Select the A, B or C input of the instrument, using ▲ and ▼, then press **F3 (OK command)** to confirm.



5. The list of the available measured and calculated quantities, relevant to the selected input is displayed. The checkmark next to a quantity indicates that the quantity measurement is enabled (appears in the display). Using ▲ and ▼, select the quantity to be enabled or disabled, then press **F1 (SEL command)** to toggle between the enabled and disabled states of the quantity.



6. Press **F3 (OK command)** to confirm.

Note: the enabled state of several quantities can be changed by selecting them one at a time, before confirming; the changed quantities are displayed in yellow to highlight changes.

The instrument allows the setting of the quantity enable state to be saved, so as to be able to restore it afterwards and cancel any changes carried out thereafter.

Select the **BKUP** command (**F2** key) to save or restore the saved setting.



Select the **SAVE** command (**F1**) to save the setting. Select the **LOAD** command (**F2**) to restore the previously saved setting. Select the **BASIC** command (**F3**) to return to the default setting.



Press **F3** (**OK** command) to confirm the restore operation.

Press **ESC** to return to the previous menu.

Number of displayed measurement lines:

The number of the displayed measurement lines is automatically updated when quantities are enabled or disabled. If you want a different measurement number to be displayed, e.g. to show simultaneously both the current value of a quantity and the relevant statistical information (Min, Max, Avg), the number of displayed measurement lines can be set manually:

1. Select the **CHANNELS NUM.** item in the CHANNELS menu, using **▲** and **▼**, then press **F3** (**OK** command) to confirm.



2. Set the number of measurement lines to be displayed using **▲** and **▼** (select the **RESET** command with **F2** key to set the default number), then press **F3** (**OK** command) to confirm.

Note: the current setting is shown in white, while the other available settings appear in yellow to show that they are not the current setting.



3. The instrument returns to CHANNELS NUM item, repeatedly press **ESC** to exit the menu.

3.5 DISPLAYING THE DIFFERENCE BETWEEN TWO HOMOGENEOUS QUANTITIES

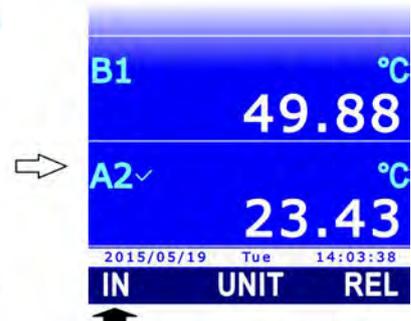
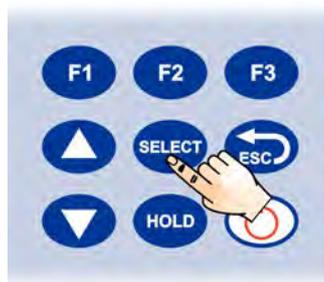
A measurement line can display the difference between the values of two homogeneous quantities, e.g. the difference between the values measured by two Pt100 probes, by two thermocouple probes, by two equal pressure probes etc.

The difference between the measurements of two different probes cannot be calculated, even if they refer to the same physical quantity, e.g. between the measurement of a Pt100 probe and a thermocouple probe, or between the measurement of two pressure probes having a different full scale value.

To display the difference between the values of two homogeneous quantities:

1. Select the first of the two quantities (e.g. A2, if you want A2-B1 to be displayed) using ▲ and ▼ keys.

2. Press **SELECT** to display the **IN** command in the command bar, then select the command by pressing **F1**.



3. Select the **DIFF** command by pressing **F2**.

Note: if a quantity consistent with the one selected is not available, the command is disabled.



4. The selected measurement line shows the difference between the value of the quantity originally included in the line (e.g. A2) and the value of another available homogeneous quantity.

If several homogeneous quantities are available, repeatedly select the **DIFF** command (**F2** key) to display the desired difference.



To disable the difference display, repeatedly select the **DIFF** command (**F2** key) to display again the value of the quantity originally present in the line.

5. Press **ESC** to exit the **IN** command.

3.6 DISPLAYING THE RELATIVE MEASUREMENT (REL)

The instrument allows the relative measurement of the quantities to be displayed, i.e. the difference between the current measurement value and a reference value, consisting in the measurement value at the moment of the REL function activation.

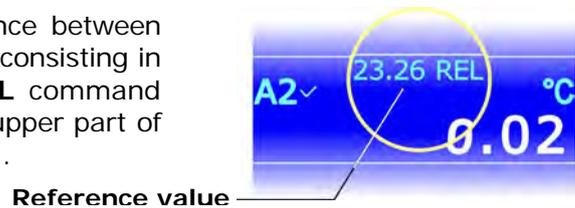
To activate the relative measure:

1. Select the quantity you want the relative measure to be enabled, using ▲ and ▼.

2. Press **SELECT** to display the **REL** command in the command bar, then select the command by pressing **F3**.



3. The selected measurement line shows the difference between the quantity current value and the reference value, consisting in the measurement value at the moment of the **REL** command activation. The reference value is displayed in the upper part of the measurement line (followed by the symbol **REL**).



Select again the **REL** command (**F3** key) to disable the display of the relative measure and return to the current measurement value.

3.7 HOLDING THE MEASUREMENT ON THE DISPLAY (HOLD)

The HOLD function holds the current measurement values on the display. The function affects all the measurement lines. When the HOLD function is active, the measurement values on the display are not updated, but remains set to the value present at the moment of the function activation.

Press **HOLD** to activate the function. The function activation is highlighted by the orange bars over and under the measurement area on the display, and by the word HOLD flashing in the top bar. The clock in the bottom bar remains stopped to the moment the key was pressed.



Fig. 3.7.1: HOLD function activation

Press again **HOLD** to disable the HOLD function and return to the current measurement values.

3.8 MEASUREMENT GRAPH

The graph of a quantity measured by the instrument can be shown in the display. Zoom functions and vertical and horizontal cursors are available during the graphical representation, allowing the graph to be analyzed in detail.

Select the quantity you want the graph to be displayed using ▲ and ▼. Press **SELECT** to display the **PLOT** command in the command bar, then press **F3**.

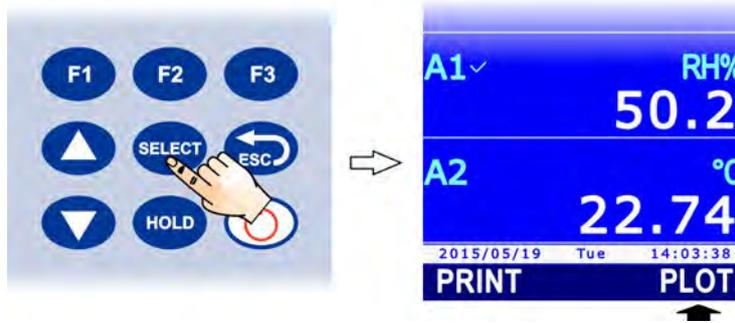


Fig. 3.8.1: PLOT command

If the graph of another quantity was previously started, a message appears asking to confirm the change: select **YES** (**F3** key) to continue (or press **F1** to select **NO** and exit). The quantity graph appears on the display.

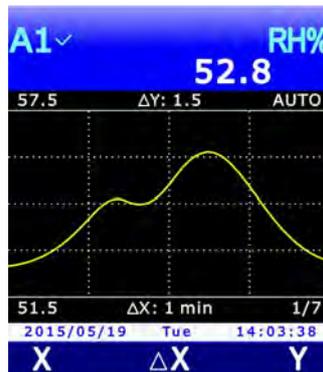


Fig. 3.8.2: graph display

The minimum and maximum values of the ordinate axis (y-axis) are shown at the left of the graph. Over the graph, in the middle, there is the ordinate scale: ΔY is the difference between two horizontal lines of the graph grid. Under the graph, in the middle, there is the abscissa scale: ΔX is the difference between two vertical lines of the graph grid.

Horizontal cursors and ordinate axis scale:

By selecting the **Y** command (**F3** keys), the horizontal cursors and the zoom commands of the ordinate axis are displayed.

The **CUR** command (**F2** key) activates alternatively the lower or the upper cursor. The active cursor is light blue, while the non-active cursor is white. You can move the active cursor using ▲ and ▼. The positions of the two cursors appear in the command bar.

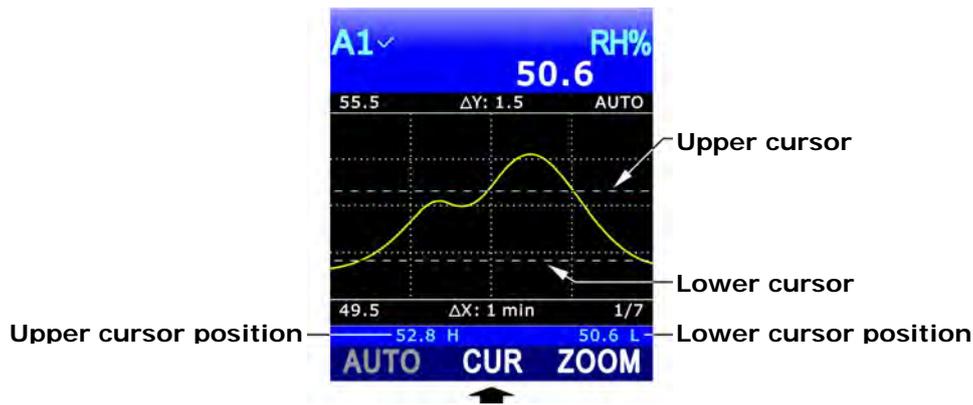


Fig. 3.8.3: horizontal cursors

The **ZOOM** command (**F3** key) enlarges the graph area included between the two horizontal cursors: the minimum and maximum values of the ordinate axis are equal to the values indicated by the lower and the upper cursor respectively. The indication **AUTO** (automatic ordinate scale) is replaced by the indication **ZOOM** over the graph, on the right.

The **AUTO** command (**F1** key) allows zooms to be disabled and to return to the automatic ordinate scale.

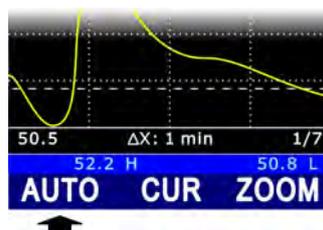


Fig. 3.8.4: AUTO command

Vertical cursors and x-axis scale:

Selecting **X** command (**F1** key) displays the vertical cursors of the abscissa axis (x-axis).

The **CUR** command (**F2** key) activates alternatively the lower or the upper cursor. The active cursor appears light blue, while the non-active cursor is white. The active cursor can be moved using <<< (**F1** key) and >>> (**F3** key) commands. The time distance between cursors (Δx) and the difference of the two measurements in correspondence with the cursors (Δy) appear over the command bar.

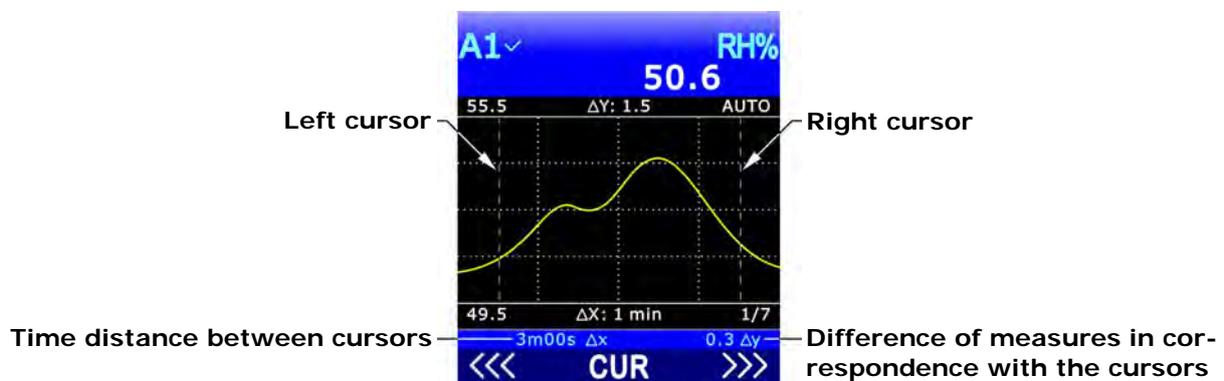


Fig. 3.8.5: vertical cursors

Press **ESC** to return to the previous command level.

The time interval between two vertical lines of the graph grid is set by default to 1 minute. Select **ΔX** command (**F2** key) to change the interval.

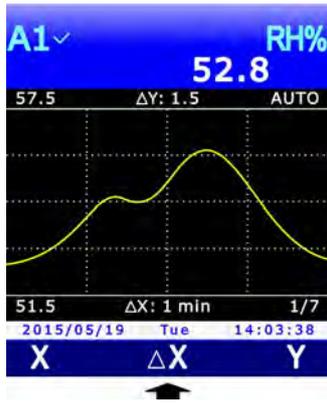


Fig. 3.8.6: command ΔX

The available intervals can be cyclically set to: 1 min, 5 min, 10 min, 30 min, 1 hour, 2 hours, 4 hours through the **NEXT** command (**F3** key).

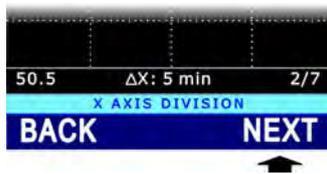


Fig. 3.8.7: x-axis scale setting

The time interval returns to the default value (1 min) by selecting the **BACK** command (**F1** key).

The sequential number of the selected interval appears under the graph on the right (e.g. 2/7 indicates the second interval of the seven available, that is 5 min).

If the interval returns to 1 minute (with the **BACK** command, or by setting the value from 4 hours to 1 minute with the **NEXT** command), the graph is reinitialized.

4 THE PROBES

The probes of the instrument are equipped with an “intelligent” module acting as interface between the probe and the instrument. Inside the module there is a microprocessor circuit with permanent memory performing different functions:

- allows the instrument to recognize the type of connected probe: Pt100, thermocouple, humidity probe, pressure probe, anemometric probe, photo/radiometric probe, ...;
- stores into memory the probe calibration data: in this way the probe can be indifferently connected to the three inputs of the instrument or to another instrument with no need to be recalibrated;
- recognizes the instrument with which it was calibrated (user-calibration);
- maintains the factory-calibration data and those concerning the last calibration made by the user, with the possibility of choosing one of the two calibrations for each of the probes connected to the instrument;
- stores into memory a serial number allowing the unique identification of the probe, a useful feature in case several probes of the same type are simultaneously used.

The recognition of SICRAM probes takes place when the instrument is started or after a reset.

SICRAM probes are supplied factory-calibrated and don't normally require further interventions from the user. Nevertheless, a new calibration can be carried out if needed. See chapter 13 for user-calibration of the probes.

4.1 PRT TEMPERATURE PROBES

Pt100 probes with SICRAM module can be connected. The probes have a 4 wire connection and the excitation current is chosen in such a way as to minimize the sensor's self-heating effect.

If your instrument needs to be connected to sensors that are not equipped with SICRAM module, one of the following two accessories will have to be placed between sensor and instrument:

- **TP471**: “intelligent” module with microprocessor and permanent memory, designed for 4-wire Pt100 Platinum sensors (**PRT**).
- **TP47**: connector without microprocessor and memory, designed for 4-wire Pt100 and 2 or 4-wire Pt1000 Platinum sensors (**PRT**).

TP471 and TP47 are provided with cable gland and grommet for 5 mm max diameter cables.

Proceed as follows:

1. Unscrew the cable gland and pull the grommet out, remove the identification label, unscrew the ring nut on the opposite side of the module/connector.

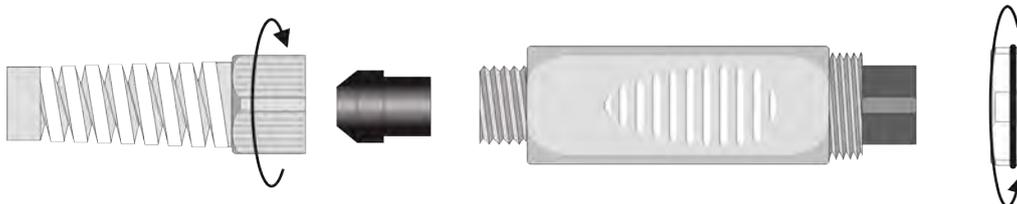


Fig. 4.1.1: opening the module/connector

2. Pass the sensor cable through the cable gland and grommet.
3. Open the two module/connector shells and connect the PRT sensor to the printed circuit as shown in the figures below. Take care that the welding is clean and skillfully made.

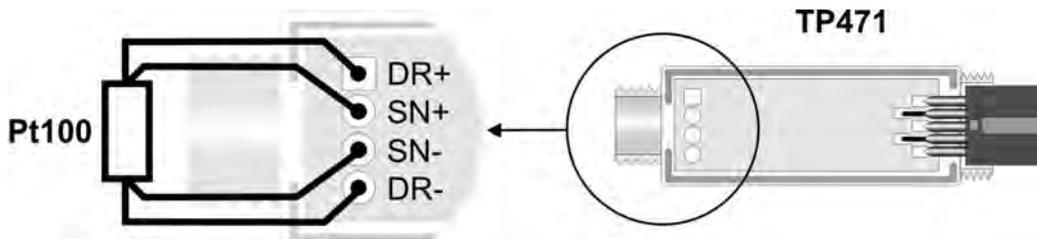


Fig. 4.1.2: connecting 4-wire Pt100 sensor to TP471 module

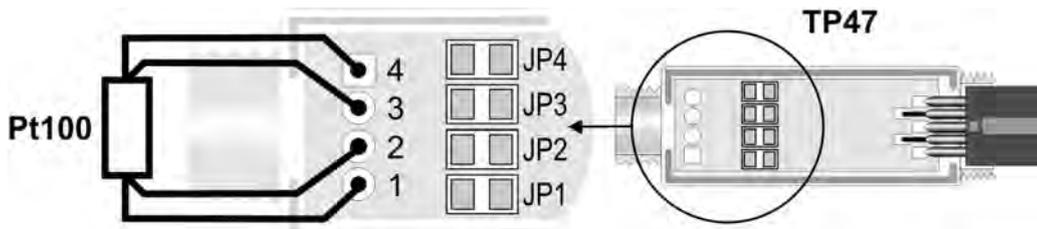


Fig. 4.1.3: connecting 4-wire Pt100 sensor to TP47 connector

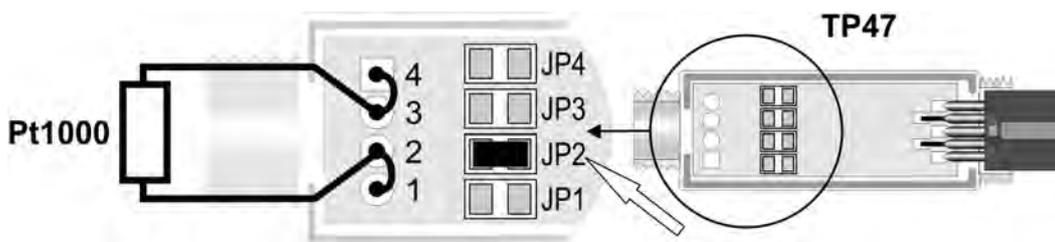


Fig. 4.1.4: connecting 2-wire Pt1000 sensor to TP47 connector

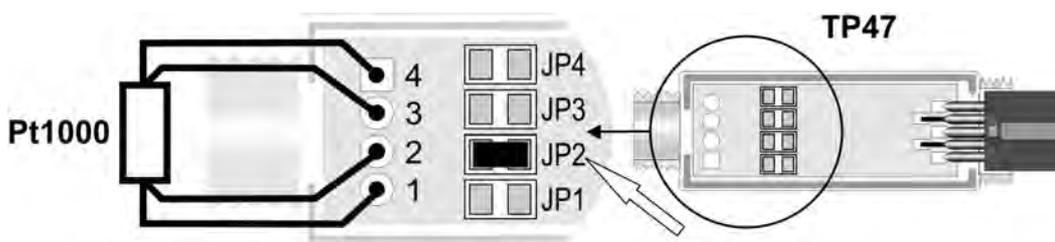


Fig. 4.1.5: connecting 4-wire Pt1000 sensor to TP47 connector

4. Close the two shells, insert the gasket in the module/connector, screw the cable gland and the ring. Make sure that the cable is not twisted when screwing the cable gland.

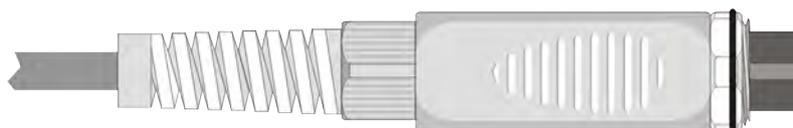


Fig. 4.1.6: PRT sensor connected to the module/connector

See paragraph 13.1 at page 90 for PRT probe calibration.

4.1.1 SETTING THE INSTRUMENT TO READ A PRT PROBE WITHOUT SICRAM MODULE

If a PRT probe without SICRAM module is connected, the type of connected probe must be set in the instrument:

1. Turn the instrument off and connect the probe.
2. Turn the instrument on.

3. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing **F2**.



4. Select the **SETUP** item using **▲** and **▼**, then press **F3** (**OK** command) to confirm.



5. Select the **CHANNELS** item using **▲** and **▼**, then press **F3** (**OK** command) to confirm.

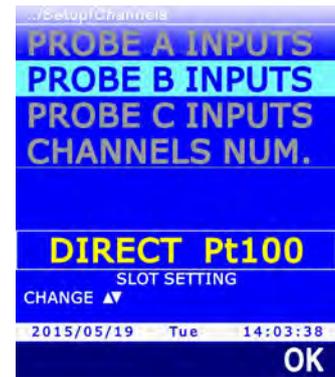


6. Using **▲** and **▼**, select the input (A, B or C) of the instrument to which the probe is connected, then press **F3** (**OK** command) to confirm.



7. Using ▲ and ▼, select the probe type: "SICRAM" (default), "DIRECT Pt100" or "DIRECT Pt1000".

Note: the current setting appears in white color, while the other available settings are in yellow color to highlight that they are not the current setting.



8. Press **F3 (OK)** command) to confirm.

9. Turn the instrument off and then back on.

Note: the probe type setting is maintained if the instrument is switched off with the probe connected; the setting returns to the default value ("SICRAM") instead if the instrument is switched off when the probe is disconnected.

4.2 THERMOCOUPLE TEMPERATURE PROBES

K, J, T, E, R, S, B and N-type thermocouple temperature probes can be connected. A SICRAM module has to be placed between the probe and the instrument choosing from the modules below:

- **TP471D0:** 1-input module without cold junction compensation.
- **TP471D:** 1-input module with internal sensor for cold junction compensation.
- **TP471D1:** 2-input module with internal sensor for cold junction compensation.

If TP471D0 module is used, without cold junction compensation, the cold junction will have to be kept at a temperature of 0 °C using a melting ice bath.

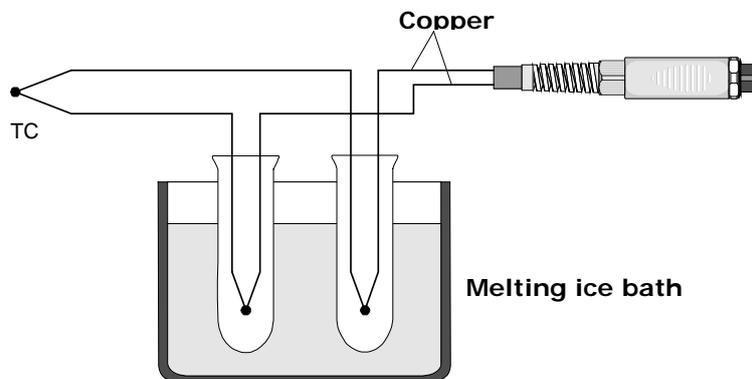


Fig. 4.2.1: cold junction at 0 °C

If TP471D and TP471D1 modules are used, the cold junction temperature is measured by the internal sensor and is used by the instrument to compensate the thermocouple measurement. The instrument displays also the cold junction temperature (as second quantity, e.g. A2, for the 1-input module, and as third quantity, e.g. A3, for the 2-input module).

See paragraph 13.2 at page 93 to set the type of thermocouple connected to the modules.

4.3 RELATIVE HUMIDITY AND TEMPERATURE COMBINED PROBES

The relative humidity and temperature combined probes use a capacitive sensor for the measurement of relative humidity and a Pt100 sensor for the measurement of temperature. By connecting a relative humidity and temperature combined probe, the instrument can display, besides the two primary quantities, the following derived humidity quantities as well:

- Saturated vapor pressure (Svp) in hPa
- Partial vapor pressure (Pvp) in hPa
- Mixing ratio in g/kg (vapor grams in 1 kg of dry air)
- Enthalpy in J/g
- Absolute humidity in g/m³ (vapor grams in 1 cubic meter of dry air)
- Dew point Temperature (Td)
- Wet bulb Temperature (Tw)
- Discomfort index (DisIdx)
- NET index (NetIdx)

Note: the calculation of the derived quantities is made taking into consideration a barometric pressure fixed value equal to 1013.25 hPa.

For measuring, place the probe avoiding areas where fast temperature variations may occur creating condensation. The measurement in no condition of fast temperature variations is almost immediate. On the contrary, if fast temperature variations occur, you have to wait the sensors and the probe body to reach thermal balance in order to obtain accurate measurements.

See paragraph 13.3 at page 94 for the calibration of relative humidity and temperature combined probes.

4.3.1 DISCOMFORT INDEX AND NET INDEX

Environmental conditions affect our physiological well-being status: particular values of temperature, humidity and air speed are perceived as unpleasant or even intolerable. While it is easy to quantify the relationship between well-being status and the measure of each variable taken separately, it is even more complex to provide an indication about their combined effect.

For this reason, different evaluation systems have been introduced leading to the formulation of climate qualitative indices (**Comfort Indices**).

The two indices provided by the instrument are the **Discomfort Index** and the **NET** index (Net Effective Temperature). The first one depends only on temperature and relative humidity, while the second one takes into consideration air speed as well. If an anemometric probe is connected to the instrument, the speed measurement detected is used for the calculation of the Net Index; if there is no probe connected, air speed is set equal to zero and its contribution is not taken into account.

Discomfort index:

$$DI = 0.81 \cdot T + \frac{H}{100} \cdot (0.99 \cdot T - 14.3) + 46.3$$

with T = temperature in °C
H = relative humidity in %

On the basis of the value provided by the discomfort index, climate conditions are defined from comfortable to unsustainable:

Comfortable	Slightly uncomfortable	Uncomfortable	Very uncomfortable	Unsustainable
68	70	75	80	86

NET index:

$$NI = 37 - \frac{37 - T}{0.68 - 0.0014 \cdot H + \frac{1}{1.76 + 1.4 \cdot v^{0.75}}} - 0.29 \cdot \left(1 - \frac{H}{100}\right) \cdot T$$

With T = temperature in °C

H = relative humidity in %

v = air speed in m/s

NET index provides the so called "apparent temperature": with optimum weather conditions, the index value is close to the environmental T temperature. As weather conditions deteriorate, humidity and air speed influence become more and more evident and the index provides a temperature value that reflects human typical sensations, deviating even significantly from the ambient temperature value:

- in hot climate, the NET index rises as temperature and/or humidity level increases, but it decreases with increasing wind force;
- in cold climate, the NET index decreases with temperature and with increasing humidity and wind level.

4.4 PRESSURE PROBES

The following SICRAM modules can be connected to the instrument:

- **PP471**: module for connection to absolute, relative and differential pressure probes of the TP704 and TP705 series. Connecting the module to the instrument displays both the instant value and the peak value of pressure. The peak value is characterized by the word "**peak**" alternating with the measurement unit.
- **PP472**: module for the detection of the barometric pressure in the range 600...1100 hPa.
- **PP473S...**: series of modules for the measurement of the differential pressure. Available full scale values: 2.5 / 10 / 20 / 50 / 100 / 200 / 500 / 1000 / 2000 mbar.

Pressure can be displayed in the following measurement units: Pa, hPa, kPa, mbar, bar, atm, mmHg, mmH₂O, kgf/cm², PSI, inHg, inH₂O. See paragraph 3.2 at page 13 for the measurement unit selection.

Some measurement units require the value to be displayed with a multiplication factor. If the displayed value is followed by the indication "E+3", it means that the value must be multiplied by 1000; if on the contrary it is followed by the indication "E-3", it means that the value must be divided by 1000.

The differential probes may be set to zero (see next paragraph). See paragraph 13.4 at page 99 for the calibration of PP472 module for the barometric pressure measurement.

4.4.1 ZEROING DIFFERENTIAL PRESSURE PROBES

There can be a small difference between the two inputs of the differential probes, that's why the instrument, with equal pressure applied to the two probe inputs, doesn't indicate zero value. A zeroing command for the differential value is available:

1. Leave the two inputs of the differential probe open, so as they may detect the same pressure.
2. Press **SELECT** to display the **ZERO** command in the command bar, then select the command by pressing **F2**.

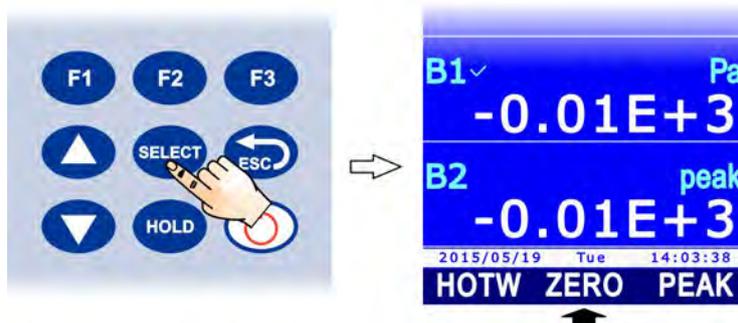


Fig. 4.4.1: ZERO command

3. Select inputs **A**, **B** or **C** the probe is connected to by pressing **F1**, **F2** or **F3** respectively.

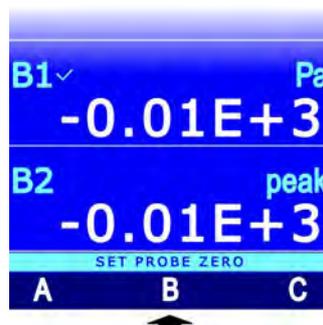


Fig. 4.4.2: selecting the differential probe for zeroing

4. The instant value is automatically zeroed.

4.4.2 PEAK VALUE RESET

The peak value detected by the probe connected to PP471 module can be reinitialized and set equal to the instant value:

1. Press **SELECT** to display the **PEAK** command in the command bar, then select the command by pressing **F2**.



Fig. 4.4.3: PEAK command

2. Select inputs **A**, **B** or **C** the probe is connected to by pressing **F1**, **F2** or **F3** respectively.

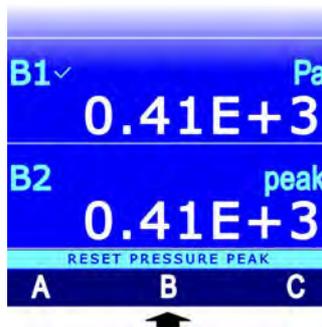


Fig. 4.4.4: selecting the probe for peak value reset

3. The peak value is reset to the instant value.

Peak value reset during logging:

If the logging interval is lower than 60 seconds, the peak value is not zeroed: the acquired value is therefore the highest peak since acquisition startup.

For logging intervals equal to or higher than 60 seconds, the peak value is on the contrary reinitialized after each acquisition: the stored peak value is therefore the one related to the single interval between two subsequent acquisitions.

Two different operation modes have been chosen for this reason: when the logging interval is short, the set of the instant measures represents closely enough the pressure trend over time. In the case of long intervals, the mere knowledge of the pressure value of each interval and of the absolute peak value doesn't provide sufficiently precise information: knowing each peak value between two subsequent samplings provides additional information on the pressure time trend.

4.5 AIR SPEED PROBES

The following probes/modules can be connected to the instrument:

- **AP471S...**: hot-wire air speed SICRAM probes.
- **AP472S...**: vane air speed SICRAM probes.
- **AP473S...**: SICRAM modules for Pitot tubes.

Some probes measure air temperature as well.

The selection of the type of probe to be used depends on the range of air speed and temperature to be measured: see the specifications of air speed probes at page 126.

Air speed can be displayed in the following measurement units: m/s, km/h, ft/min, mph, knot. See paragraph 3.2 at page 13 for the measurement unit selection.

TAB. 4.5.1: conversion table of air speed measurement units

	m/s	ft/min	km/h	mph	knot
1 m/s	1	196.87	3.60	2.24	1.944
1 ft/min	0.00508	1	0.01829	0.01138	$9.874 \cdot 10^{-3}$
1 km/h	0.2778	54.69	1	0.6222	0.5399
1 mph	0.4464	87.89	1.6071	1	0.8689
1 knot	0.5144	101.27	1.852	1.151	1

4.5.1 FLOW-RATE MEASUREMENT

If an air speed probe is connected, the instrument can calculate the air flow rate of an air duct or air vent orthogonal to the flow. For the calculation of the air flow rate, you need to configure the value of the duct or air vent section as described in paragraph 9.4 at page 76.

The air flow rate can be displayed in the following measurement units: l/s, m³/s, m³/min, m³/h, ft³/s, ft³/min. See paragraph 3.2 for the measurement unit selection.

Note: in air flow measurements, use only one anemometric probe at a time, since only one section is available for setting. There are no limitations instead to the simultaneous use of several anemometric probes for air speed measures.

4.5.2 NOTES ON FLOW MEASUREMENTS

If the surface area of the considered measurement is large or there is air turbulence, e.g. in front of a grid or a diffuser, air speed and air flow may vary both geographically (from one point to another) and over time (in the same point but in subsequent moments). To obtain most significant values, it is therefore advisable to average the acquired instant measurements. The instrument provides two methods for the calculation of the measured average flow:

- 1) Use of the **RECORD** function: the function allows averaging of the acquired instant values starting from the moment of the function activation. Additionally, the function provides the minimum and maximum acquired values. See chapter 5 for the RECORD function use.
- 2) Use of **moving average**: the function allows displaying the average of the last **n** instant measurements - instead of the instant measurement - where **n** can be set from 1 to 100. See paragraph 9.5 at page 78 for the setting of the parameter **n (FLOW AVG. TIME)**.

The presence of vent grills or diffusers with tilting flaps produces errors in the flow measurement due to the generated turbulence, since part of the flow is slowed down by the obstacle repre-

sented by the flap, while the remaining flow proceeds at maximum speed. In this case, a channel having a length of about the double of the grill diagonal should be placed temporarily in front of the grill and measurements should be taken at the channel's end. The section to be considered for flow calculations will be that of the temporary channel placed between grill and probe.

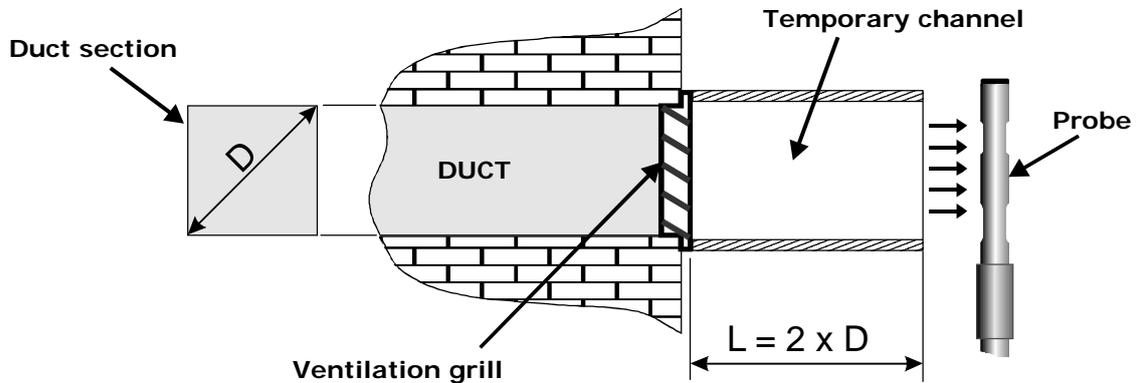


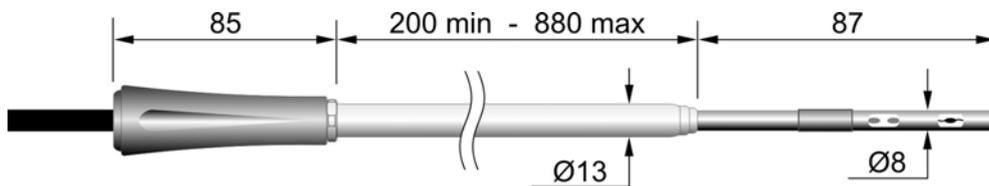
Fig. 4.5.1: flow measurement in the presence of vent grills or diffusers

4.5.3 HOT-WIRE AIR SPEED PROBES AP471S...

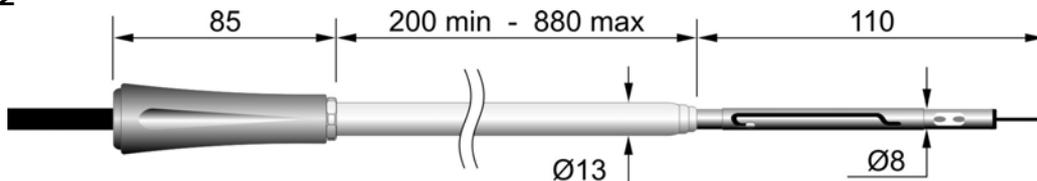
AP471S1 and AP471S3 probes measure incident air flows up to 40 m/s; AP471S2 and AP471S4 probes, equipped with omnidirectional sensor, measure air speed up to 5 m/s in any direction of the air flow incident on the probe. Air speed measurement temperature is compensated in the range 0...+80 °C.

AP471S4 probe is provided with supporting base and sensor protection.

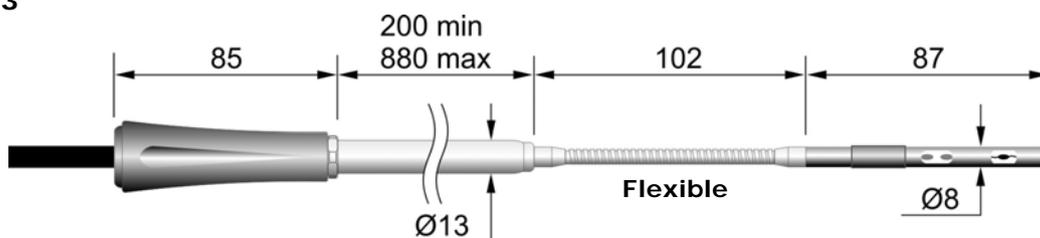
AP471S1



AP471S2



AP471S3



AP471S4

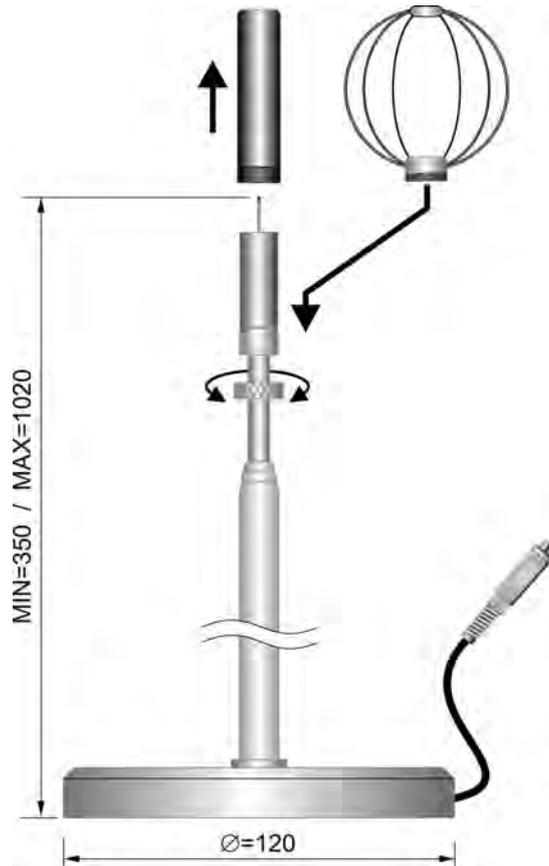


Fig. 4.5.2: AP471S...series probes

AP471S1, AP471S2 and AP471S3 probes are provided with a cylindrical shield sliding longitudinally along a guide rail. The shield has two end of stroke positions which lock it in measurement condition (lowest level) or at rest condition (highest level).

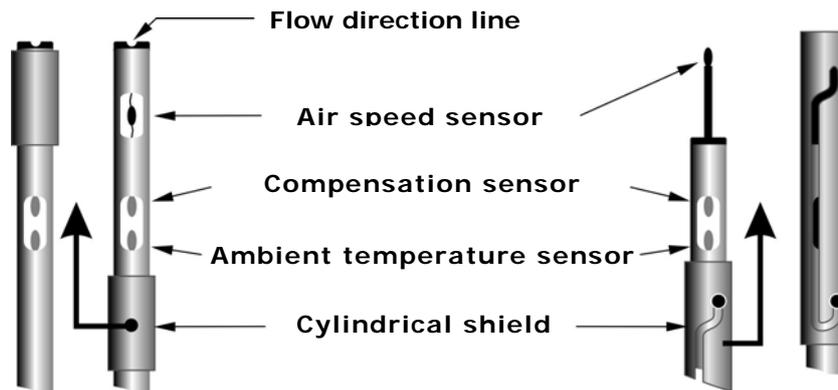


Fig. 4.5.3: description of AP471S1- AP471S2- AP471S3 probes

To reduce the amount of space when it is not used, the AP471S4 probe is equipped with a protection cylinder to be screwed onto the probe's head (see fig. 4.5.2).

The probes of AP471S... series are factory-calibrated and don't require user-calibrations.

Before the measurement, set to zero the probe as indicated in paragraph 4.5.6 at page 38.

To perform the measurement, extend the telescopic rod for the necessary length ensuring that the cable may slide freely and without efforts. Uncover the sensor and insert the probe in the

air flow to be measured, keeping the arrow on top of the probe parallel to the flow, as indicated in the figures below. The probe must be kept orthogonal to the flow and not inclined.

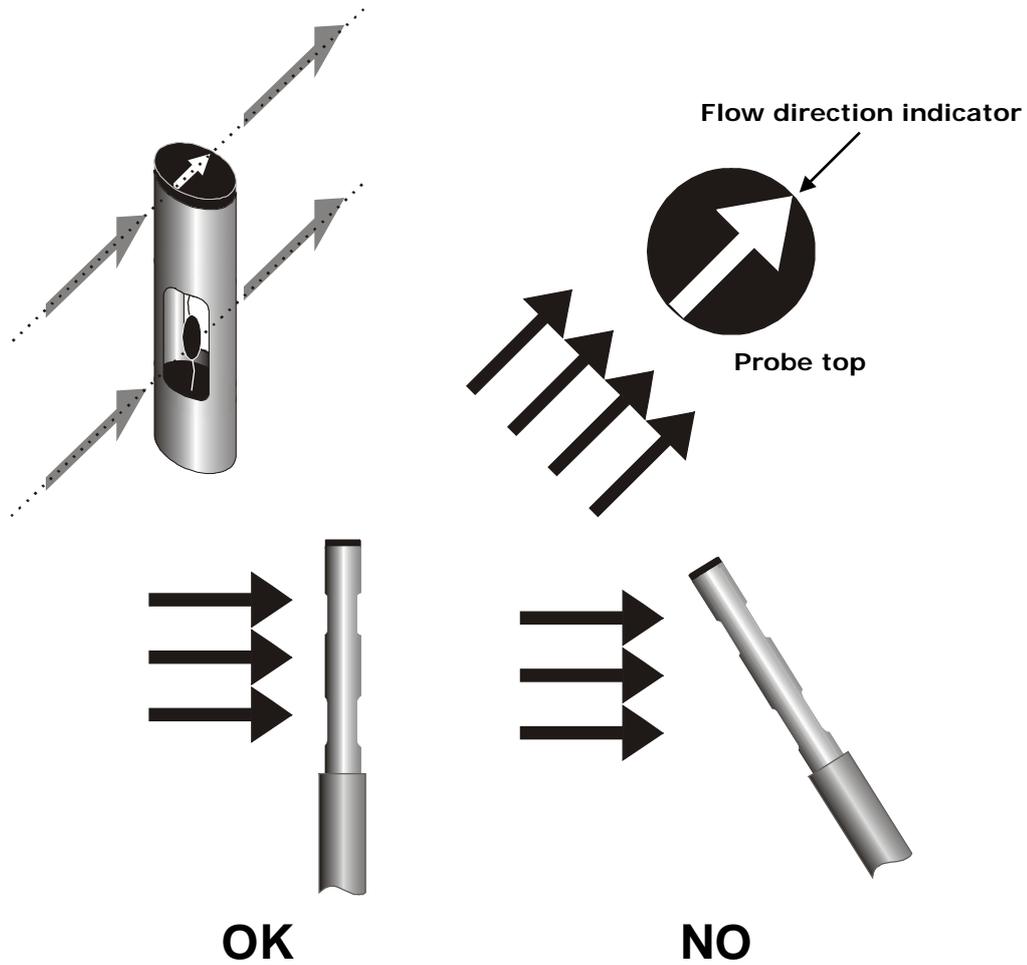


Fig. 4.5.4: positioning hot wire probes

Probe power supply:

To reduce battery drain, the hot-wire probe is not powered at instrument startup: **OFF** appears in place of air speed and flow measurements. To power the probe:

1. Press **SELECT** to display the **HOTW** command in the command bar, then select the command by pressing **F1**.

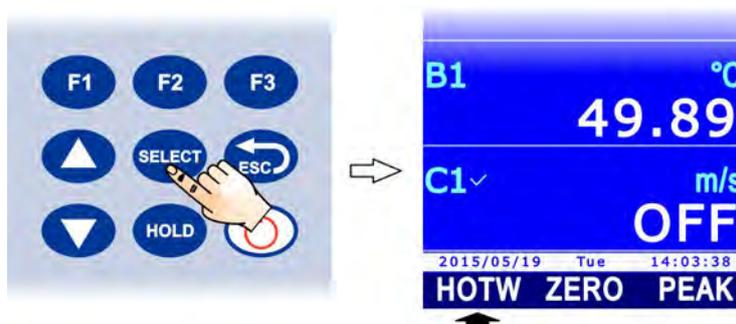


Fig. 4.5.5: HOTW command

2. OFF indication on the display is replaced by the measurement.

Select again the HOTW command to switch off the probe.



AP471S... probe speed sensor is heated and fire or explosion might occur, if vapors or gases are present. Do not use the probe in the presence of flammable gases. Make sure there are no gas or explosive vapor leaks in the environment.

Care and maintenance of hot-wire probes:

The probe is a very sensitive device and should be handled with extreme care. Even a simple shock, particularly with omnidirectional probes whose sensor is uncovered, can make the probe unusable. Once the measure is finished, the sensor placed on the probe's head should be protected with the metal shield or with the threaded cylinder supplied. During use, the omnidirectional probe AP471S4 should be protected with the special metallic grid provided. For transportation, the sensor should be closed inside the protection cylinder by screwing it at the probe's end.

Do not touch with your fingers.

Use only alcohol to clean the probe.

4.5.4 AIR SPEED VANE PROBES AP472S...

AP472S1 and AP472S2 vane probes measure the speed and flow rate of an incident air flow. AP472S1 probe measures also the temperature through a type K thermocouple. They are equipped, upon request, with an extensible telescopic rod (**AST.1**) which facilitates measurements in hard-to-reach areas (e.g. air-vents).

The bigger diameters are suitable for flow measurements in the presence of low-to-medium air speed turbulence (e.g. duct outlets). Lower diameters are suitable for applications where the probe surface must be much smaller than the transversal section of the duct, inside which the measurement is performed, e.g. aeration channels.

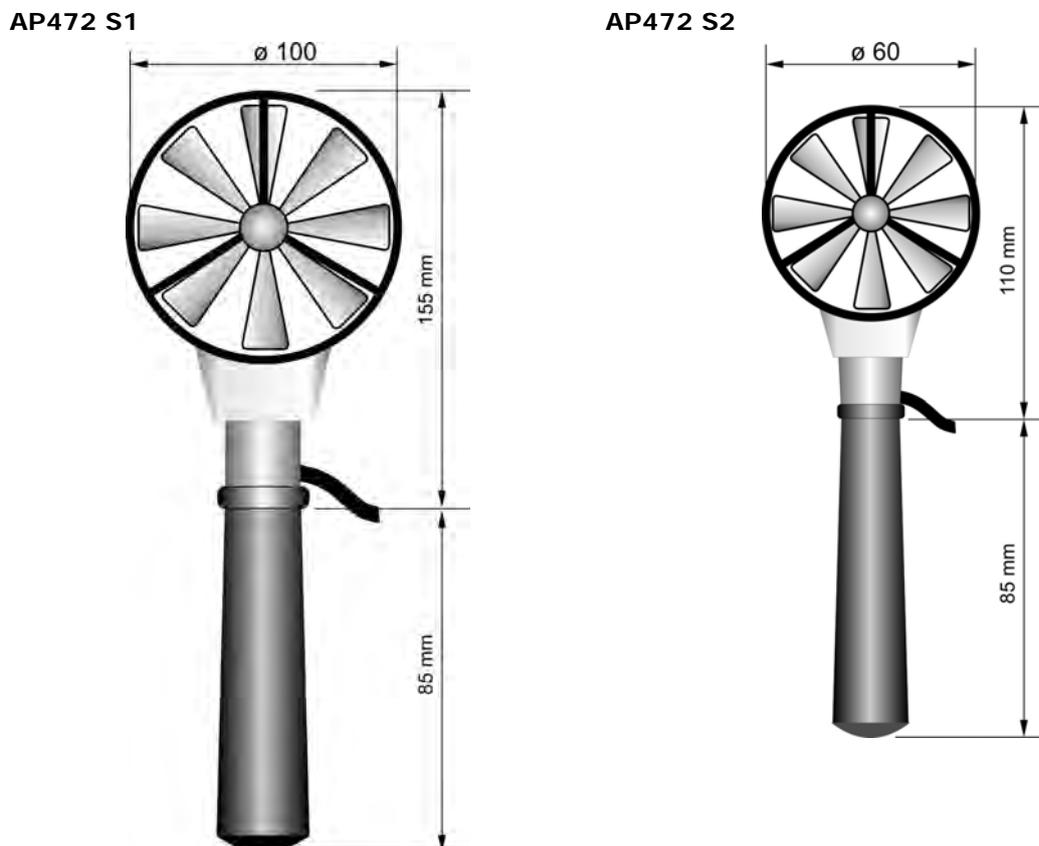


Fig. 4.5.6: probes of AP472S...series

The AP472S... series probes are factory calibrated and don't require user calibration.

ATTENTION: vane probes can be connected only to the C input of the instrument. If the probe is connected to A or B inputs, the indication "Slot C" appears to indicate that the probe should be moved to the C input .

To perform the measurement, extend the telescopic rod for the necessary length making sure that the cable slides freely and without efforts. Insert the probe in the air flow to be measured, keeping the propeller axis parallel to the flow, as indicated in the figures below. The probe should be kept orthogonal to the flow and not inclined. The probe is correctly positioned in the air flow when the maximum value is detected.

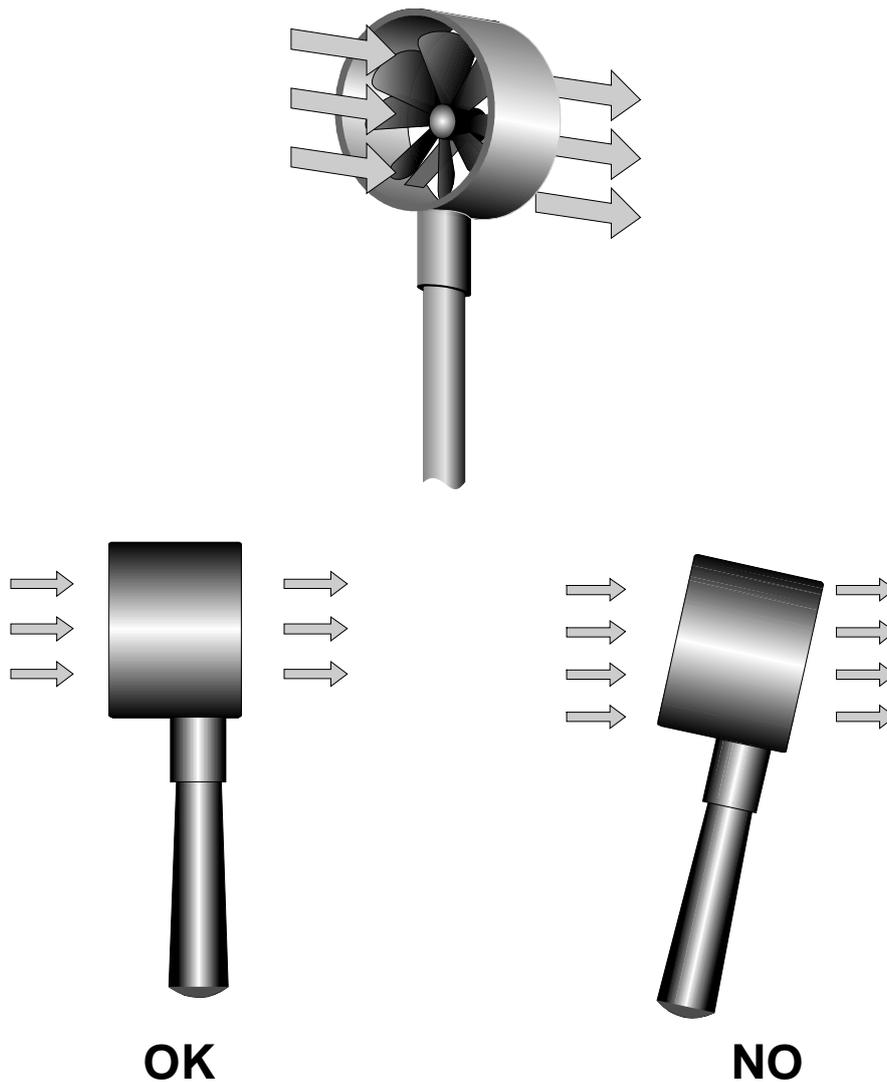


Fig. 4.5.7: positioning vane probes

The probes AP472S1 and AP472S2 , plus auction telescoping AST.1 with swivel head, can use a \varnothing 16 mm rigid extension rod. To unscrew the handle (3) hold the probe body at the point (1). Screw the rod top **AP471S1.23.6** (4) on the screw (2). Other extension rods **AP471S1.23.6** can be added. The last element can be the handle (3) or the extension rod **AP471S1.23.7** (5).

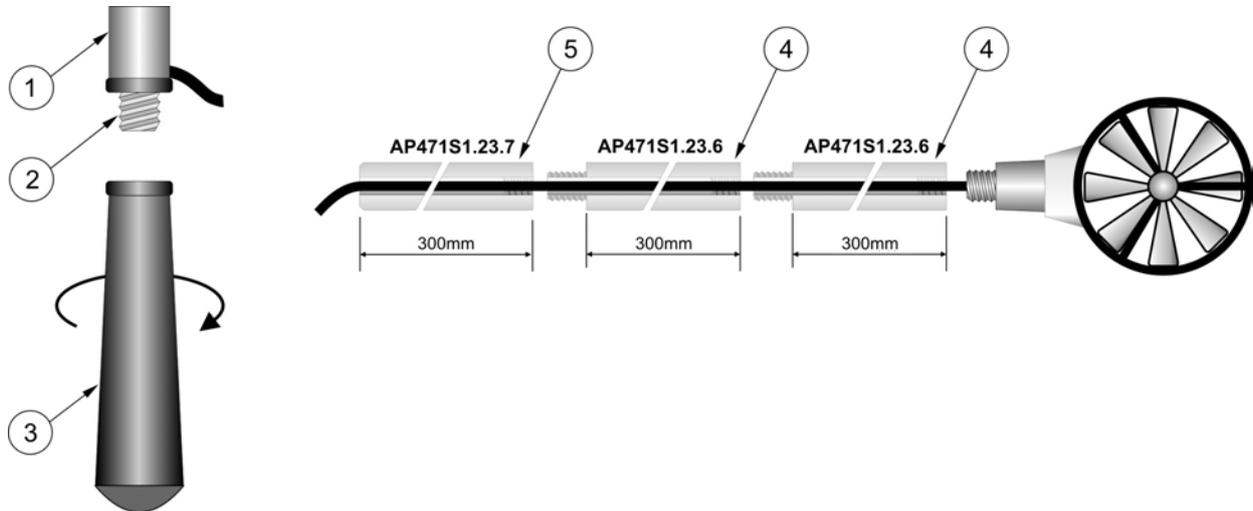


Fig. 4.5.8: adding extensions to vane probes

Care and maintenance of vane probes:

Probe performances, especially at the lowest speed, depend widely on the very low friction with which the propeller rotates around its own axle. So as not to jeopardize this feature, it is recommended not to force, lock or rotate the propeller with your fingers and not to introduce it in air flows which could soil it, as far as possible.

4.5.5 AP473S... MODULES FOR PITOT TUBES

Pitot tube is a simple method for measuring air speed in difficult to access areas (e.g. aeration ducts) and in the presence of high air speed and temperature. Since there is no air passage through the Pitot tube, it is particularly indicated for measurements in harsh environments.

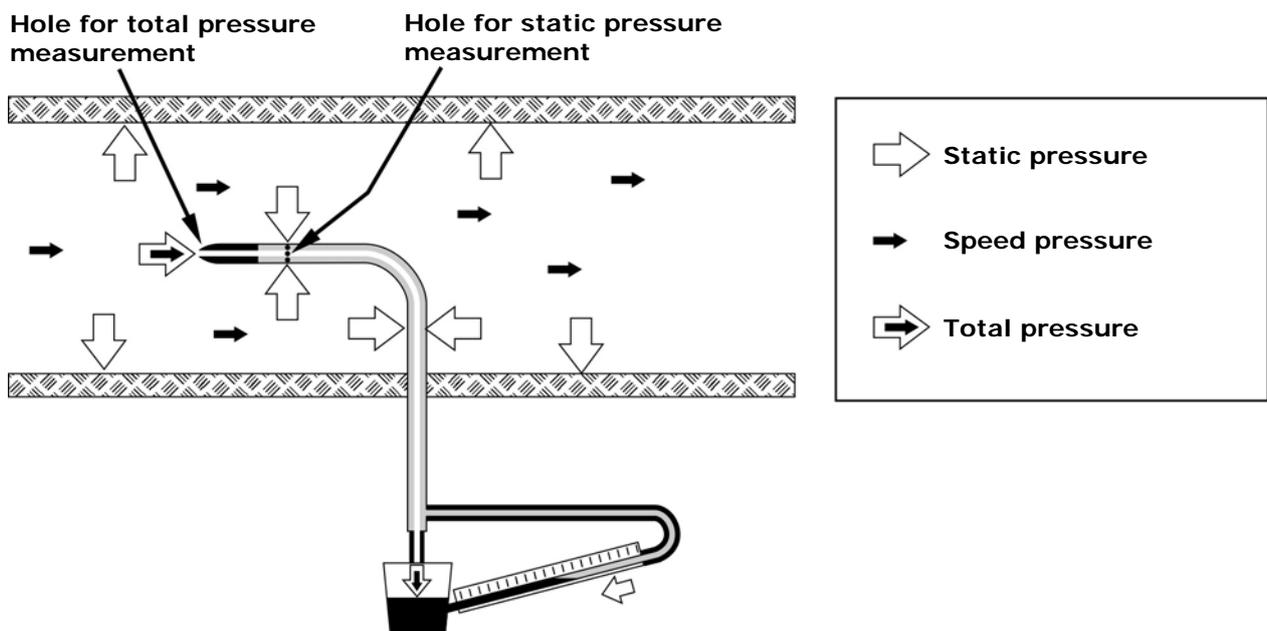


Fig. 4.5.9: Pitot tube measuring principle

The pressure inside the duct is the result of three different pressures:

- 1) barometric pressure (barometric B);
- 2) static pressure Ps;
- 3) dynamic pressure Pv due to non-null air speed inside the duct.

The formula below provides air speed in relation to the three pressures and of air temperature.

$$v = C \cdot 1,291 \cdot \sqrt{\left[\frac{1000}{B} \cdot \frac{T}{289} \cdot \frac{100.000}{100.000 + P_s} \cdot P_v \right]}$$

[v] = m/s

[B] = mbar

[Pv] = [Ps] = Pa

[T] = °K

Pitot tube provides the difference between the pressure existing at the front inlet of the duct and the pressure detected at the lateral air escapes that is the dynamic **Pv**:

$$(P_s + P_v) - P_s = P_v$$

Static pressure **Ps** represents the pressure difference between the inside of the duct in static conditions and the barometric pressure. If Ps is lower than 2500 Pa (=25 mbar), the term [100.000/(100.000+Ps)] can be disregarded, since the error committed is of about 1%.

B represents the barometric pressure existing at the moment of the measurement: the value can be given by a barometric pressure probe connected to the instrument or it can be set manually (see paragraph 9.3 at page 74).

T is the temperature detected by the thermocouple K present in some models of Pitot tubes. If the Pitot tube is provided with a thermocouple K, an external thermocouple K with Mignon connector can be added to the Pitot tube. In alternative, the temperature value can be added manually. See paragraph 9.2 at page 72 for the setting of temperature compensation.

C is the tube constant. See paragraph 9.5 at page 78 for the parameter setting.

In order to connect a Pitot tube to the instrument, a SICRAM AP473S...module must be placed between the tube and the instrument. Any of the Pitot tubes can be connected to each of the available modules, with the relevant thermocouple, if any. In standard temperature and barometric pressure conditions, AP473S1 model has a full scale of 40 m/s, AP473S2 of 55 m/s, and AP473S3 model of 90 m/s.

AP473S...modules are provided with two pressure inputs to be connected to the Pitot tube outputs, and with a thermocouple K input.

By connecting a AP473S... module, the instrument displays: air speed, the air temperature detected by the thermocouple, flow rate and the Pv differential pressure.

In order to perform the measurement, insert the AP473S... module connector into one of the instrument inputs; connect the outputs of the Pitot tube (pressure and thermocouple) to the module. The outputs of the Pitot tube must be connected to the module respecting the correct polarity. The output oriented downwards of the Pitot tube, indicated in the figure below by the plus sign (+), must be connected to the positive input of the module; the lateral output of the Pitot tube, indicated in the figure below by the minus sign (-) must be connected to the negative input of the module.

Insert the Pitot tube into the air flow to be measured, keeping the small rod at the base of the tube parallel to the flow as indicated in the figure below.

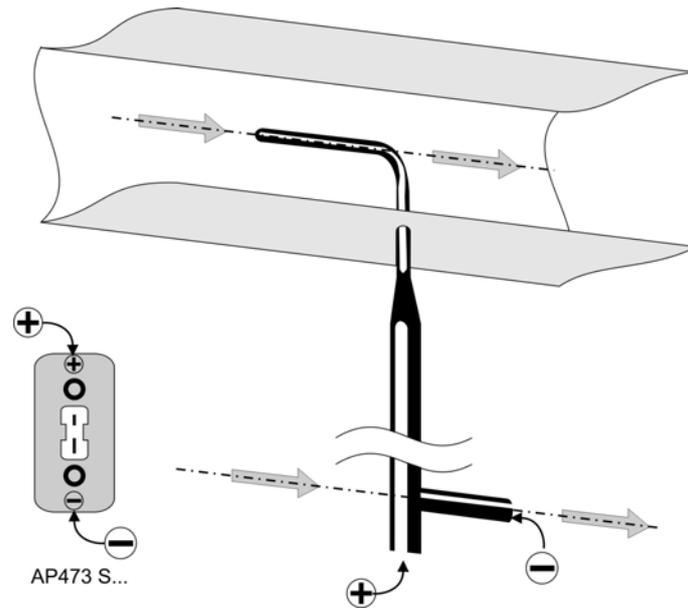


Fig. 4.5.10: positioning the Pitot tube

The error committed in the event of a misalignment is shown in the graph below:

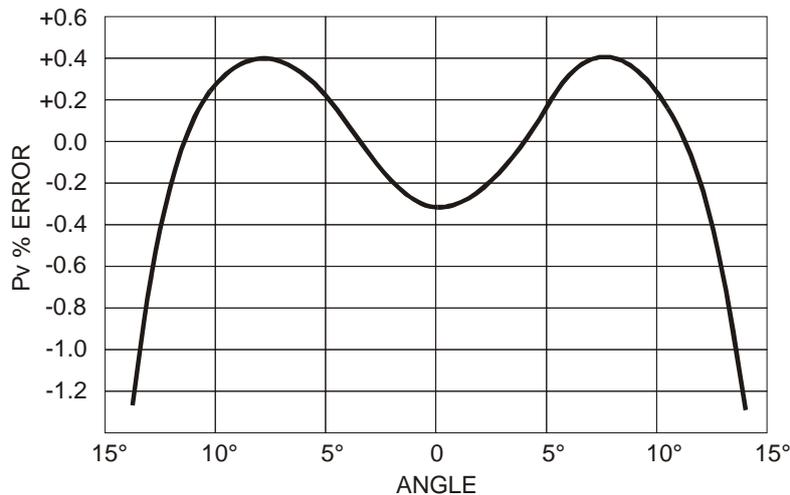


Fig. 4.5.11: misalignment error of the Pitot tube

The rotation angle around its own vertical axis with respect to the flow direction (yaw) is shown in the abscissa (x-axis), while the % error on the measurement of the Pv differential pressure is displayed in the y-axis (ordinate). As can be seen, a difference greater than 10° leads to an error in the measurement of the differential pressure of less than 0.5%.

4.5.6 ZEROING AIR SPEED PROBES

With hot-wire and Pitot probes, the probe zero should be corrected before performing a measurement, i.e., ensure that - under wind-free conditions - the speed and flow rate values provided by the probe are equal to zero, at a temperature close to that of the air flow to be measured.

1. As to AP471S1, AP471S2 and AP471S3 probes, slide the cylindrical shield upwards until the window of the air speed sensor on top of the probe is completely closed. As to the AP471S4 probe, close the probe head with the protection cylinder. As to Pitot probes, leave the two inputs of AP473S...module open, so as they detect the same pressure.

2. Press **SELECT** to display the **ZERO** command in the command bar, then select the command by pressing **F2**.



3. Select **A**, **B** or **C** input the probe is connected to by pressing **F1**, **F2** or **F3** key respectively.



4. The instant value is automatically zeroed.

4.6 VP472 MODULE FOR THE CONNECTION OF PYRANOMETERS AND ALBEDOMETERS

SICRAM VP472 module allows pyranometers and albedometers to be connected to the instrument.

When connecting a pyranometer to the module, the instrument displays:

- the mV signal generated by the thermopile;
- the global radiation in W/m^2 .

When connecting an albedometer to the module, the instrument displays:

- the mV signal generated by the thermopile detecting incident light;
- the mV signal generated by the thermopile detecting reflected light;
- the net radiation, in W/m^2 , defined as the difference between the incident global radiation and the diffuse global radiation.
- The albedo, defined as the relation between the reflected global radiation and the incident global radiation.

VP472 module is equipped with a 6-pole terminal block with screw connectors. Connect the pyranometer or the albedometer respecting the correct polarity of signals. The figures below show the connection of the pyranometer (LPPYRA02, LPPYRA03, etc.) and of LPPYRA05, LPPYRA06 and LPPYRA11 albedometers. In case a single-output pyranometer is attached, connect only input 1 of the module (incident radiation) and make a bridge between inputs 2. Connect the cable shield to the ground terminal indicated by the "ground" symbol.

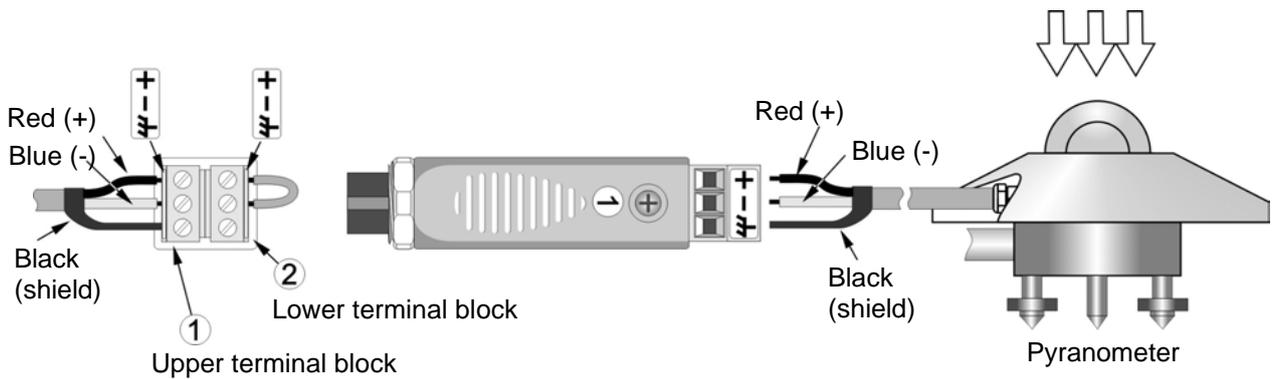


Fig. 4.6.1: connecting a pyranometer

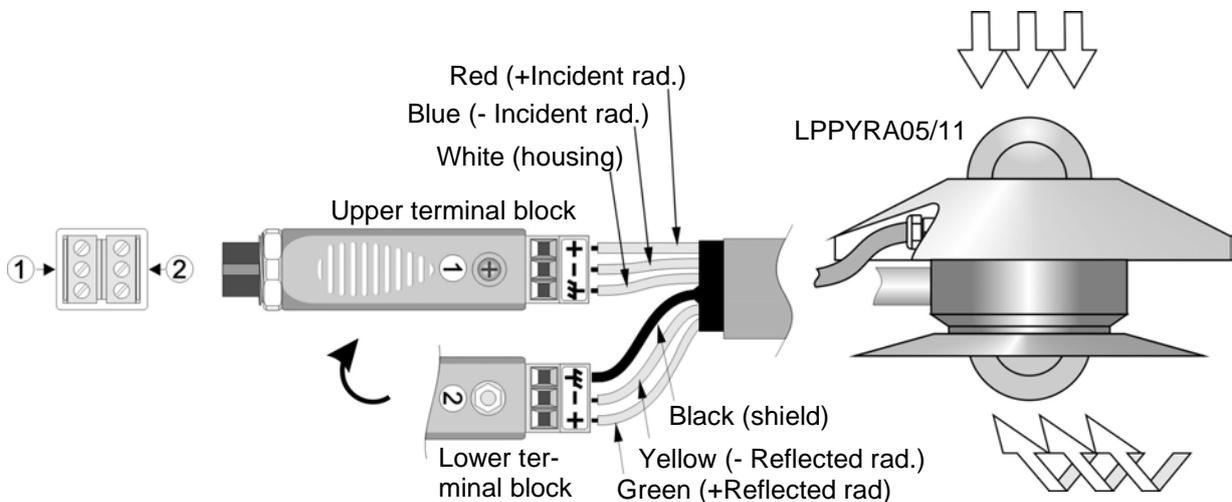


Fig. 4.6.2: connecting LPPYRA05 and LPPYRA11 albedometers

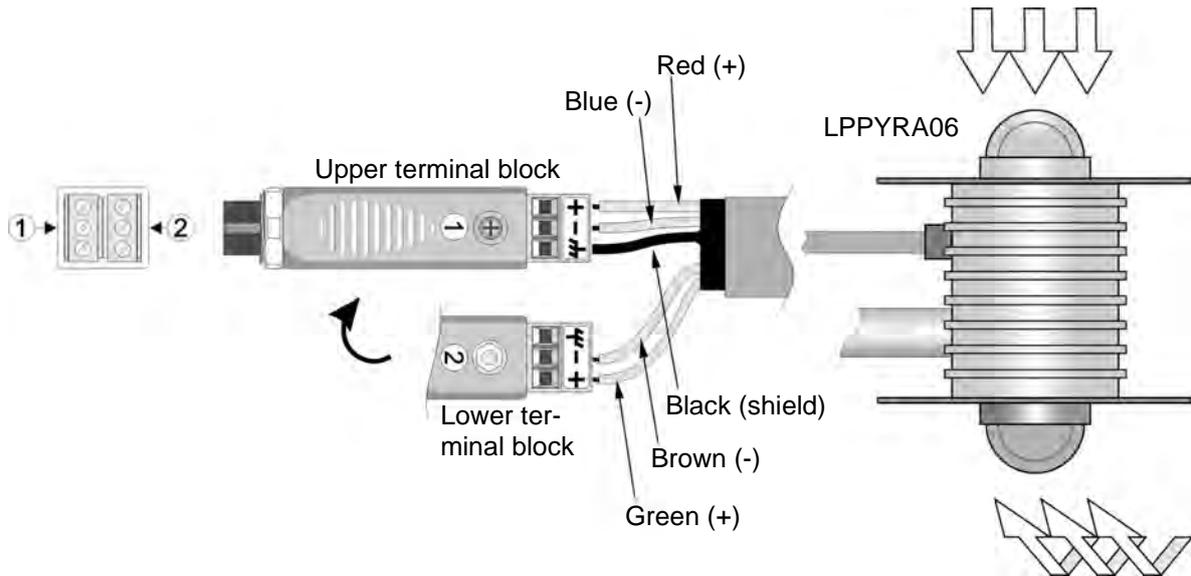


Fig. 4.6.3: connecting LPPYRA06 albedometer

In order to calculate the global radiation in W/m^2 with respect to the output voltage signal of the pyranometer, the pyranometer sensitivity must be set in the instrument, supplied with the pyranometer itself. The sensitivity must be set in $nV/(Wm^{-2})$ and range between 5000 and 30000 $nV/(Wm^{-2})$. The default value is 10000 $nV/(Wm^{-2})$. To set the sensitivity:

1. Press **SELECT** to display the **MENU** command in the command bar, then select **MENU** by pressing the **F2** key.
2. Select the **CALIBRATION** item using **▲** and **▼**, then press **F3** (**OK** command) to confirm.
Note: CALIBRATION item is not shown if the instrument is in protected mode. See paragraph 8.2 to change the protection status.
3. The list of the connected probes is displayed. Each probe is identified by its own serial number and by the type of measurement. Select VP472 module using **▲** and **▼**, then press **F3** (**OK** command) to confirm.
4. Set the first digit of the pyranometer sensitivity which measures the **incident** radiation using **▲** and **▼**, then select the command "-->" (**F2** key) to proceed to the next digit (the currently selected digit flashes). To return to the previous digit, select "<--" (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the value.
5. Set the first digit of the pyranometer sensitivity which measures the **reflected** radiation using **▲** and **▼**, then select the command "-->" (**F2** key) to proceed to the next digit (the currently selected digit flashes). To return to the previous digit, select "<--" (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the value.
Note: the second sensitivity is necessary only if an albedometer is connected; if this isn't the case, leave the default value.
6. Press **ESC** twice to return to the measurement mode.

4.7 PHOTOMETRIC AND RADIOMETRIC PROBES WITH SICRAM MODULE

The photometric and radiometric probes of **LP471...** series can be connected to the instrument.

The measurement unit is chosen by the instrument depending on the probe connected. If several measurement units are provided for the same probe, see paragraph 3.2 at page 13 for the selection of the desired unit.

All the probes are factory-calibrated and do not require user calibrations.

4.7.1 INTEGRATION

Besides the instant measurement, the instrument calculates and displays the time integral of the acquired measurements (except for the LP 471 LUM2 probe):

$$Q(t) = \sum_0^t u(t) \cdot \Delta t, \quad \Delta t = 1s$$

where $u(t)$ is the instant value of the input variable at time t . The sampling interval is fixed and equal to 1 second.

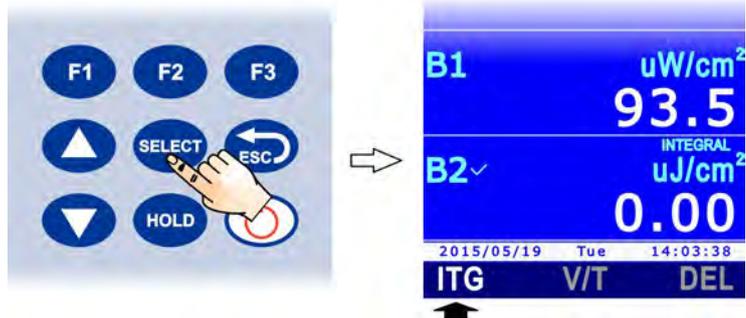
The integral calculation is started manually. The operation can be stopped manually or automatically when the user-settable threshold values are reached. The maximum integration time is 100 hours.

Integral measurements are featured by the indication **INTEGRAL** over the measurement unit. If INTEGRAL-type measurements are not specifically selected for integral calculation, this is enabled for all the available integral measurements. Integral calculation can be started only for some INTEGRAL-type measurements, by specifically selecting them.

Selecting an INTEGRAL-type measurement for integral calculation:

1. Select the integral calculation to be enabled using **▲** and **▼**. Integral measurements are featured by the indication **INTEGRAL** over the measurement unit.

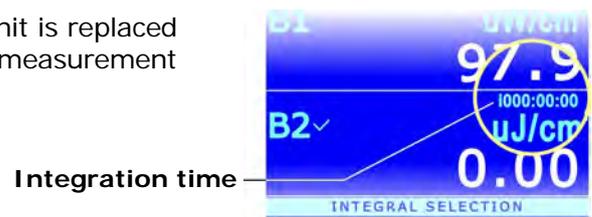
2. Press **SELECT** to display the **ITG** command in the command bar, then select the command by pressing **F1**.



3. Select the **SEL** command by pressing **F3**.



4. The indication **INTEGRAL** over the measurement unit is replaced by the integration countdown, to indicate that the measurement line is selected for calculating the integral.



To deselect the measurement line for calculating the integral, select again the **SEL** command (**F3** key): the integration countdown is replaced by the indication **INTEGRAL**.

Similarly select all the INTEGRAL-type measurement of which you want the integral calculation to be performed.

Starting the integral calculation:

To start the integral calculation, select the **RUN** command by pressing **F1**.



The RUN command starts the integral of all the INTEGRAL-type measurements selected for calculation. If integral measurements have not been specifically selected, the integral of all the INTEGRAL-type measurements is started.

Note: RUN command is available only if an INTEGRAL-type measurement is selected on the display (indicated by a check-mark) and if one of the measurements chosen for calculation is selected on the display, in case only some measurements were specifically selected for calculation.

Manual stop of integral calculation:

After startup, the RUN command is replaced by the STOP command. To manually stop calculating the integral, select the **STOP** command by pressing **F1**. The obtained integration value is maintained on the display.

Setting the integration time and the limit value:

If a time limit or a threshold limit is set for integration, the calculation is automatically stopped after the set time limit is reached or if the integral value reaches the set threshold value (if both conditions have been set, the calculation is stopped when at least one of the two conditions occurs).

The integration time limit is common to all integral measurements, while the threshold limit can be different for each integral measurement.

After reaching the set limit, the value of the integral is displayed in orange color, to highlight that the calculation was automatically stopped.

To set the integration time limit or the threshold limit:

1. Select the integral measurement you want the integration time limit to be applied.
2. Select the **V/T** command by pressing **F2**.

Note: the V/T command is disabled if the measurement is not selected for the calculation of the integral; in this case select it for calculation as previously indicated.



3. Select **TIME** (**F2** key) to set the integration time limit, or **VAL** (**F1** key) to set the threshold limit of the integral.



4. Set the first digit using ▲ and ▼, then select the command "->" (F2 key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the command "<--" (F1 key). After setting all the digits, press **OK** (F3 key) to confirm the value.

The integration time limit must be set in: "hours:minutes:seconds".



5. The set value appears at the left of the integration time counter. If both the time and the threshold limits were set, the two values alternate on the display.

Integration limits



To set time and threshold limits to zero, select the **CLR** command (clear) by pressing **F3**.



Reset and deactivation of the integral calculation:

If the integral calculation is restarted after a stop, the calculation restarts from the value reached at the moment of the stop. To zero the integral measurement, select the **DEL** command by pressing **F3**.



Then select the **CLR** command by pressing **F3**.



To disable the integral calculation, select instead the **CANC** command by pressing **F1**.

Integration and logging:

The integral values appearing on the display can be stored in the SD card through the LOGGING function (see chapter 7 at page 53) similarly to the current values of quantities. The data logger allows various behaviors of the ITG (INTEGRAL) function to be set when logging is started:

- Automatic reinitialization and reactivation, if in stop condition, of the function when logging is started.
- Automatic activation, if in stop condition, without reinitialization (the function continues from the reached value) of the function when logging is started.
- The function is neither automatically reinitialized nor enabled automatically, if in stop condition, when logging is started (the row will turn to orange to highlight the stop status).

See paragraph 7.12 at page 66 to set the ITG function behavior when logging is started.

The value of the integral is stored into memory (if selected for logging) only if the instrument is set not to turn off between two subsequent samplings, because calculating the integral each second requires the instrument to stay always on. If the instrument is set to turn off between two subsequent acquisitions, only the instant value of the signal supplied by the probe will be stored.

Integration and REC and REL functions:

REC (RECORD) and REL (relative measurement) functions are not available for integral measurements.

4.8 CO₂ PROBES

HD31.B3 and HD31.B3-10 CO₂ probes use a double wavelength infrared sensor with **NDIR** technology (Non-Dispersive Infrared Technology). The use of a double filter and of a particular measuring technique ensures accurate and stable measurement for a long time.

A protective membrane, through which the air to be analyzed is diffused, protects against dust and atmospheric agents.

During the measurement, it is recommended to stay not too close to the sensor, to avoid altering the CO₂ values to be acquired.

See paragraph 13.5 at page 100 for CO₂ probe calibration.

For a better measurement accuracy, it is recommended to use the barometric pressure compensation as described at paragraph 9.3 at page 74.

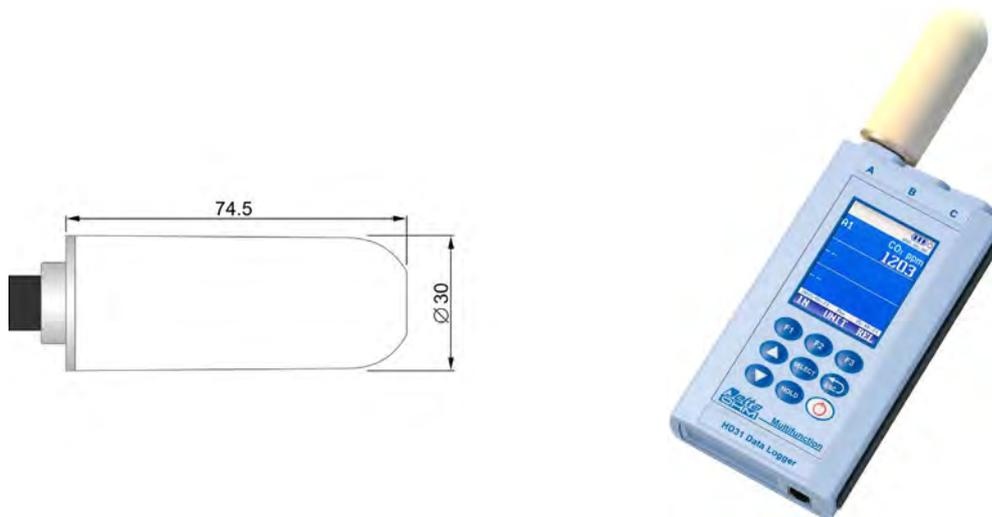


Fig. 4.8.1: CO₂ probe

Note: when the HD31.B3 probe is inserted, the connector of the instrument immediately next to the probe cannot be used because of the size of the probe; therefore, only an additional sensor can be connected.

4.9 VP473 AND IP472 MODULES FOR MEASURING DIRECT VOLTAGE AND CURRENT

VP473 SICRAM module measures the direct voltage applied at the input in the range -20 Vdc to +20 Vdc. The module input impedance is 1 M Ω .

If connected to a voltage output transmitter, it can acquire its signal.

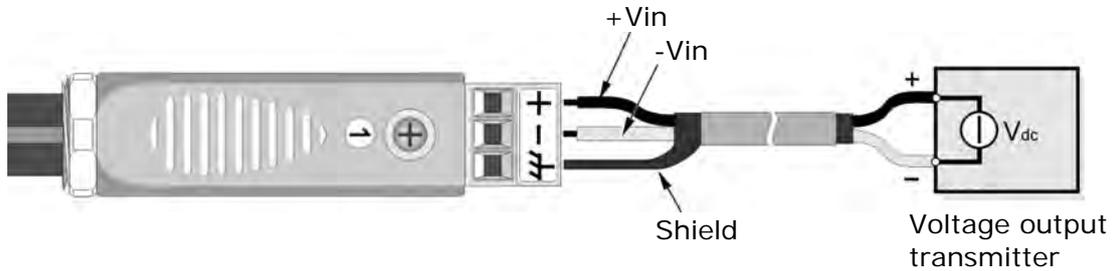


Fig. 4.9.1: VP473 module connected to voltage output transmitter

IP472 SICRAM module measures the direct current applied at the input in the range 0...24 mA. The module input impedance is 25 Ω .

Typical application is the acquisition of the output signal of an active or passive current transmitter, as shown in the figures below:

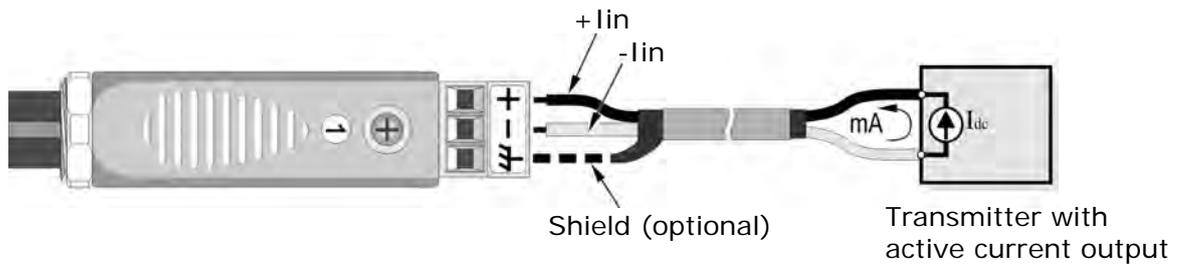


Fig. 4.9.2: IP472 module connected to transmitter with active current output

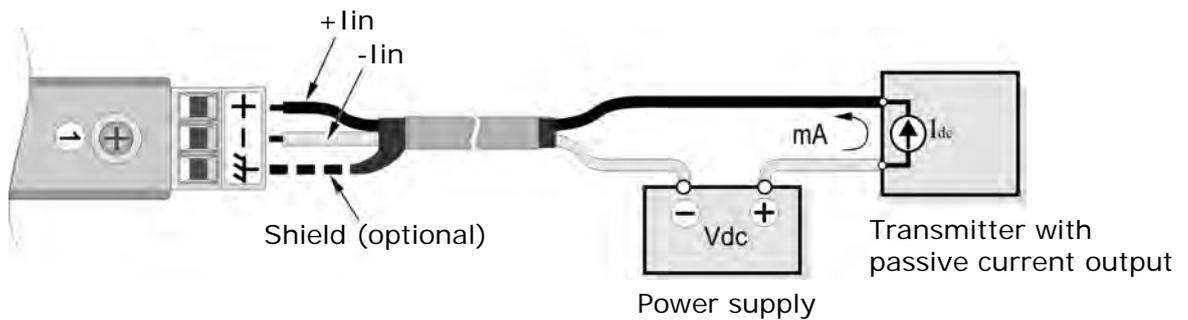


Fig. 4.9.3: IP472 module connected to transmitter with passive current output

5 RECORD FUNCTION

RECORD function stores the minimum, average and maximum values of the displayed quantities.

The upgrade of the minimum, average and maximum values takes place after each sample acquired using the RECORD function. The sample acquisition can be **automatic** (once per second) or **manual** (at the touch of a button).

Attention: data acquired using the RECORD function for the calculation of minimum, average and maximum values are not saved in the SD card and cannot be transmitted to a PC. Only the time trend of the minimum, average and maximum values can be recorded in the SD card through the LOGGING function (see chapter 7 at page 53).

If quantities are not explicitly selected for the RECORD function, the function activation takes place for all the quantities displayed (except for INTEGRAL-type measurements). The RECORD function can be started only for some quantities, by explicitly selecting them.

5.1 SELECTING A QUANTITY FOR THE RECORD FUNCTION

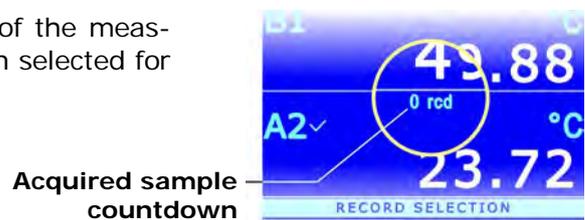
1. Select the quantity you want the RECORD function to be enabled for, using ▲ and ▼.
2. Press **SELECT** to display the **REC** command in the command bar, then select the command by pressing **F1**.



3. Select the **SEL** command by pressing **F3**.



4. The indication "0 rcd" appears on the upper part of the measurement line, to indicate that the quantity has been selected for the RECORD function.



To deselect the quantity for the RECORD function, select again the **SEL** command (**F3** key): the indication "0 rcd" disappears.

Select in the same way all the quantities you want the RECORD function to be enabled for.

5.2 SAMPLE ACQUISITION

1. Press **SELECT** to display the **REC** command in the command bar, then select the command by pressing **F1**.



2. Select the **AUTO** command by pressing **F1** to start automatic once-per-second sample acquisition.

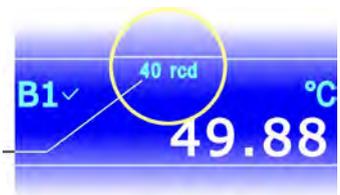


Select the **MANL** command by pressing **F2** to manually acquire a sample.



3. The number of acquired samples appears in the upper part of the measurement line.

Number of acquisitions



AUTO and MANL commands start the acquisition of all the quantities selected for the RECORD function. If quantities have not been explicitly selected, the acquisition of all the quantities is started (except for the INTEGRAL-type ones).

Note: in case only some quantities were explicitly selected for the RECORD function, AUTO and MANL commands are available only if one of the quantities chosen for the function is selected on the display (indicated by a checkmark).

Select again the **AUTO** command (**F1** key) to stop the automatic acquisition of the samples.

Press **ESC** to exit the REC menu.

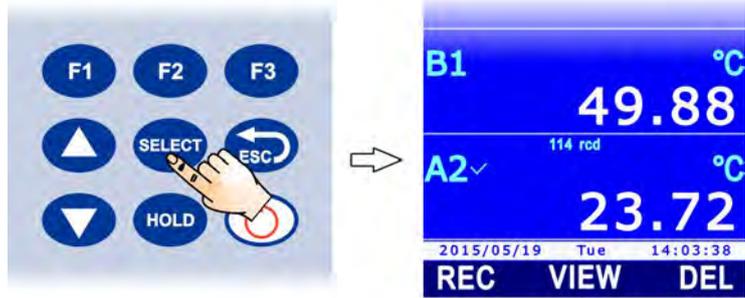
5.3 DISPLAYING MINIMUM, AVERAGE AND MAXIMUM VALUES

To display the minimum, average and maximum values acquired with the RECORD function :

1. Select the desired measurement line using ▲ and ▼.

2. Press **SELECT** to display the **VIEW** command in the command bar, then select the command by pressing **F2**.

Note: the VIEW command is disabled if there are no samples acquired with the RECORD function for the selected quantity.



3. Select the command:

- **MIN** (F1 key) to display the minimum of the acquired values.
- **AVRG** (F2 key) to display the average of the acquired values.
- **MAX** (F3 key) to display the maximum of the acquired values



4. The indication of the performed selection is shown in the upper part of the measurement line, next to the number of the acquired samples.

Type of statistics



Minimum, average and maximum values can be displayed also when the RECORD function is active: values are updated after each acquisition.

To disable the display of the statistical value and return to the current value, press again the button corresponding to the displayed statistics (e.g., select again MAX with the F3 key if the maximum value is displayed).

Press **ESC** to exit the **VIEW** menu.

Note: by displaying the same quantity in several measurement lines, both the quantity current value and the statistic information can be shown.

5.4 RESETTING AND DISABLING THE RECORD FUNCTION

The acquired values are added to the ones saved in memory. Delete the already acquired values by selecting the **DEL** command (F3 key) to start a new calculation session of the minimum, average and maximum values.



Then select the **CLR** command by pressing the **F3** key: the counter of the acquired samples is zeroed.



To disable the RECORD function, select instead the **CANC** command by pressing the F1 key.

Press **ESC** to return to the previous menu level.

5.5 RECORD FUNCTION BEHAVIOR AT LOGGING STARTUP

Minimum, average and maximum values calculated with the RECORD function, which appear on the display, can be recorded onto the SD card thanks to the LOGGING function (see chapter 7 at page 53) exactly like the current values of the quantities. The data logger allows various behaviors of the RECORD function to be set at logging startup:

- Automatic reinizialization and activation, if in stop condition, of the function when logging is started.
- Automatic activation, if in stop condition, without reinitialization (the function continues from the reached value) of the function when logging is started.
- The function is neither automatically reinitialized nor automatically enabled, if in stop condition, when logging is started (the row will turn orange to highlight the stop status).

See paragraph 7.12 at page 66 to set the RECORD function behavior at logging startup.

The minimum, average or maximum values are stored (if selected for logging) only if the instrument is set to not turn off between two subsequent samplings, because calculating the minimum, average or maximum values each second requires the instrument to stay always on. If the instrument is set to turn off between two subsequent acquisitions, only the instant value of the signal supplied by the probe will be stored.

5.6 RECORD FUNCTION AND RELATIVE MEASUREMENT

If the RECORD function is used with relative measurements, pay attention that the meaning of the RECORD function is different depending on whether the function is enabled before or after the REL function.

If the REL function is enabled first and secondly the RECORD function, the values acquired by the RECORD function are the relative values of the quantity, and minimum, average or maximum values viewed on the display refer to the relative measurement. If the REL function is disabled, the RECORD function is automatically disabled too, because new relative quantity values are no more available.

If the RECORD function is enabled first (starting therefore to acquire the quantity actual values) and secondly the REL function, the RECORD function is not reinitialized, but continues to acquire the quantity actual values (and not the relative measurement displayed). The value appearing on the display is the difference between current value (if the "rdc" indication appears next to the number of acquisitions of the RECORD function) or the value calculated by the RECORD function (if the MIN, AVG or MAX indication appears next to the number of acquisitions of the RECORD function) and the reference value (actual value of the quantity at the moment in which the REL function was enabled). If the REL function is successively disabled, the RECORD function remains active and continues to acquire the quantity actual values.

The activation order of the functions appears on the display: the firstly enabled function is indicated in the upper part at the center of the measurement line, the secondly enabled function is indicated in the upper part at the right of the measurement line.

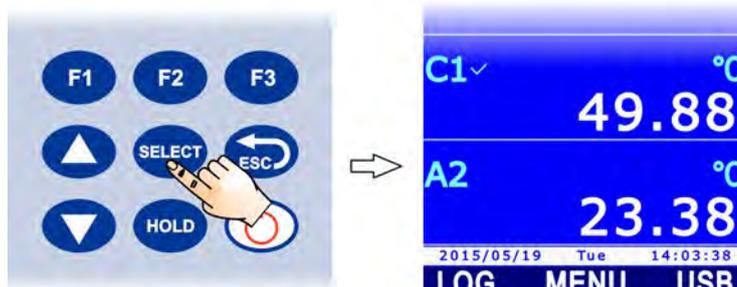


Fig. 5.6.1: activation order of RECORD and REL functions

6 SETTING DATE AND TIME

The logging function stores the date and the time of the acquisition of each sample. Before using the function, make sure that the correct date and time are set in the instrument. If necessary, adjust the instrument clock as follows:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **SETUP** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



3. Select the **TIME & DATE** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



4. Select the different the date and time fields with "**<<<**" (**F1** key) or "**>>>**" (**F2** key) commands, the selected field flashes. Use **▲** and **▼** to change the value.



5. Press **F3** (**OK** command) to confirm: a message appears asking to confirm the operation, select **YES** (**F3** key) to continue, or **NO** (**F1** key) to cancel.
6. Press **ESC** to exit.

7 LOGGING

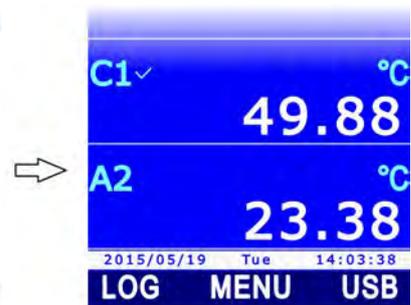
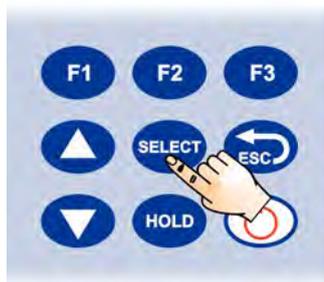
The LOGGING function allows the measurement detected by the instrument to be saved in the SD memory card. The data, stored in CSV format, can be subsequently transferred to a PC.

Logging can be **automatic** (the logging interval can be configured to 1, 5, 10, 15, 30 seconds / 1, 2, 5, 10, 15, 20, 30 minutes / 1 hour) or **manual** (at the touch of a button). Start and stop of automatic logging can be manual (at the touch of a button) or programmed (by setting the initial and final instant).

Either all the measurement lines or only those selected by the user can be logged. The logging function requires a SD memory card to be inserted into the instrument; the function is disabled if no SD memory card is inserted.

7.1 SETTING THE AUTOMATIC LOGGING INTERVAL OR THE MANUAL LOGGING

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.

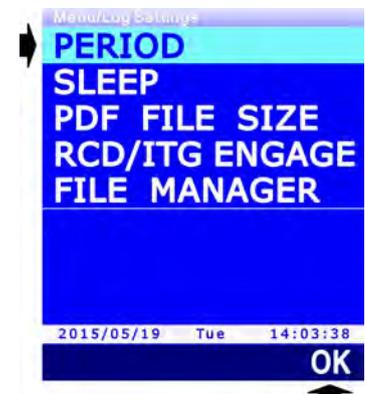


2. Select the **LOG SETTINGS** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

Note: the item is disabled if the logging is in progress.



3. Select the **PERIOD** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



- Using ▲ and ▼, select the interval for the automatic logging or the "MANUAL" item to set the manual logging.

Note: the current setting appears in white, while the other available settings are shown in yellow to highlight that they are not the current setting.

By selecting an interval exceeding or equal to 60 seconds (120 seconds if the CO₂ probe is connected), the indication "SLEEP AVAILABLE" appears under the interval value, to remind that the Auto-off of the instrument can be enabled between two logging instants (see paragraph 7.5).



- Select **OK (F3 key)** to confirm, or ESC to exit without changing the value.
- The instrument returns to the PERIOD menu item, press **ESC** twice to exit the menu and return to the measurement mode.

7.2 SELECTING THE MEASUREMENT LINES FOR LOGGING

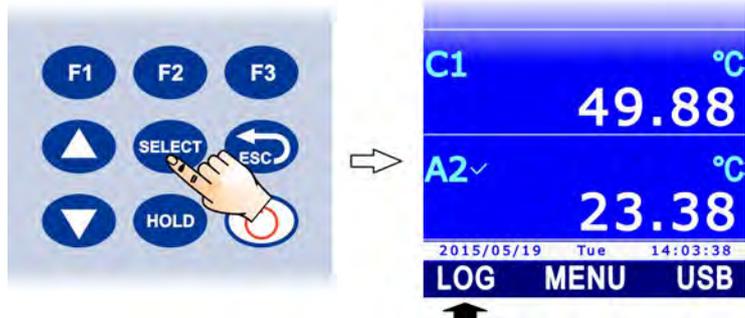
If measurement lines are not explicitly selected for logging, the logging activation generates the storage of all the measurement listed on the display (all the measurement lines which can be scrolled with the ▲ and ▼ keys, and not only the three measurements displayed at that moment). Logging can be performed only for some measurement lines, by explicitly selecting them.

Attention: you can log a maximum 16 measurement lines; if more than 16 lines can be displayed, only the logging of the first 16 lines of the list will be performed.

To select a measurement line for the logging:

- In measurement mode, select the desired measurement line using ▲ and ▼.

- Press **SELECT** to display the **LOG** command in the command bar, then select the command by pressing the **F1** key.

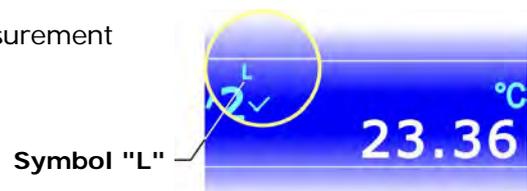


- Select the **SEL** command by pressing the **F2** key.

Note: the SEL command is disabled if logging is in progress.



- The **L** symbol is displayed in the upper part of the measurement line, to indicate that the line is selected for logging.



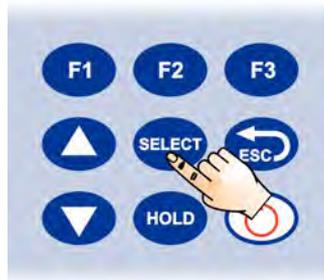
To deselect the measurement line for logging, select again the **SEL** command (**F2** key): the **L** symbol disappears.

Select in the same way all the measurement lines you want the logging to be performed.

Press **ESC** to exit the LOG menu.

7.3 MANUALLY START/STOP AUTOMATIC LOGGING

1. Press **SELECT** to display the **LOG** command in the command bar, then select the command by pressing the **F1** key.



2. To start logging, select the **RUN** command by pressing the **F1** key.

Note: the RUN command is replaced by the STOP command if logging is in progress.

Note: the RUN command will not go into effect if the instrument is waiting for a programmed startup.



3. The logging of the measurement lines selected for logging, or the logging of all the measurement lines if no line was explicitly selected for logging, is started. The LOG indication, the set logging interval and the logging duration appear in the display status bar.



4. To stop logging, select again the **LOG** command (**F1** key), then select the **STOP** command (**F1** key).



5. After the stop command, the logging stop message appears: wait for the completion of the operation.

7.4 PROGRAMMING AUTOMATIC LOGGING START/STOP TIME

1. Press **SELECT** to display the **LOG** command in the command bar, then select the command by pressing the **F1** key.



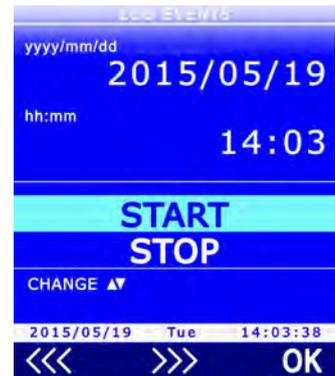
2. Select the **PROG** command by pressing the **F3** key to program the logging start/stop time.



3. Using ▲ and ▼, select **START** to set the start time, or **STOP** command to set the stop time. If a programmed time has not been entered, the fields appear empty, otherwise the entered time is shown. Select **OK** by pressing the **F3** key to continue.



4. Select the different date/time fields using "<<<" (**F1** key) or ">>>" (**F2** key) commands, the selected field flashes. Use ▲ and ▼ to change the value.



5. Press **F3** (OK command) to confirm.

6. Press **ESC** to return to measuring mode. The programmed logging symbol appears in the display status bar.

Programmed logging



At the set start date/time, the logging of the measurement lines explicitly selected for logging, or the logging of all the measurement lines if no line was explicitly selected for logging is started. The LOG indication, the set logging interval and the logging duration are shown in the display status bar.

Logging will automatically stop at the set stop date/time. If you want logging to be stopped in advance, date/time programming must be deleted and stop logging manually as explained below:

1. Press **SELECT** to display the **LOG** command in the command bar, then select the command by pressing the **F1** key.
2. Select the **PROG** command by pressing the **F2** key.
3. Select the **CLR** command by pressing the **F1** key. A message is displayed asking to confirm the operation, select **YES** (**F3** key) to continue: logging programming is deleted.



4. Press **ESC** to return to the previous command level.

5. Select the **STOP** command by pressing the **F1** key.

Note: if you try to stop logging manually without first deleting the programming function, the instrument displays an error message ("Log: Event conflict").



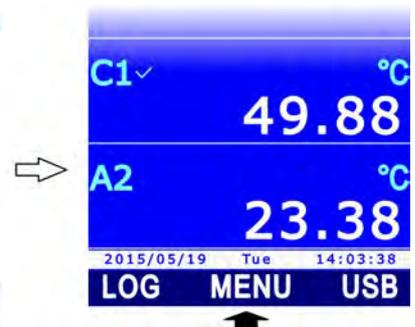
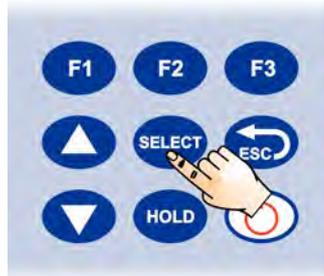
Only the logging start time can be set, in this case it will have to be stopped manually, or only the logging stop time, in this case it will have to be started manually.

After programming the logging function, the instrument can be switched off: it will be switched on automatically at the date/time set for the logging startup.

7.5 AUTO-OFF DURING AUTOMATIC LOGGING

If the logging interval is lower than 60 seconds (120 seconds if the CO₂ probe is connected), the instrument will remain switched on during logging. If the logging interval exceeds or is equal to 60 seconds (120 seconds if the CO₂ probe is connected), the instrument can be set to switch off between to subsequent loggings, to save battery life. If Auto-off is enabled, the instrument will automatically switch on at sampling and switch off immediately after. To enable and disable Auto-off:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **LOG SETTINGS** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.

Note: the item is disabled if logging is in progress.



3. Select the **SLEEP** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



- Using ▲ and ▼, select "ENABLED" to enable the Auto-off or "DISABLED" to disable it.

Note: the current setting is shown in white, while the other available setting appears in yellow color to highlight that it is not the current setting.

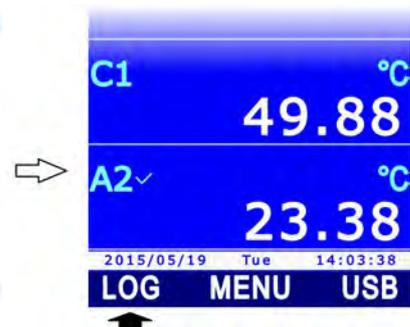
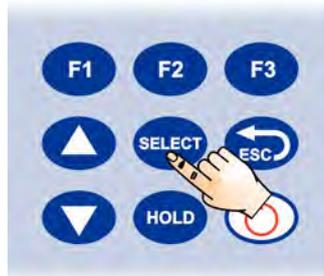


- Select **OK (F3 key)** to confirm, or **ESC** to exit without changing the value.
- The instrument returns to the **SLEEP** menu item, press **ESC** twice to exit the menu and return to the measuring mode .

7.6 MANUAL LOGGING

To perform manual logging, it is first necessary to set "MANUAL" as logging interval (see paragraph 7.1). To perform manual logging:

- Press **SELECT** to display the **LOG** command in the command bar, then select the command by pressing the **F1** key.



- Start a logging session by selecting the **RUN** command (**F1** key).

Note: the **RUN** command does not acquire a sample, but is used to indicate that the samples acquired manually after the command, up to the **STOP** command, form a logging session.

Note: the **RUN** command is replaced by the **STOP** command if logging is in progress.

Note: the **RUN** command will not go into effect if the instrument is waiting for a programmed startup of a logging session.



- The **LOG** indication, the **MANL** indication and the logging session duration appear in the display status bar.

To manually acquire a sample (consisting of the measurement lines explicitly selected for logging or all the measurement lines, if no line was explicitly selected for logging), select the **MANL** command (**F3** key).



- To end the logging session, select the **STOP** command (**F1** key).

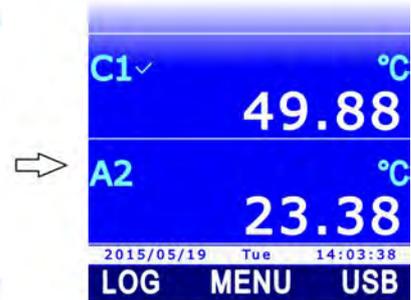
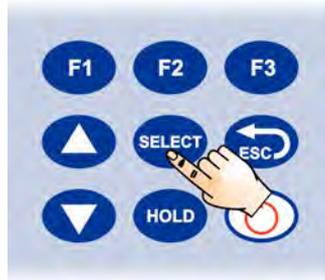
After the stop command, the logging stop message appears: wait for the completion of the operation.



7.7 PDF REPORT

At the end of each logging session, the instrument can also automatically create into the SD memory card a PDF report containing the acquired data in table format and, optionally, a graph. To set the PDF report creation mode:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **LOG SETTINGS** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.

Note: the item is disabled if logging is in progress.



3. Select the **PDF FILE SIZE** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



4. Using **▲** and **▼**, select:

- **DISABLED**, to disable the automatic creation of the PDF report at the end of the logging session.
- **FULL**, to enable the automatic creation of the PDF report, with data in graphic and table form, at the end of the logging session.
- **NO GRAPH**, to enable the automatic creation of the PDF report, with data in table form only, at the end of the logging session.

Note: the current setting appears in white color, while the other available settings are in yellow color to highlight that they are not the current setting.



5. Select **OK** (**F3** key) to confirm, or **ESC** to exit without changing the value.

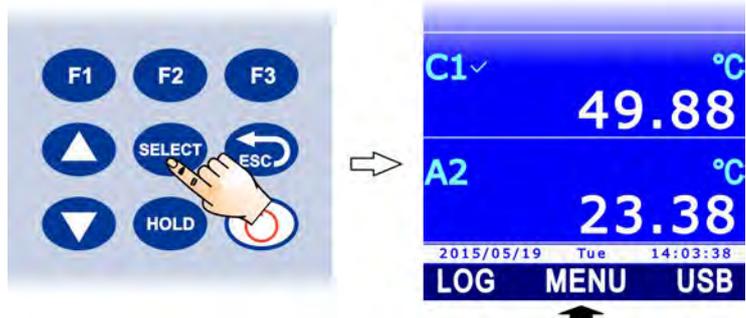
6. The instrument returns to the PDF FILE SIZE menu item, press **ESC** twice to exit the menu and return to the measurement mode.

Encryption Key for PDF report:

The instrument allows setting an encryption key to generate an alphanumeric control string inserted at the end of the report file and calculated according to the data in the report and the encryption key set. The control string is used to detect any report data tampering. The verification of the report integrity is done with the help of DeltaLog9 application software.

To enter the encryption key for the report:

1. Press **SELECT** to display the **MENU** command in the command bar, then select it by pressing the **F2** key.

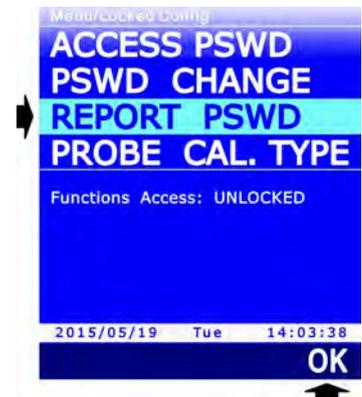


2. Select the **LOCKED CONFIG** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



3. Select the **REPORT PSWD** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.

Note: the REPORT PSWD item is not shown if the instrument is in protected mode (LOCKED). See paragraph 8.2 to change the protection status.



4. Set the first digit using the password with **▲** and **▼**, then select the "-->" command (**F2** key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the new password.

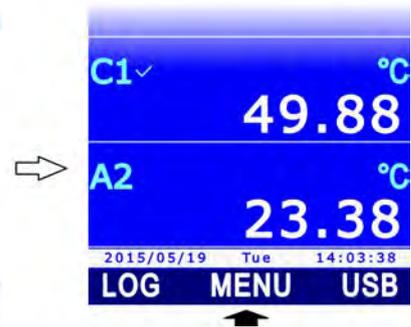
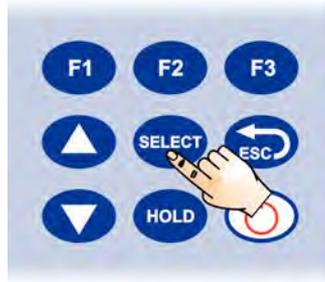


5. The instrument returns to the REPORT PSWD item, press **ESC** twice to exit the menu.

7.8 DISPLAYING LOGGING SESSIONS IN THE SD MEMORY CARD

To display the logging sessions included in the SD memory card:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **LOG SETTINGS** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.

Note: the item is disabled if logging is in progress.



3. Select the **FILE MANAGER** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



4. If the automatic RECORD function or the ITG (INTEGRAL) function are enabled, a message appears reminding that displaying the information in the SD memory card requires the measuring process to stop. Select **YES** (**F3** key) to continue (or Press **F1** to select NO and exit).

5. Wait a few seconds for the instrument to read the content of the SD memory card, then select the **SELECT LOG** item using **▲** and **▼**. Press **F3** (**OK** command) to confirm.



6. The list of the stored logging sessions is displayed, starting from the most recent one. Scroll the sessions using ▲ and ▼. The sequential number of the session is shown next to the session date. The size of the CSV and PDF files is indicated for each session (a dash appears in place of the size if the PDF file is not displayed because the PDF report automatic creation option was disabled).



7. To access the data recorded in the selected logging session, select the **VIEW** command by pressing the **F3** key. The stored data appear on the display. The green line under the measurement area shows the date and the time of the displayed sample. The orange line over the measurement area shows:

- the logging interval and the logging duration up to the displayed sample, in the case of automatic logging;
- the MANL indication and the sequential number of the displayed sample, in the case of manual logging.



8. Select the <<< (**F1** key) or >>> commands (**F3** key) to scroll the stored data backward and forward in time respectively. To display the graphic trend of the values of one of the stored quantities, select the measurement line using ▲ and ▼, then select the **PLOT** command by pressing the **F2** key (see next paragraph for the details regarding the graph).

9. Repeatedly press **ESC** to exit the stored data display mode.

7.9 STORED DATA GRAPH

The functions already described at paragraph 3.8 concerning the graph of the real time measurements are made available by displaying, through the PLOT command, the stored data graph. The only difference concerns the management of the x-axis zoom: x-axis zoom cannot be performed using real time data (only the x-axis scale can be changed, causing the graph to be reinitialized, since data are not stored); on the contrary, with the stored data a time interval can be selected using the two vertical cursors and the graph area comprised between the two cursors can be enlarged by pressing **SELECT**.

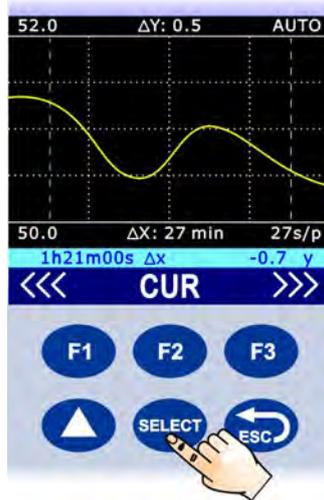


Fig. 7.9.1: stored data horizontal zoom

If the data were stored with an automatic logging, the number displayed on the right under the graph indicates the time corresponding to a pixel on the display (e.g. 27s/p indicates 27 seconds per pixel). The number depends on the logging interval and on the zoom applied. The number is not indicated if the data were stored with a manual logging (in this case, also the value of ΔX is not indicated).

Select the **FULL** command (**F2** key) to cancel the zoom and return to the full x-axis.

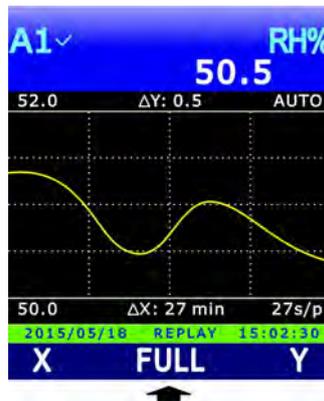


Fig. 7.9.2: FULL command

Note: by displaying the stored data, the FULL command replaces the ΔX command (x-axis choice) available when real time data are displayed.

7.10 DELETING LOGGING SESSIONS IN THE SD MEMORY CARD

The single logging sessions, all the sessions recorded on a determined date or all the sessions stored in the SD memory card can be cancelled.

Attention: the deleted files cannot be recovered!

In order to cancel the single logging sessions or all the sessions recorded on a determined date, access the sessions following the procedure at paragraph 7.8 (Displaying logging sessions in the SD"), then select the **CANC** command by pressing the **F1** key.



Fig. 7.10.1: deleting stored logging sessions

Select the **FILE** command by pressing the **F1** key to delete the selected session. Select the **DATE** command by pressing the **F2** key to delete all the sessions recorded on the same date of the selected session.

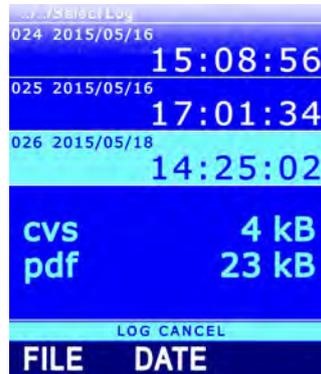


Fig. 7.10.2: deleting single sessions or date-recorded sessions

To erase all the sessions stored in the SD memory card, enter MENU >> LOG SETTINGS >> FILE MANAGER, select the **ERASE ALL** item using ▲ and ▼, then press the **F3** key (OK command) to confirm.



Fig. 7.10.3: deleting all the stored logging sessions

Before each erasing operation a message appears asking for confirmation of data cancellation, select **YES (F3 key)** to confirm or select **NO (F1 key)** to exit without erasing data.

7.11 DISPLAYING THE AMOUNT OF FREE MEMORY AVAILABLE IN THE SD MEMORY CARD

Before starting new logging sessions make sure that there is enough free memory available in your SD memory card. To display the amount of free memory available in your SD memory card, enter MENU >> LOG SETTINGS >> FILE MANAGER, select the **SD CARD MEMORY** item using ▲ and ▼, then press the **F3 key (OK command)** to confirm.



Fig. 7.11.1: selecting the SD CARD MEMORY menu item

The display shows: the SD card memory total capacity, the amount of free memory (AVAILABLE), the number of folders divided by logging start date and time, the number of CSV and PDF files stored in the card.



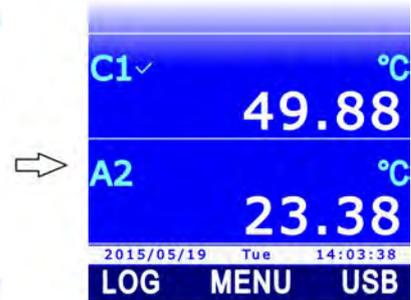
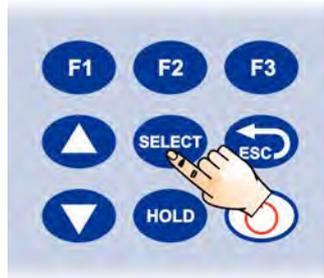
Fig. 7.11.2: displaying the amount of free memory

Press **ESC** to exit the screen.

7.12 LOGGING AND RECORD AND INTEGRAL FUNCTIONS

The minimum, average and maximum values calculated with the RECORD function and the integral calculated with the ITG (INTEGRAL) function displayed can be stored into the SD memory card exactly like the current values of the quantities. The data logger allows setting various behaviors of the RECORD and ITG functions at logging startup.

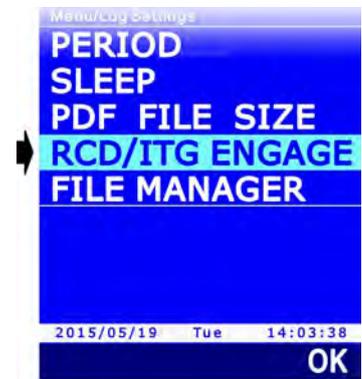
1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **LOG SETTINGS** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



3. Select the **RCD/ITG ENGAGE** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



4. Using **▲** and **▼**, select one of the three available options:

- **CLEARED**: the RECORD and INTEGRAL functions to be stored are automatically reinitialized and reactivated, if in stop mode, at logging startup.
- **ENABLED**: the RECORD and INTEGRAL functions to be stored are automatically activated, if in stop mode, but not reinitialized (the function continues from the reached value) at logging startup.
- **DISABLED**: the RECORD and INTEGRAL functions to be stored are neither automatically reinitialized nor reactivated, if in stop mode, at logging startup.



5. Select **OK** (**F3** key) to confirm, or **ESC** to exit without changing the value.

6. The instrument returns to the RCD/ITG ENGAGE menu item, press **ESC** twice to exit the menu and return to the measurement mode.

8 PROTECTED MODE

The calibration of the connected probes can be protected against unwanted alterations by entering a security password. The password (8 digits) is factory-set to the value **11111111** (eight times 1) and can be changed.

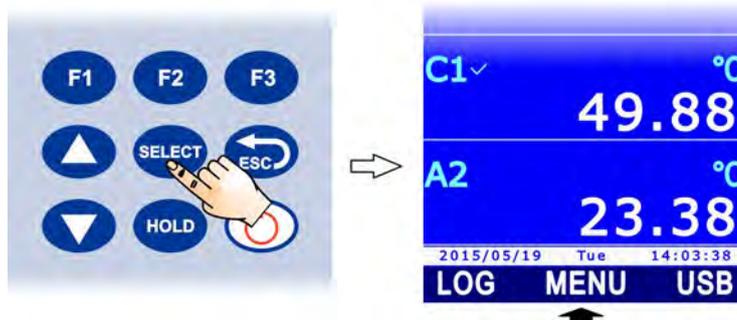
Attention: if the password is changed, be sure to keep it in a safe place. In case of loss of the password, you should contact an authorized Technical Assistance Service.

Note: the password setup is not available if the instrument is in logging; in that case, stop the logging in progress to proceed with configuration.

8.1 PASSWORD CHANGE FOR THE PROTECTED MODE

For security reasons, the preset default password should be changed. To change the password, proceed as follows:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.

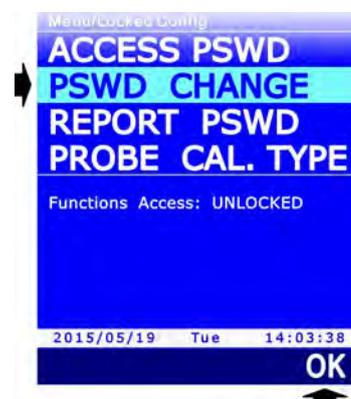


2. Select the **LOCKED CONFIG** item by using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



3. Select the **PSWD CHANGE** item by using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.

Note: PSWD CHANGE item is not displayed if the instrument is in secure mode. See paragraph 8.2 to change the protection status.



- Set the first digit of the password by using ▲ and ▼, then select the "-->" command (F2 key) to move to the next digits (the digit currently selected flashes). To return to the previous digit, select the "<--" command (F1 key). After setting all the digits, press OK (F3 key) to confirm the new password.

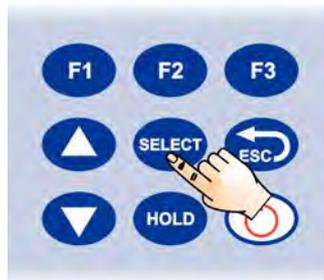


- The instrument returns to the PSWD CHANGE item, press ESC twice to exit the menu.

8.2 ENABLING/DISABLING THE PROTECTED MODE

In order to check the calibration protection status, simply enter MENU and check for the presence of the CALIBRATION item: if the function is locked, the item doesn't appear. You need to enter the password to change the protection status; proceed as follows:

- Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.

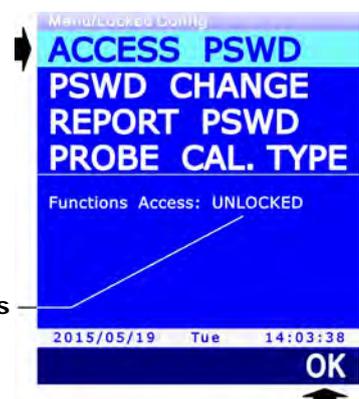


- Select the **LOCKED CONFIG** item using ▲ and ▼, then press the **F3** key (OK command) to confirm.



- The current protection status (Access Functions) appears at the end of the menu item list. The word **LOCKED** indicates the protected status; the word **UNLOCKED** indicates the unprotected status. To change the status, select the **ACCESS PSWD** item, using ▲ and ▼ if necessary, then press the **F3** key (OK command) to confirm.

Protection status



4. Set the first digit of the password using ▲ and ▼, then select the "-->" command (F2 key) to move to the next digits (the currently selected digit flashes). To return to the previous digit, select the "<--" command (F1 key). After setting all the digits, press OK (F3 key) to confirm the new password.



5. The instrument returns to the ACCESS PSWD item. The indication of the protected status appearing at the end of the menu item list is updated to the new status. Press ESC twice to exit the menu.

9 MEASUREMENT SETTINGS

The following paragraphs show the procedures for setting the following parameters:

- Type of calibration to be used for the probes connected (paragraph 9.1)
- Temperature compensation (paragraph 9.2)
- Barometric pressure compensation (paragraph 9.3)
- Duct section for flow rate measurements (paragraph 9.4)
- Coefficient of the Pitot or Darcy tube (paragraph 9.5)
- Average air speed measurements (paragraph 9.6)

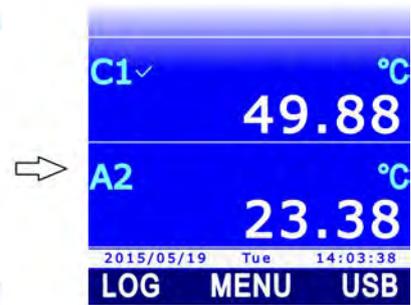
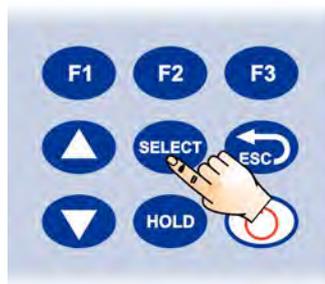
Note: the parameter configuration is not available if the instrument is in logging; in this case, stop the logging in progress to proceed with the configuration.

9.1 TYPE OF CALIBRATION TO BE USED FOR PROBES

Setting the type of calibration allows choosing whether to use the factory calibration or the user calibration for the various probes connected to the instrument. The return to the factory calibration after a user calibration may be useful, for instance, in the case the user has performed inadvertently an incorrect calibration.

To select the type of calibration:

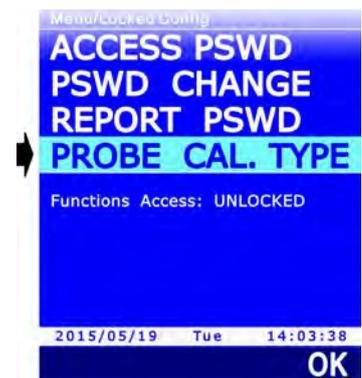
1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



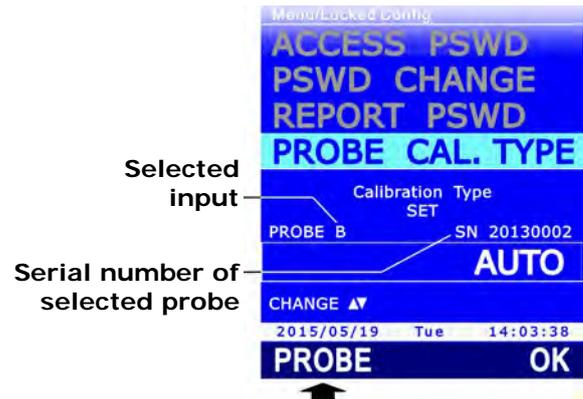
2. Select the **LOCKED CONFIG** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



3. Select the **PROBE CAL. TYPE** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



4. Select the probe connected to A, B or C input using the **PROBE** command (**F1** key).



5. Use ▲ keys ▼ to change the setting of the type of calibration for the selected probe. The available settings are:

- **FACTORY**: factory calibration is used, even if an user calibration is available.
- **USER**: user calibration is used, if available, even if it has been performed with an instrument different from the one the probe is connected to. If the user calibration is not available, factory calibration is used.
- **AUTO**: user calibration is used, if available, only if it has been performed with the instrument the probe is connected to.

Note: if a user calibration is not available for the selected probe, the default setting is AUTO and cannot be changed.

Note: the type of calibration cannot be changed if the instrument is in secure mode. See paragraph 8.2 to change the protection status.

Note: the current setting appears in white, while the other available settings are shown in yellow to highlight that they are not the current setting.

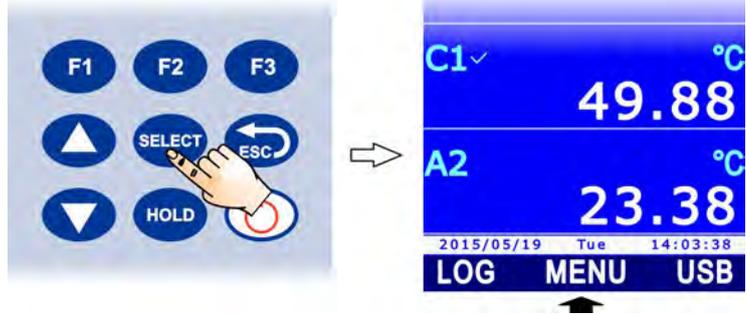
6. Press **F3** (**OK** command) to confirm the setting for the selected probe. A message appears asking to confirm the change of calibration type: select **YES** (**F3** key) to continue (or press F1 to select NO and exit).

7. Repeatedly press **ESC** to exit the menu.

9.2 TEMPERATURE COMPENSATION

Some types of measurements, for example the air speed measurement with Pitot tube, require compensation of the temperature of the medium in which the probe is inserted. The instrument allows choosing whether to compensate the temperature measured by the probe connected to input A, B or C, or whether to use the temperature set manually.

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **SETUP** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



3. Select the **OPTIONS** item, using if necessary **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.

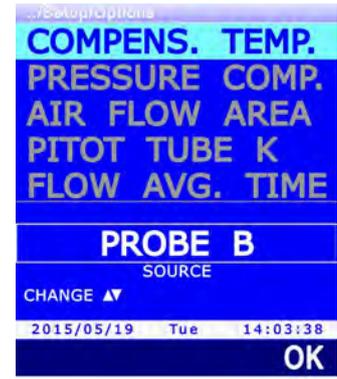


4. Select the **COMPENS. TEMP.** item, using if necessary **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.

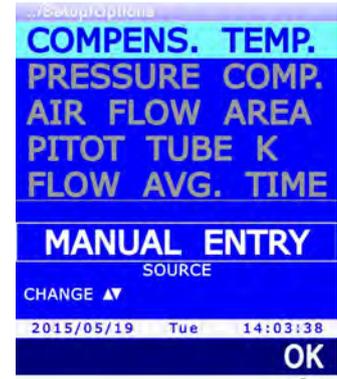


- For the automatic temperature compensation, select, using ▲ and ▼, the probe providing the temperature measurement (PROBE A, PROBE B or PROBE C), then press the **F3** key (**OK** command) to confirm.

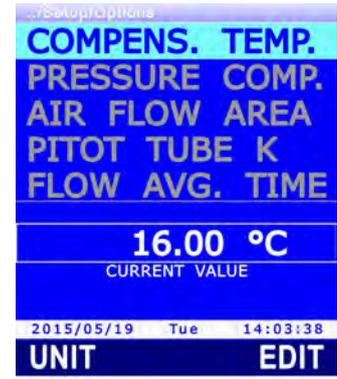
Note: the current setting appears in white color, while the other available settings are yellow to highlight that they are not the current setting.



For manual temperature compensation, select, using ▲ and ▼, the **MANUAL ENTRY** item, then press the **F3** key (**OK** command) to confirm.



- For manual compensation, confirming the **MANUAL ENTRY** option displays the current setting of the temperature value. Select the **UNIT** command by pressing the **F1** key to change the measurement unit (°C, °F or K).



- To set the temperature value, select the **EDIT** command by pressing the **F3** key.

- Set the first digit using ▲ and ▼, then select the "-->" command (**F2** key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the value.

The value must be set to two decimal digits after the comma and must be in the range between -30 °C and +120 °C (or the values equivalent in other units of measurement).

Note: the value set in °F is converted internally in °C, therefore it is possible to verify a deviation of ± 0.1 °F between the value set by the user and the actual stored value, due to the rounding of the conversion result.

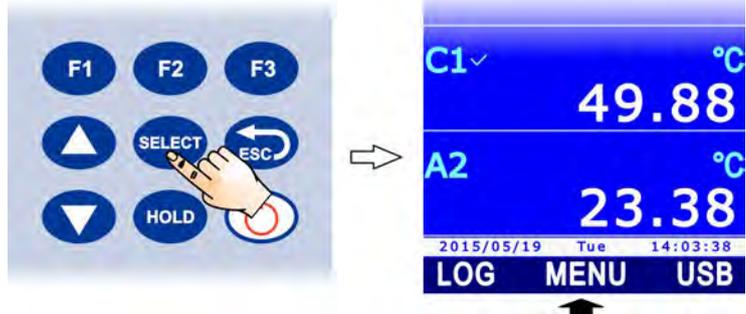


- Repeatedly press the **ESC** button to exit the menu.

9.3 BAROMETRIC PRESSURE COMPENSATION

Some types of measurements, for example air speed measurement with Pitot tube and CO₂ measurement, require the barometric pressure compensation. The instrument allows selecting whether to use for compensation the barometric pressure measured by the probe connected to input A, B or C, or whether to use the pressure set manually.

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **SETUP** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



3. Select the **OPTIONS** item, using if necessary ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

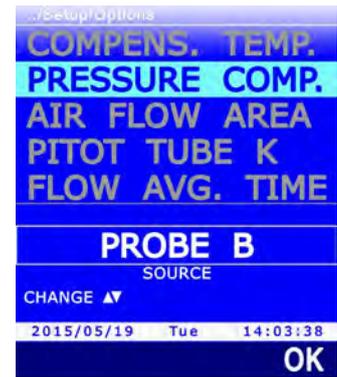


4. Select the **PRESSURE COMP.** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

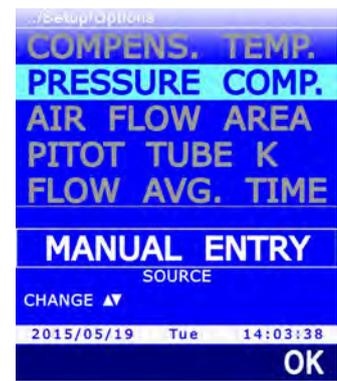


- For the automatic barometric pressure compensation, select, using ▲ and ▼, the probe providing the pressure measurement (PROBE A, PROBE B or PROBE C), then press the **F3** key (**OK** command) to confirm.

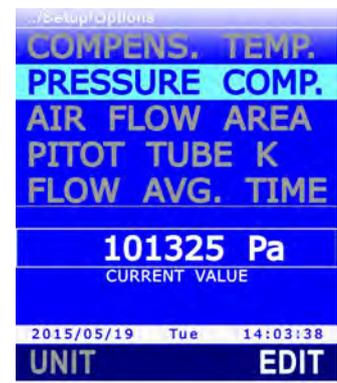
Note: the current setting appears in white color, while the other available settings are yellow to highlight that they are not the current setting.



For the manual barometric pressure compensation, select, using ▲ and ▼, the **MANUAL ENTRY** item, then press the **F3** key (**OK** command) to confirm.



- For manual compensation, after confirming the **MANUAL ENTRY** option, the barometric pressure value current setting is displayed. Select the **EDIT** command by pressing the **F3** key to change the pressure value.



- Set the first digit using ▲ and ▼, then select the "-->" command (**F2** key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the value.

The set value must be in the range between 80000 Pa (800 mbar) and 110000 Pa (1100 mbar).



- Repeatedly press **ESC** to exit the menu.

9.4 SELECTING THE DUCT FOR FLOW RATE MEASUREMENTS

The flow rate measurement performed with the air speed probes requires to know the section of the duct or of the inlet perpendicular to the flow.

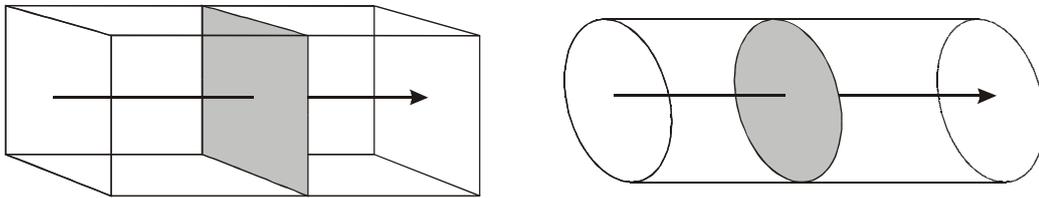
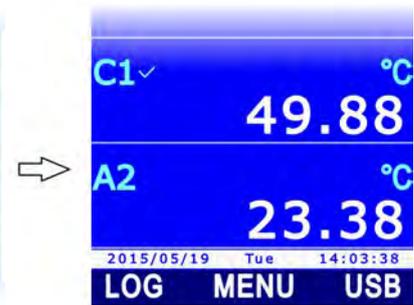
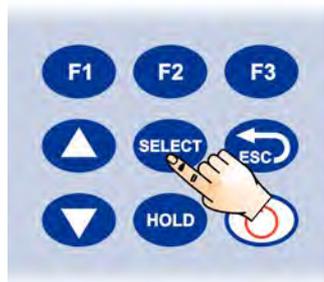


Fig. 9.4.1: air duct section

The instrument allows the section to be set for flow rate calculation:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



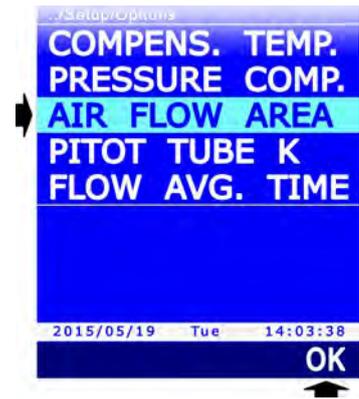
2. Select the **SETUP** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



3. Select the **OPTIONS** item, using if necessary **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



4. Select the **AIR FLOW AREA** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



5. The section current setting appears. Select the **UNIT** command by pressing the **F1** key to change the measurement unit (cm² or in²).

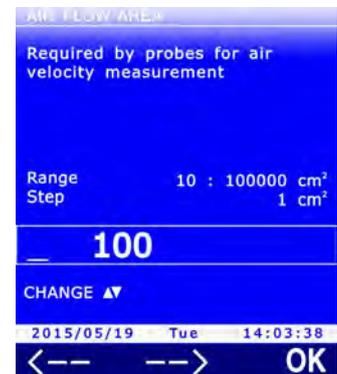


6. To set the section value, select the **EDIT** command by pressing the **F3** key.

7. Set the first digit using ▲ and ▼, then select the "-->" command (**F2** key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the value.

If cm² is used as measurement unit, the set value must be integer and range from 10 to 100000 cm². If in² is used as measurement unit, the set value must have a decimal digit after the comma and range from 1.5 to 15500.0 in².

Note: the value set to in² is internally converted into cm², therefore a deviation of ± 0.1 in² between the value set by the user and the value actually stored may occur, due to the rounding up of the conversion result.

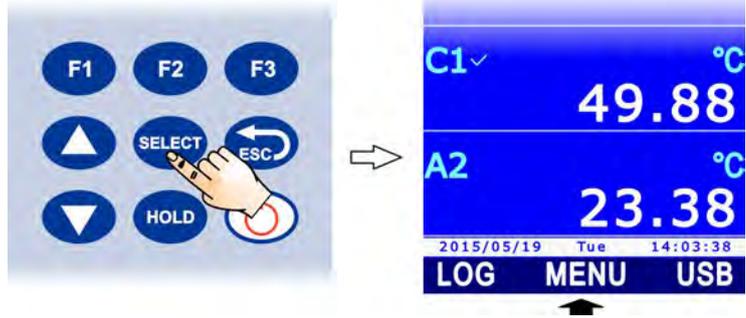


8. Repeatedly press **ESC** to exit the menu.

9.5 PITOT OR DARCY TUBE COEFFICIENT

In air speed measurements with Pitot or Darcy tube, the instrument allows setting the coefficient of the tube used.

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **SETUP** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



3. Select the **OPTIONS** item, using if necessary ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



4. Select the **PITOT TUBE K** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



- The coefficient current setting is displayed. Select the **EDIT** command by pressing the **F3** key to change the coefficient value.



- Set the first digit using **▲** and **▼**, then select the "-->" command (**F2** key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the value.

The coefficient value must be set in % and must range from 60% (= coefficient 0.60) to 120% (= coefficient 1.20). If the tube coefficient is not known, enter 100% (= coefficient 1.00) for Pitot tubes and 84% (= coefficient 0.84) for Darcy tubes.



- Repeatedly press **ESC** to exit the menu.

9.6 AIR SPEED MEASUREMENT AVERAGE

In air speed measurements the detected value can appear to be quite unstable due to air turbulences. In order to limit measurement instability, the use of the average of the last n instant measurements (moving average) instead of the instant measurement is preferable.

For instance, the graph below represents the time trend of the air speed instant measurements acquired by the instrument (curve 1) and the moving average displayed by the instrument in the case of $n=3$ (curve 2).

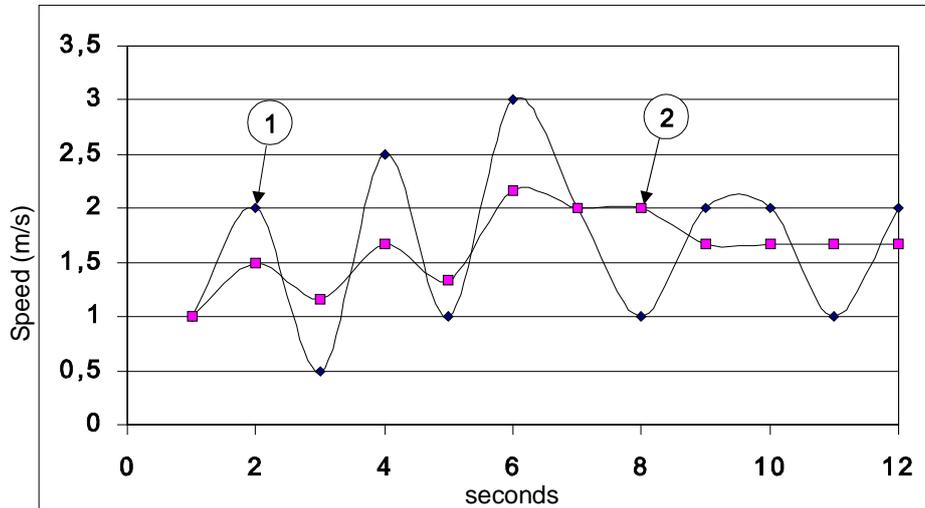
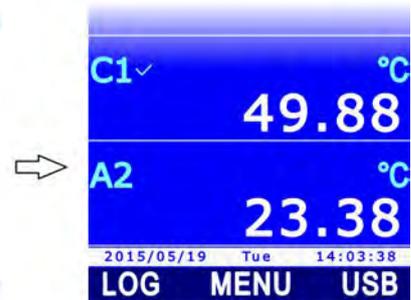
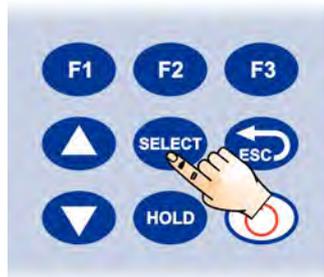


Fig. 9.5.1: average effect in air speed measurements

To set the number of instant measurement to be considered in the moving average calculation:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



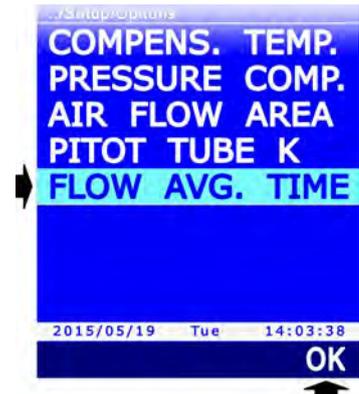
2. Select the **SETUP** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



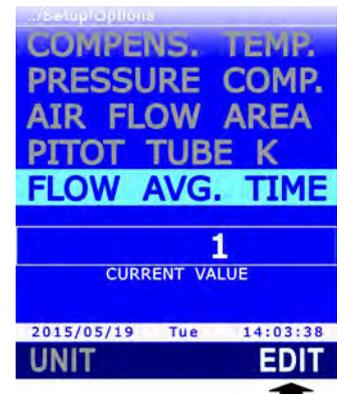
3. Select the **OPTIONS** item, using if necessary ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



4. Select the **FLOW AVG. TIME** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

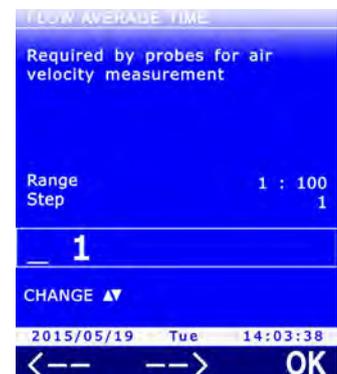


5. The current setting is displayed. Select the **EDIT** command by pressing the **F3** key to change the value.



6. Set the first digit using ▲ and ▼, then select the "-->" command (**F2** key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the value.

The set value must be between 1 and 100.



7. Repeatedly press **ESC** to exit the menu.

10 PRINTING MEASUREMENTS

The instrument has one RS232C serial output which allows sending to a serial printer or to a PC, by simply pressing a button, the measurement values of the three quantities displayed when pressing the button.

Connect the RS232C serial output of the instrument to a printer or a PC through the **CP31RS** cable. The communication parameters are:

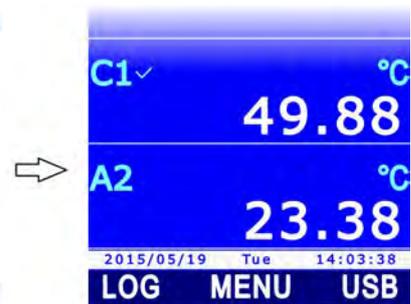
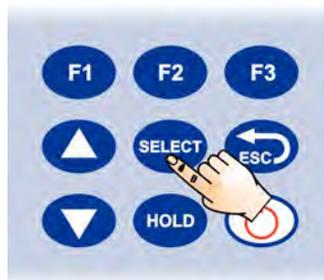
- Data bits = 8
- Parity = None
- Stop bits = 1
- Flow control = Xon / Xoff

The Baud Rate of the instrument can be configured from 1200 to 115200.

10.1 SETTING THE BAUD RATE OF THE INSTRUMENT

For correct printing, the same Baud Rate must be configured in the instrument and in the serial printer or in the PC. To set the Baud Rate in the instrument:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **SETUP** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



3. Select the **SERIAL RATE** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



- Select the Baud Rate using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

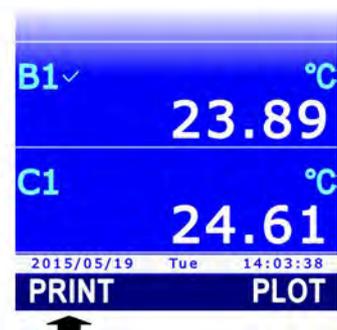
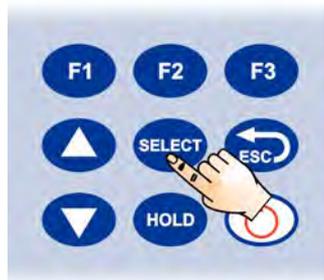
Note: the current setting appears in white color, while the other available settings are yellow to highlight that they are not the current setting.



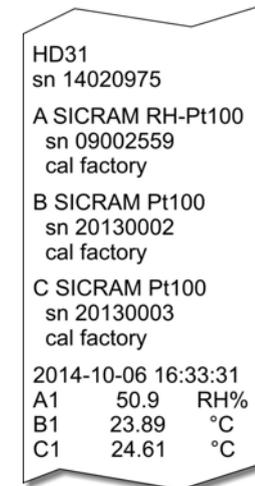
- The instrument returns to the SERIAL RATE item, Press **ESC** twice to exit the menu.

10.2 SENDING MEASUREMENTS FOR PRINTING

- Press **SELECT** to display the **PRINT** command in the command bar.



- Select the **PRINT** command by pressing the **F1** key, the information regarding the connected probes (type of probe, serial number and type of calibration) and the three measurements currently displayed are sent to the printer or to the PC.



10.3 RECEIVING MEASUREMENTS INTO PC

You need to activate a serial communication program in your PC, such as Hyperterminal, if you want to receive the measurements sent by the instrument with the PRINT function into your PC.

The RS232C serial output of the instrument must be connected to a RS232C serial port of your PC or, if your PC doesn't have serial ports, to a USB port through a RS232C/USB converter (e.g. **C205M** adapter cable). If a RS232C/USB converter is used, install into your PC the related USB drivers.

The number of the COM port the instrument is connected to must be set in the communication program and the communication parameters indicated at the beginning of the chapter must be configured (8N1, Xon/Xoff, Baud Rate equal to the one set in the instrument).

If the serial communication program has the autosave function of the received characters (e.g. the "Transfer >> Capture Text " command in Hyperterminal), the function for saving the received measurements into a file of your PC can be enabled.

11 INFORMATION ON INSTRUMENT AND PROBES

The instrument hardware and firmware revision can be displayed, along with the serial number and the calibration date of the instrument and of the connected probes.

To access information, enter "**MENU >> INFO**", then select the "**DEVICE HW/FW**" item for information concerning the instrument, or the "**PROBES SN/CAL**" item for information concerning the connected probes.

The information concerning the instrument is divided into two screens: the first screen shows model, serial number, hardware and firmware revision; the second screen shows the dates of the hardware ohmmetric and voltmetric calibration. Press **F1** key to toggle from one screen to the other (the indication corresponding to the key changes from **CALIB** to **HW/FW** according to the displayed screen).



Fig. 11.1: information concerning the instrument

The information concerning the connected probes is divided into three screens, corresponding to A, B and C inputs. Select the **PROBE** command by pressing the **F1** key to toggle from one screen to the other.



Fig. 11.2: information concerning the connected probes

12 USE OF THE BATTERY

The instrument is provided with one 3.7 V–2250 mA/h lithium-ion **rechargeable** battery, placed in the battery compartment.

The battery symbol on the display continuously provides information about the battery charge status. As the battery runs out, the symbol "empties".



Fig. 12.1: battery charge levels

If the battery charge is insufficient to ensure a correct measurement, the instrument turns off. The data stored in the SD memory card are retained even with a discharged battery.

Battery starts recharging when the instrument's USB port is connected to a PC USB port (at least 500 mA) or to the external stabilized power supply unit **SWD05**. The battery symbol flashes when the battery is recharging.

The battery charge is complete when the symbol stops flashing. A complete recharging operation requires about 7 hours starting from a completely discharged battery.

If you plan to have the instrument powered uniquely by battery, make sure that the charge level is sufficient to complete measurements.

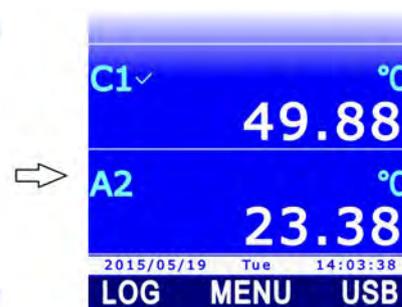
The battery autonomy depends on the number and the type of the connected probes. For instance, with three Pt100 probes connected the autonomy is about 18 hours of continuous operation, starting from a completely charged battery.

12.1 AUTOMATIC SWITCH-OFF FUNCTION

In order to save the battery charge, the auto-switchoff function can be enabled. It allows the instrument to automatically switchoff after a certain number of minutes since the last key pressure. The auto-off time can be configured to 2, 5, 10, 15, 20 or 30 minutes.

To set the auto-off:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **SETUP** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



- Select the **AUTO SWITCHOFF** item using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



- Set the number of minutes using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

Note: the current setting appears in white, while the other settings appear in yellow to highlight that they are not the current setting.

Note: during the setting, the battery symbol in the status bar of the display is replaced by the battery charge percent level.



If you want the auto-switchoff function to be disabled, select the **DISABLED** option.



- The instrument returns to the **AUTO SWITCHOFF** menu item, press **ESC** twice to exit the menu and return to the measurement mode.

The auto-switchoff is automatically disabled if the external power supply or the PC is connected.

See paragraph 7.5 at page 57 to enable or disable the auto-switchoff during logging.

If the auto-switchoff is enabled but functions requiring the instrument to remain switched on are active (e.g. the **RECORD** function, the **INTEGRAL** function, the **LOGGING** function with interval lower than 60 s, etc.), the instrument doesn't switch off automatically but the display brightness is reduced.

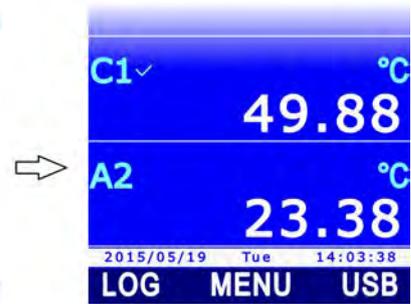
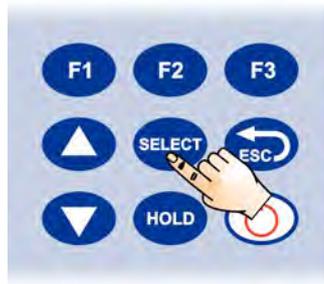
The auto-switchoff is automatically disabled when the calibration menu is entered.

12.2 DISPLAY BRIGHTNESS

To save more battery life, besides the auto-switchoff function, the instrument can additionally automatically reduce the display brightness a few instants after the last key pressure.

To set the brightness level:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **SETUP** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



3. Select the **BRIGHTNESS** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



4. Set the brightness level using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm. The available settings are:

- **AUTO**: the brightness level is always set to maximum until the battery charge exceeds 4%. If the battery charge is lower than 4%, the brightness level is automatically reduced.
- **30%**: the brightness level is reduced to 30% a few instants after the last key pressure. Brightness rises automatically to the maximum level when a key is pressed, then decreases again if no keys are pressed.

Note: the current setting appears in white color, while the other available setting appears in yellow to highlight that it is not the current setting.



5. Repeatedly press **ESC** to exit the menu.

12.3 PROLONGING BATTERY LIFE

The battery can be charged and discharged hundreds of times, but its capacity diminishes with use. The battery life can be prolonged with a few practical measures:

- When first using the device, make a complete charge of the battery.
- From time to time, make a complete cycle of discharging and recharging.
- Do not leave the battery discharged for a long period.
- Do not discharge the battery below the minimum threshold: recharge the battery when the battery symbol on the display reaches the minimum level.
- Do not expose the battery to extreme temperatures.

12.4 REPLACING THE BATTERY

When the battery capacity is heavily reduced, it is necessary to replace it. To replace the battery proceed as follows:

1. Disconnect the external power supply unit or the PC, if connected.
2. Remove the protective rubber shell, if any.
3. Untighten the 4 screws securing the battery compartment cover on the back of the instrument.
4. Remove the battery.
5. Remove the connector paying attention not to tear the wires away.
6. Attach the connector to the new battery: the connector has a reference which prevents an erroneous insertion.
7. Place the battery in its housing.
8. Close the battery compartment with the 4 fixing screws.

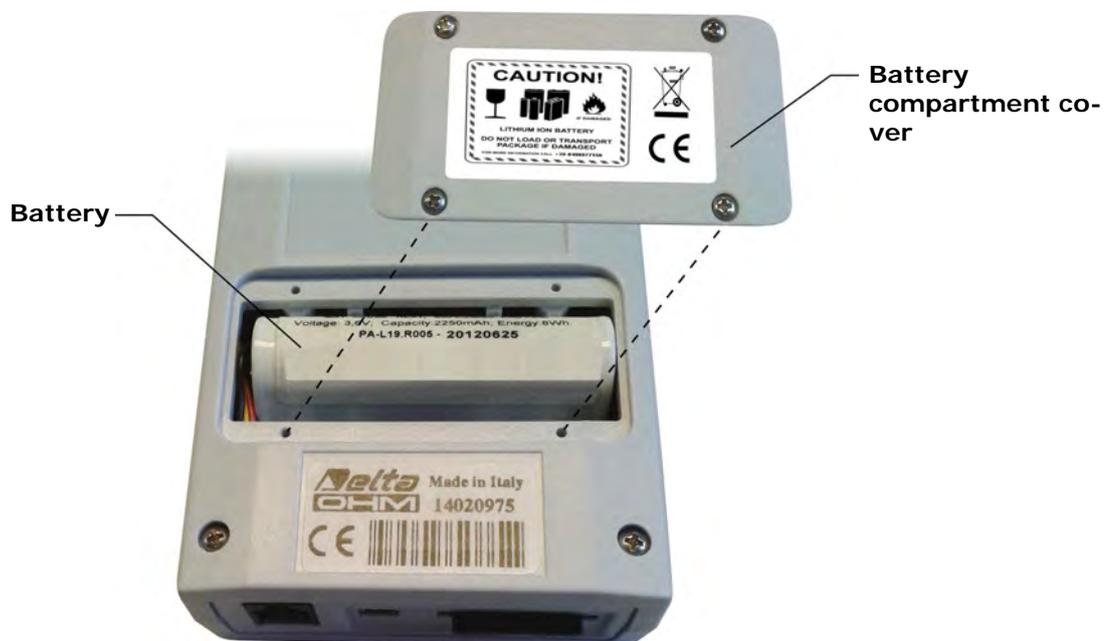


Fig. 12.2: battery compartment

For replacement, use a 3.7 V **rechargeable** lithium-ion battery, capacity 2250 mA/h, dimensions 22 x 18.5 x 67.5 mm, with 3-pole JST connector (code **HD35-BAT1**).

12.5 IMPORTANT WARNINGS



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.

Battery 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.

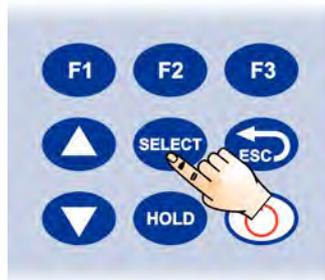
13 CALIBRATION

The probes are supplied factory-calibrated and usually don't require additional user intervention. Nevertheless a new calibration can be performed.

Note: it is essential to know and respect the physical phenomena measurements are based on in order to achieve correct calibration: it is recommended to perform new calibrations only if you have the adequate technical expertise and to carefully follow the procedures described in this manual.

To access probe calibration:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **CALIBRATION** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.

Note: the CALIBRATION item is not displayed if the instrument is in protected mode. See paragraph 8.2 to change the protection status.



3. The list of the connected probes is displayed. Each probe is identified by its own serial number and by the type of measurement. Select the probe to be calibrated using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



4. The displayed screen depends on the type of probe selected. According to the type of probe, continue as indicated in the paragraphs below.

13.1 CALIBRATION OF TEMPERATURE-ONLY PROBES WITH PRT SENSOR

Selecting a Pt100 or Pt1000 temperature-only probe for calibration displays four possibilities:

- **NEW TUNING:** calibrates the probe in one, two or three points. The possible calibration points are 0 °C, one point ranging from 95 °C to 105 °C and one point ranging from 150 °C to 400 °C. The probe can be calibrated either in one point or in two points: for the non-calibrated points, the instrument will use the values stored in the previous user-

calibration or, failing this, the factory values.

- **STANDARD PT100**: sets the user-calibration with the nominal values of the Pt100 sensor. An option to be used if the probe is not calibrated and it is not possible to perform a new calibration.
- **FACTORY**: sets the user-calibration equal to the factory calibration. It is useful if incorrect user-calibration data were entered and if you are temporarily unable to perform a new calibration.
- **PARAMETERS**: displays and/or changes the coefficients of the Callendar Van Dusen equation used by the instrument to obtain the temperature depending on the resistance of the PRT sensor (see appendix for details).



Fig. 13.1.1: PRT probe calibration types

Select the desired type of calibration using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

If a message is displayed reminding that the operation will change the probe calibration data, select **YES** (**F3** key) to continue (or Press **F1** to select **NO** and exit).

13.1.1 NEW TUNING OPTION FOR PRT SENSORS

1. The instrument suggests that the first calibration point is set to 0 °C (*SETPOINT* line). If you don't want the point to be calibrated, press **F1** (**SKIP** command) to move to the next point, otherwise place the probe in a bath at 0 °C. The display shows the temperature value measured by the probe (*MEASURE* line). When the reading is stable, press **F3** (**OK** command) to confirm: the instrument displays a countdown (*ACQUIRING*) of a few seconds, then moves to the next calibration point.

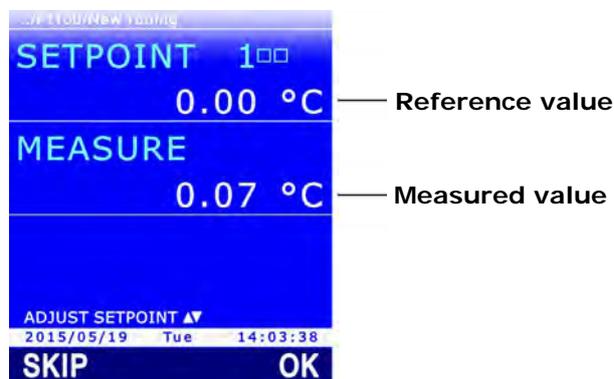


Fig. 13.1.2: PRT calibration at 0 °C

2. The instrument suggests that the second calibration point is set to 100 °C (*SETPOINT* line). If you don't want the point to be calibrated, press **F1** (**SKIP** command) to move to the next point, otherwise place the probe in a bath ranging from 95 °C to 105 °C. The display shows the temperature value measured by the probe (*MEASURE* line). The calibration point can be adjusted using ▲ and ▼. When the reading is stable, press **F3** (**OK** command) to confirm:

the instrument displays a countdown (*ACQUIRING*) of a few seconds, then moves to the next calibration point.

3. The instrument suggests that the third calibration point is set to 200 °C (*SETPOINT* line). If you don't want the point to be calibrated, press **F1** (**SKIP** command) to terminate the calibration, otherwise place the probe in a bath ranging between 150 °C and 400 °C. The display shows the temperature value measured by the probe (*MEASURE* line). The calibration point can be adjusted using **▲** and **▼**. When the reading is stable, press **F3** (**OK** command) to confirm: the instrument displays a countdown (*ACQUIRING*) of a few seconds and at the end, a message reminding that the operation will change the probe calibration data, select **YES** (**F3** key) to continue (or press **F1** to select **NO** and exit).

Calibration can be exited at any moment by pressing **ESC**.

Note: the boxes near the *SETPOINT* number represent the three available calibration points; a box becomes full when the corresponding point is calibrated.

13.1.2 PARAMETERS OPTION FOR PRT SENSORS

The instrument displays the parameters (R_0 , α , δ and β) used for calculating temperature depending on the measured resistance of the PRT sensor (see appendix for details).

1. Select the parameter you want to be changed using **▲** and **▼**, then press the **F1** key (command **EDIT**) to confirm.



Fig. 13.1.3: parameters for temperature calculation equation

2. Set the first digit using **▲** and **▼**, then select the "-->" command (**F2** key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the value.



Fig. 13.1.4: setting a parameter of the equation

R_0 parameter is expressed in thousands: enter 100000 to indicate 100.000 Ω .

α parameter is expressed without zeroes on the left: enter 385055 to indicate 0.00385055.

δ parameter is expressed without decimal point: enter 1499785 to indicate 1.499785.

β parameter is expressed without the zero on the left: enter 10863 to indicate 0.10863.

3. To definitively save the changed values in the instrument, select the **SAVE** command by pressing the **F3** key: a message appears reminding that the operation will change the probe calibration data, select **YES (F3 key)** to continue (or press F1 to select NO and exit).

Calibration can be exited at any moment by pressing **ESC**.

13.2 CALIBRATION OF THERMOCOUPLE TEMPERATURE PROBES

Thermocouple temperature probes do not provide for user calibration to be performed. By selecting a thermocouple temperature probe for calibration, you can only set the type of thermocouple connected to the instrument input.

Select the type of thermocouple using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



Fig. 13.2.1: selecting the type of thermocouple

If the type of thermocouple is changed, a message appears reminding that the operation will change the probe data, select **YES (F3 key)** to continue (or press F1 to select NO and exit).

You can exit the setting at any time by pressing **ESC**.

13.3 CALIBRATION OF COMBINED RELATIVE HUMIDITY AND TEMPERATURE PROBES

When selecting a combined probe for calibration, you will be asked which of the two sensors you want to calibrate. Select the sensor using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

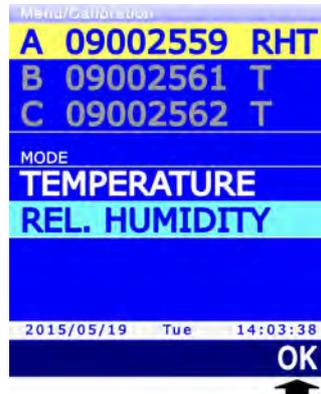


Fig. 13.3.1: selecting the sensor to be calibrated

13.3.1 CALIBRATION OF THE TEMPERATURE SENSOR OF RH/T COMBINED PROBES

If the combined RH/T probe has a Pt100 sensor, two options are displayed:



Fig. 13.3.2: types of calibration for the temperature sensor

- **NEW TUNING:** calibrates the probe at any point within the operating range of the probe.
- **STANDARD PT100:** sets the user calibration with the nominal values of the Pt100 sensor. Select this option if the probe is not calibrated and it is not possible to perform a new calibration.

Select the type of desired calibration using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

By selecting the **NEW TUNING** option, the display shows the temperature value measured by the probe. Place the probe to be calibrated, together with a reference thermometer, in a constant temperature environment (**respecting the operating range of the RH probe**) and wait for the measurement to become stable; using ▲ and ▼, adjust the reading of the instrument to coincide with the reading of the reference thermometer, then press the **F3** key (**OK** command) to confirm: a message appears reminding that the operation will change the probe calibration data, select **YES** (**F3** key) to continue (or Press **F1** to select **NO** and exit).

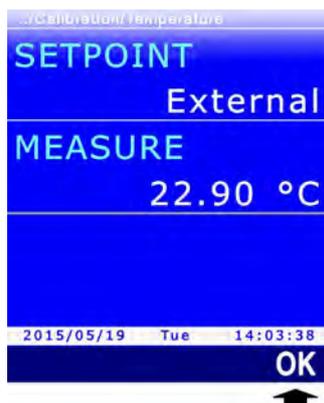


Fig. 13.3.3: calibration of the Pt100 sensor to the reference value

13.3.2 CALIBRATION OF THE RELATIVE HUMIDITY SENSOR

Before starting the calibration operation, better **verify**, using saturated solutions (75.4%RH and 33%RH), if a new calibration is needed: proceed with calibration only if an error of a few humidity points in one of the two calibration points is discovered.

When selecting the calibration of the relative humidity sensor, four options are displayed:



Fig. 13.3.4: types of RH sensor calibration

- **FULL TUNING**: calibrates the probe in one, two or three points. The possible calibration points are 75%RH, 33%RH and 11%RH. The probe can also be calibrated in one or in two points only: as for the non-calibrated points, the instrument will use the values stored in the previous user calibration or, failing this, the factory values. As for one-point calibration it is recommended to use the next options.
- **75% TUNE-UP**: calibrates the probe at 75%RH.
- **33% TUNE-UP**: calibrates the probe at 33%RH.
- **11% TUNE-UP**: calibrates the probe at 11%RH.

Select the desired type of calibration using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

Pre-calibration operations:

Check that the elements below are all present inside the chamber with saturated saline solutions:

- solid state salt,
- liquid solution or wet salt, especially for the 75%RH solution.

The instrument and the saturated solutions to be used for this operation must be placed in a stable temperature environment for the entire calibration period. Wait for at least a couple of

hours at stable temperature so as the instrument and the saturated solutions may reach thermal balance with the environment before starting the calibration procedure. To obtain a good calibration, it is essential that the probe and the solution have the same temperature. You should keep in mind that the plastic material is a poor heat conductor.

The calibration must be performed in a temperature range from 15 to 30°C.

Full calibration procedure (FULL TUNING option):

1. Unscrew the protection cover of the probe and, if necessary, tighten the M12×1 thread ring nut (the thread ring nut is necessary only for Ø 14 mm probes).

Avoid any contact of the sensitive element with hands or any other object or liquids. **If moisture is inside the measurement chamber, dry it with clean absorbent paper.**

2. Unscrew the closure cap of the 75%RH saturated solution. Tighten the thread ring nut with the probe to the saturated solution container and wait for at least 30 minutes.
3. In the instrument, select the calibration option **FULL TUNING** and press **F3 (OK command)** to confirm.
4. The instrument suggests that the first calibration point is set to 75%RH (*SETPOINT* line) and displays the temperature and the relative humidity measured by the probe (*MEASURE* line).

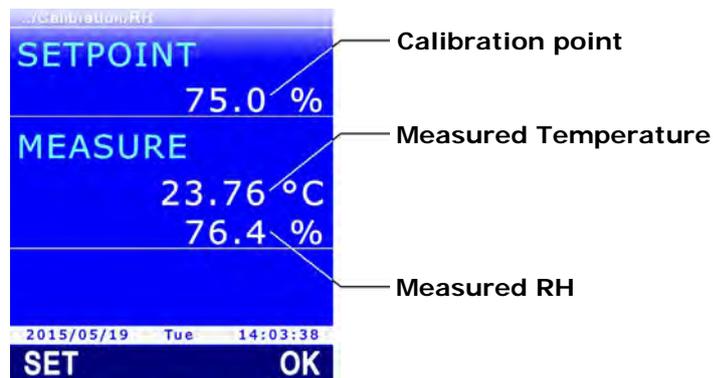


Fig. 13.3.5: calibration at 75%RH

5. Using ▲ and ▼, set the calibration point (*SETPOINT* line) to the saturated solution value at the measured temperature (see the table below).

TAB. 13.3.1: saturated solution at 75%RH

Temperature (°C)	Solution 75%RH
15	75.6
20	75.4
25	75.2
30	75.0

6. When the reading is stable, press **F3 (OK command)** to confirm. The instrument displays a countdown (*ACQUIRING*) of a few seconds; at the end, a message is shown reminding that the operation will change the calibration data of the probe, select **YES (F3 key)** to continue (or press F1 to select NO and exit), the instrument moves to the next calibration point.

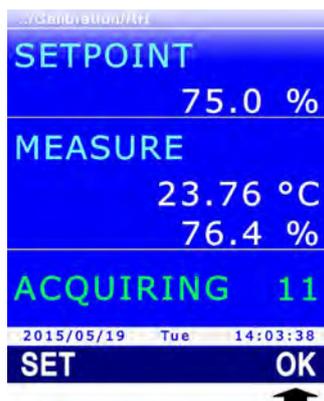


Fig. 13.3.6: calibration point confirmation

During the countdown you can exit the procedure without calibrating the point by pressing **ESC**.

In alternative to the **F3** key (**OK** command) calibration can be confirmed by pressing the **F1** key (**SET** command). Pressing the SET command keeps the instrument in the current screen, instead of moving immediately to the next point. This allows confirmation of the performed correction before continuing. After pressing the SET command, you need to select the OK command (F3 key) to move to the next point, or press **ESC** to exit calibration.

7. Remove the probe (with thread ring, if any) from the saturated solution container and close the container.
8. Unscrew the closing cap of the 33%RH saturated solution. Tighten the thread ring nut with probe to the saturated solution container and wait at least 30 minutes.
9. The instrument suggests that the second calibration point is set to 33%RH. Using **▲** and **▼**, set the calibration point to the saturated solution value at the measured temperature (see the table below).

TAB. 13.3.2: saturated solution at 33%RH

Temperature (°C)	Solution 33%RH
15	33.3
20	33.0
25	32.7
30	32.4

Note: press **ESC** if you want to exit the procedure without calibrating the point.

10. When the reading is stable, press **F3** (**OK** command) to confirm. The instrument displays a countdown (*ACQUIRING*) of a few seconds; at the end, a message is shown reminding that the operation will change the calibration data of the probe, select **YES** (**F3** key) to continue (or press F1 to select NO and exit), the instrument moves to the next calibration point.
11. Remove the probe (with thread ring nut, if any) from the saturated solution container and close the container.
12. Unscrew the closing cap of the 11%RH saturated solution. Tighten the thread ring nut with probe to the saturated solution container and wait at least 30 minutes.
13. The instrument suggests that the third calibration point is set to 11%RH. Using **▲** and **▼**, set the calibration point at 11.3 %RH (solution value between 15 and 30 °C).

Note: press **ESC** if you want to exit the procedure without calibrating the point.

14. When the reading is stable, press **F3** (**OK** command) to confirm. The instrument displays a countdown (*ACQUIRING*) of a few seconds; at the end, a message is shown reminding that the operation will change the calibration data of the probe, select **YES** (**F3** key) to continue (or press F1 to select NO and exit), the instrument exits calibration.

15. Remove the probe (with thread ring nut, if any) from the saturated solution container and close the container.
16. Unscrew the M12X1 thread ring nut, if any, from the probe and reposition the sensor protection cover.

Single-point calibration procedure (75%, 33%, 11% TUNE-UP options):

By selecting 75% TUNE-UP, 33% TUNE-UP and 11% TUNE-UP options the calibration of the relative humidity sensor is performed only in the selected point. The procedure is entirely similar to the information given about complete calibration, with the difference that the instrument exits calibration after confirming the point, instead of moving to the next point:

1. Unscrew the protection cover of the probe and, if necessary, tighten the M12×1 thread ring nut (the thread ring nut is necessary only for Ø 14 mm probes).

Avoid any contact of the sensitive element with hands or any other object or liquids. **If moisture is inside the measurement chamber, dry it with clean absorbent paper.**

2. Unscrew the closure cap of the saturated solution. Tighten the thread ring nut with probe to the saturated solution container and wait for at least 30 minutes.
3. In the instrument, select **75% TUNE-UP**, **33% TUNE-UP** or **11% TUNE-UP** calibration options according to the point to be calibrated, then press the **F3** key (**OK** command) to confirm.
4. The instrument suggests the calibration point (*SETPOINT* line) and displays the temperature and the relative humidity measured by the probe (*MEASURE* line).
5. Using **▲** and **▼**, set the calibration point (*SETPOINT* line) to the value of the saturated solution at the measured temperature (see the tables shown in the complete calibration procedure).
6. When the reading is stable, press **F3** (**OK** command) to confirm. The instrument displays a countdown (*ACQUIRING*) of a few seconds; at the end, a message is shown reminding that the operation will change the calibration data of the probe, select **YES** (**F3** key) to continue (or press F1 to select NO and exit).

During the countdown you can exit the procedure without calibrating the point by pressing **ESC**.

In alternative to the **F3** key (**OK** command) calibration can be confirmed by pressing the **F1** key (**SET** command). Pressing the SET command keeps the instrument in the current screen, instead of moving immediately to the next point. This allows confirmation of the performed correction before continuing. After pressing the SET command, you need to select the OK command (F3 key) or press **ESC** to exit calibration.

7. Remove the probe (with thread ring nut, if any) from the saturated solution container and close the container.
8. Unscrew the M12X1 thread ring nut, if any, from the probe and reposition the sensor protecting cover.

13.4 CALIBRATION OF PP472 MODULE (BAROMETRIC PRESSURE)

The calibration of PP472 module for measuring the barometric pressure is performed in two points: 800.0 mbar and 1013.0 mbar. In order to calibrate you will need a precision pressure generator.

After selecting PP472 module for calibration, proceed as follows:

1. Deliver 800.0 mbar pressure at the module inlet.
2. The instrument displays the first calibration point at 800.0 mbar (*SETPOINT* line) and the pressure value measured by the module (*MEASURE* line).

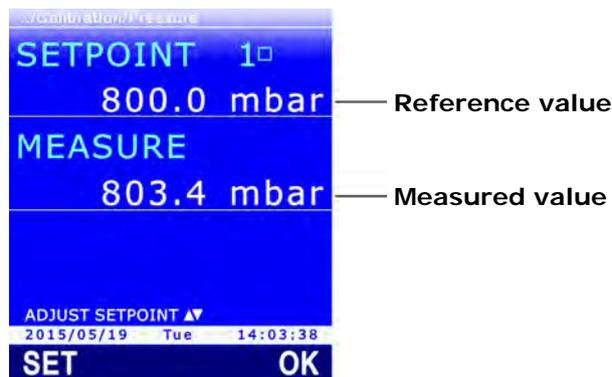


Fig. 13.4.1: barometric pressure calibration

3. The calibration point can be adjusted (*SETPOINT* line) using ▲ and ▼ to fit the effectively applied pressure value.
4. When the reading is stable, press **F3** (**OK** command) to confirm: the instrument displays a countdown (*ACQUIRING*) of a few seconds and then moves to the next calibration point.

In alternative to the **F3** key (**OK** command) calibration can be confirmed by pressing the **F1** key (**SET** command). Pressing the SET command keeps the instrument in the current screen, instead of moving immediately to the next point. This allows confirmation of the performed correction to be received before continuing. After pressing the SET command, you need to select the OK command (F3 key) to move to the next point or press **ESC** to exit calibration.

5. Deliver 1013.0 mbar pressure at the module inlet.
6. The instrument displays the second calibration point at 1013.0 mbar. If necessary, adjust the calibration point using ▲ and ▼.

Note: press **ESC** if you want to exit the procedure without calibrating the point.

7. When the reading is stable, press **F3** (**OK** command) to confirm. The instrument displays a countdown (*ACQUIRING*) of a few seconds; at the end, a message is shown reminding that the operation will change the calibration data of the probe, select **YES** (**F3** key) to continue (or press F1 to select NO and exit).

Note: the boxes next to the SETPOINT number represent the available calibration points; a box becomes full when the corresponding point is calibrated.

13.5 CALIBRATING THE CO₂ PROBE

Three options are shown by selecting a CO₂ probe for calibration:

- **ZERO/FRESH AIR:** calibrates the probe in one single point (any value included in the measuring range).
- **LINEAR GAINS:** calibrates the probe in two, three or four points.
- **FACTORY:** sets user calibration equal to factory calibration. This is useful if wrong user calibration data have been entered and you are temporarily unable to perform a new calibration.



Fig. 13.5.1: calibrations for CO₂ probes

Note: the value used for the barometric pressure compensation is shown at the bottom of the display; if necessary, change the setting as indicated at paragraph 9.3 at page 74.

Select the desired type of calibration using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

If a message appears reminding that the operation will change the probe calibration data, select **YES** (**F3** key) to continue (or press **F1** to select **NO** and exit).

13.5.1 ZERO/FRESH AIR OPTION FOR CO₂ PROBES

By selecting the ZERO/FRESH AIR calibration option, the instrument displays the calibration point (*SETPOINT* line) and the CO₂ value measured by the probe (*MEASURE* line). The calibration point can be adjusted using ▲ and ▼.

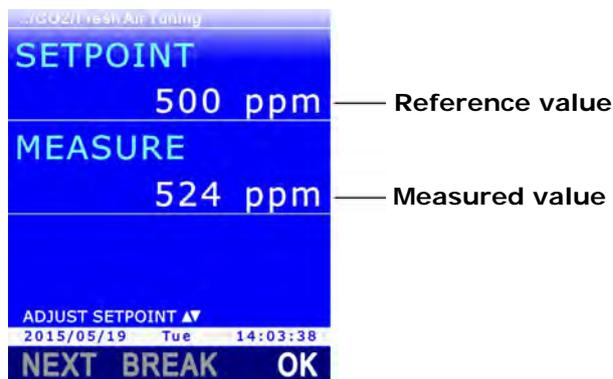


Fig. 13.5.2: ZERO/FRESH AIR calibration for CO₂ probes

Calibration can be performed:

- Positioning the probe in environment with known CO₂ concentration value, e.g. **in clean air**.

- **At 0 ppm** with the help of nitrogen bottles. In this case, unscrew the probe filter, screw the **HD31.B3A** adapter and connect the nitrogen cylinder (MINICAN.12A); adjust the bottle flow meter to get a constant flow between 0.3 and 0.5 l/min.

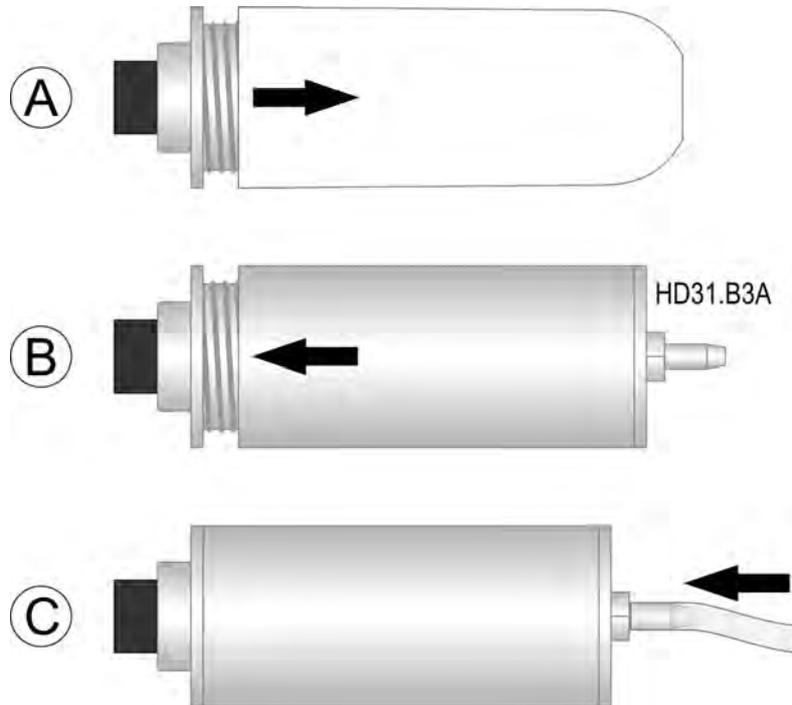


Fig. 13.5.3: CO₂ calibration with nitrogen bottle

After placing the probe in clean air or connecting it to the nitrogen bottle, wait at least 15 minutes before proceeding with the calibration.

When the reading is stable, press **F3 (OK command)** to confirm. The instrument displays a first countdown (*Waiting*) of 60 seconds and then a second countdown (*ACQUIRING*) of 60 seconds. At the end of the second countdown, press **F1 (NEXT command)** to save the new calibration: a message appears reminding that the operation will change the probe calibration data, select **YES (F3 key)** to continue (or press F1 to select NO and exit).

During the countdown you can exit the procedure without calibrating the point by pressing **ESC**.

13.5.2 LINEAR GAINS OPTION FOR CO₂ PROBES

Three options are shown if you select LINEAR GAINS calibration option:



Fig. 13.5.4: CO₂ multi-point calibration

- **2 POINTS:** calibrates the probe at any two points.
- **3 POINTS:** calibrates the probe at any three points.
- **4 POINTS:** calibrates the probe at any four points.

Select the desired type of calibration using ▲ and ▼, then press the **F3** key (**OK** command) to confirm. The instrument displays the first calibration point (*SETPOINT* line) and the CO₂ value measured by the probe (*MEASURE* line). The calibration point can be adjusted using ▲ and ▼.

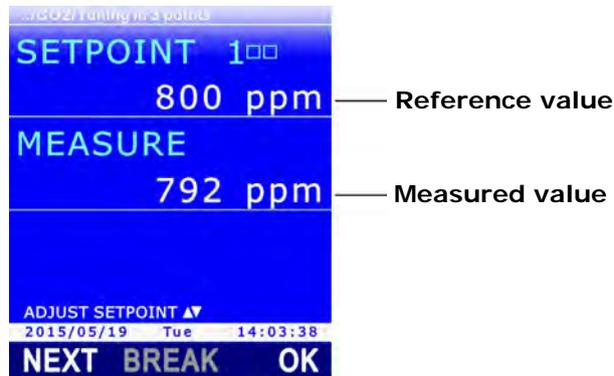


Fig. 13.5.5: LINEAR GAINS calibration for CO₂ probes

When the reading is stable, press **F3** (**OK** command) to confirm. The instrument displays a first countdown (*Waiting*) of 60 seconds and then a second countdown (*ACQUIRING*) of 60 seconds. During the countdown you can exit the procedure without calibrating the point by pressing **ESC**.

Press **F1** (**NEXT** command) to move to the next point. You can as well move to the next points without calibrating the current point.

After acquiring the last point, press **F1** (**NEXT** command) to save the new calibration: a message appears reminding that the operation will change the probe calibration data, select **YES** (**F3** key) to continue (or press **F1** to select **NO** and exit).

Press **F2** (**BREAK** command) to exit the calibration before calibrating all the points, keeping the points already calibrated. The **BREAK** command is enabled only if at least one point has been calibrated.

Note: the boxes next to the *SETPOINT* number represent the available calibration points; a box becomes full when the corresponding point is calibrated.

Press **ESC** to exit calibration at any time.

13.6 CALIBRATION OF VP473 MODULES (VOLTAGE) AND IP472 (CURRENT)

The instrument allows defining a linear correspondence between the voltage and current values acquired by VP473 and IP472 modules and the values of a physical quantity (usually the physical quantity detected by the transmitter whose analog output is connected to the module). In this way, the values of the physical quantity detected by a transmitter can be directly displayed and stored, besides the values of the voltage and current signals.

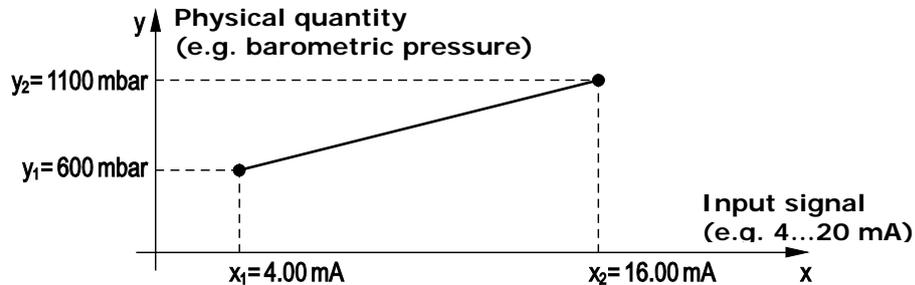


Fig. 13.6.1: example of association of a physical quantity to the acquired signal

Three options appear when you select a VP473 or IP472 module for calibration:

- **20 V SCALE** (for VP473 module) or **24 mA SCALE** (for IP472 module): cancels, if previously entered, the association between the voltage and current values acquired by the modules and the values of a physical quantity. Selecting this option displays and stores only the acquired voltage or current values.
- **USER SCALE**: defines a linear correspondence between the voltage or current values acquired by the modules and the values of a physical quantity.
- **USER LABEL**: sets the measurement unit of the physical quantity corresponding to the voltage and current values acquired by the modules.



Fig. 13.6.2: VP473 and IP472 module settings

Select the desired option using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

If a message appears asking to confirm the operation, select **YES** (**F3** key) to continue (or press **ESC** to cancel).

13.6.1 DEFINITION OF LINEAR CORRESPONDENCE

1. Select the **USER SCALE** option using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



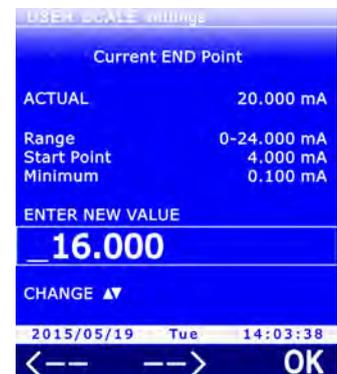
2. Using ▲ and ▼, select a range (e.g. ±10000) for the physical quantity to be associated to the voltage or current values, then press the **F3** key (**OK** command) to confirm.



3. Set the minimum value of the voltage or current signal (e.g. 4 mA, point X1 of the example at Fig. 13.6.1). Set the first digit using ▲ and ▼, then select the "-->" command (**F2** key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the value.



4. Set the maximum value of the voltage or current signal (e.g. 16 mA, point X2 of the example at Fig. 13.6.1). Set the first digit using ▲ and ▼, then select the "-->" command (**F2** key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (**F1** key). After setting all the digits, press **OK** (**F3** key) to confirm the value.



- Set the minimum value of the physical quantity to be associated to the voltage or current values (e.g. 800, point Y1 of the example at Fig. 13.6.1). Set the first digit using ▲ and ▼, then select the "-->" command (F2 key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (F1 key). After setting all the digits, press **OK** (F3 key) to confirm the value.

Note: the value has the resolution selected at point 2.



- Set the maximum value of the physical quantity to be associated to the voltage or current values (e.g. 1100, point Y2 of the example at Fig. 13.6.1). Set the first digit using ▲ and ▼, then select the "-->" command (F2 key) to move to the next digits (the currently selected digit flashes). To return to a previous digit, select the "<--" command (F1 key). After setting all the digits, press **OK** (F3 key) to confirm the value.

Note: the value has the resolution selected at point 2.

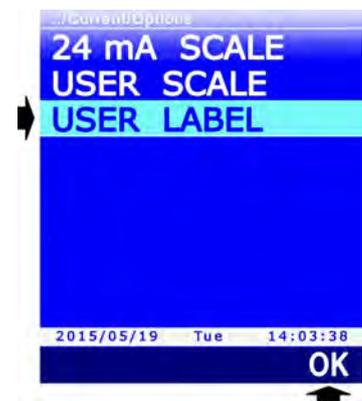


- A message appears asking to confirm the operation, select **YES** (F3 key) to continue (or press ESC to cancel). The values are stored in the SICRAM module.

13.6.2 MEASUREMENT UNIT OF THE ASSOCIATED QUANTITY

A measurement unit, which can be selected from a list of standard measurement units, can be assigned to the physical quantity associated to the voltage or current values, or a custom measurement unit can be set.

- Select the **USER LABEL** option using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.



- Using ▲ and ▼, select a measurement unit (e.g. *mbar*) for the physical quantity to associate to the voltage or current values, then press the **F3** key (**OK** command) to confirm.

If the measurement unit is not available among the listed units, you can select the generic item *user* or define a new unit. Proceed to the next step to define a new unit.



- To define a new unit, select "." item using ▲ and ▼, then press the **F1** key (command **SET**) to confirm.



- Enter the first character using ▲ and ▼, then select the "-->" command (**F2** key) to move to the next characters (the currently selected character flashes). To move to a previous character, select the "<--" command (**F1** key). After setting all the characters, press **OK** (**F3** key) to confirm.

Note: enter the new measurement unit by aligning it on the right, leaving any empty spaces on the left. The maximum length is 8 characters.



- The new measurement unit now appears in the list of available units. Press **F3** (**OK** command) to select.

Note: Press **F2** (**RESET** command) to cancel a user-defined measurement unit from the list of available units.



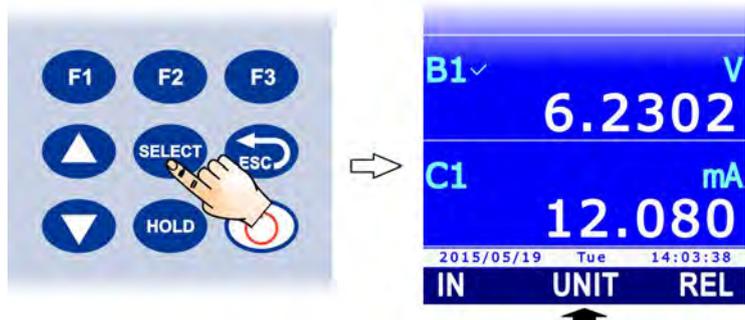
13.6.3 DISPLAYING THE ASSOCIATED QUANTITY

After defining a physical quantity associated to the voltage or current values acquired by a module, it can be displayed in a measurement line of the display:

- In measurement mode, select the measurement line corresponding to the VP473 or IP472 module using ▲ and ▼.

- Press **SELECT** to display the **UNIT** in the command bar, then select the command by pressing the **F2** key.

Note: if the RECORD and/or LOG functions are enabled, the command is disabled.



3. Select "<<<" (F1 key) or ">>>" (F3 key) to move from the voltage or current value to the associated physical quantity.



4. Press **ESC** to exit the **UNIT** command.

14 COMMUNICATING WITH A PC

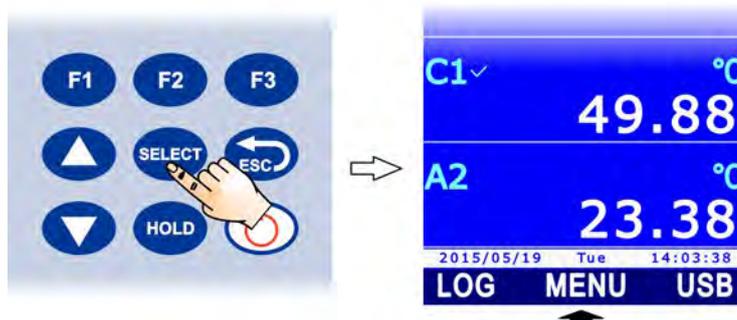
Connect the USB port of the instrument to your PC with the help of **CP31** cable. The USB port can operate in two modes: **HID** (Human Interface Device) or **VIRTUAL COM**.

HID mode has the advantage of requiring no USB driver installation: when you connect the instrument to your PC, Windows® operating system automatically recognizes the instrument and uses the drivers already included in the operating system.

VIRTUAL COM mode requires, on the contrary, USB drivers to be installed and is used mainly for communicating with the instrument by sending commands through a generic serial communication program.

To set the port operation mode:

1. Press **SELECT** to display the **MENU** command in the command bar, then select the command by pressing the **F2** key.



2. Select the **SETUP** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.

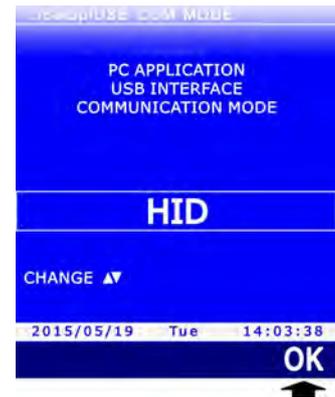


3. Select the **USB COM MODE** item using **▲** and **▼**, then press the **F3** key (**OK** command) to confirm.



4. Select HID or VIRTUAL COM modes using ▲ and ▼, then press the **F3** key (**OK** command) to confirm.

Note: the current setting appears in white color, while the other available setting is yellow to highlight that it is not the current setting.



5. The instrument returns to the USB COM MODE item, press **ESC** twice to exit the menu.

Note: if your PC doesn't detect the instrument after changing the USB port mode, switch the instrument on and off.

Installing USB drivers:

If you select the VIRTUAL COM mode, you need to install the relevant USB drivers into your PC. The driver installation is requested by Windows® operating system the first time the instrument in VIRTUAL COM mode is connected to your PC.

When the operating system asks you to install the USB drivers, select the driver installation option through a specific path, then select **DeltaOHM_VirCOMDriver** folder included in the installation folder of DeltaLog9 software (DeltaLog9 software needs to be previously installed, the software installation folder is usually "C:\DeltaLog9", if this has not been changed during installation).

Note: if during the installation of the USB drivers a system protection message appears, select " *Install driver software*".

14.1 STORED DATA TRANSFER TO PC

Each time a logging session is launched, the instrument opens a new file, in CSV format, where the measurements acquired within the end of the session are stored. The file is created in a folder identified by the logging start time (e.g. "R_164905" if the logging operation has been started at 16:49:05), in turn contained in a folder identified by the logging start date (e.g. "D_150513" if the logging operation has been started on 13/05/2015).

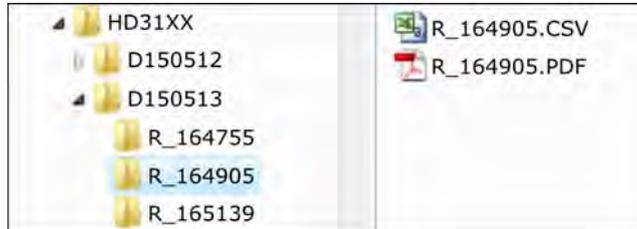


Fig. 14.1.1: structure of the SD memory card

The report in PDF format is also contained in the same folder of the CSV file of the logging session, if generated.

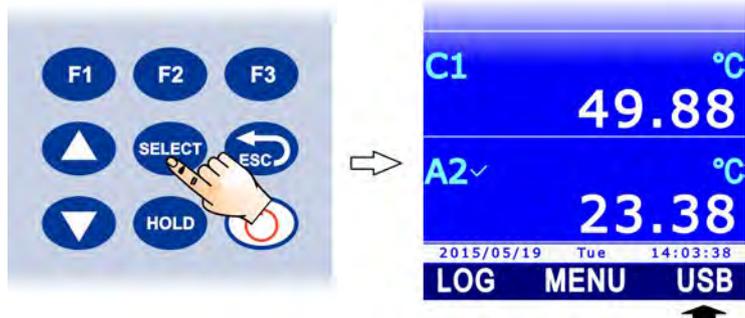
The stored data can be transferred to PC in the following ways:

- Removing the SD memory card from the instrument and inserting it in a card reader connected to your PC.
- Connecting the USB port of the instrument to your PC through the **CP31** cable and with the help of DeltaLog9 application software. Additionally, the use of DeltaLog9 software allows the analysis of the downloaded data through the processing functions included in the software. See the software instructions for data download through DeltaLog9 software.
- Connecting the USB port of the instrument to your PC through the **CP31** cable and setting the instrument to "card reader" mode; thanks to this mode, the SD card inserted in the instrument is read by the PC as a disc unit (therefore, it allows data files to be copied using Windows® Explorer).

To set the instrument to "card reader" mode:

1. Press **SELECT** to display the **USB** in the command bar, then select the command by pressing the **F3** key.

Note: USB command is disabled if logging is in progress or the instrument is not connected to the PC.



2. A message appears reminding that the "card reader" mode requires the measurement process to be stopped (and consequently the automatic RECORD function as well, if enabled). Select **YES (F3 key)** to continue (or Press F1 to select NO and exit).
3. In "card reader" mode, the display shows the image of a SD card. Select again the **USB** command by pressing the **F3** key to return to the measurement mode; a message will appear asking to confirm exit from the "card reader" mode, select **YES (F3 key)** to exit.
Note: the exit from the "card reader" mode is automatic if you disconnect the USB cable.

14.2 SERIAL COMMANDS

If the USB port of the instrument is set to VIRTUAL COM mode, communication with the instrument is possible by sending commands through a generic serial communication program (e.g. Hyperterminal, etc.).

Communication parameters must be set to PC as follows:

- Baud rate: 115200
- Data bits: 8
- Parity: None
- Stop bit: 1

The available serial commands are listed below.

Date/Time:

Command	Response	Description
RTC:	RTC: yyyy/mm/dd HH:MM:SS	Reads the date and time set in the instrument.
RTC: yyyy/mm/dd HH:MM:SS	RTC: yyyy/mm/dd HH:MM:SS; ok	Enters date/time.

Note: date and time cannot be entered if the instrument is logging.

Information:

Command	Response	Description
FWVERSION:	FWVERSION: <i>version</i>	Reads firmware version.
DEVSTATE:	<i>Information on instrument</i>	Reads the instrument general information: model, HW and FW revision, serial number, connected probes, calibration dates.
ACTIVEPRB:	<i>Information on probes</i>	Reads the information on the connected probes: type of probe, serial number, type of used calibration, calibration date.

Power supply:

Command	Response	Description
BATTERY:	BATTERY: <i>charge%</i>	Reads battery charge percent.
BATSAVE:	BATSAVE: nn	Reads the auto-switchoff time, in minutes, set in the instrument.
BATSAVE: nn (nn = 00, 02, 05, 10, 15, 20, 30)	BATSAVE: nn; ok	Sets the auto-switchoff time to nn minute value.
HWIREPOWER:	HWIREPOWER: n; ok	Enables/disables hot-wire air speed probe power supply: <ul style="list-style-type: none"> ▪ disables if n=0 ▪ enables if n=1

Password:

Command	Response	Description
USER:	USER: n	Reads the activation status of the protected mode: <ul style="list-style-type: none"> ▪ protected mode enabled if n=1 ▪ protected mode disabled if n=2
USER: <i>password</i>	USER: Locked; ok USER: Unlocked; ok	Changes the activation status of the protected mode.
USERPWD: <i>password</i>	USERPWD: <i>password</i> ; ok	Changes the password for the management of the protected mode.

Print of measurements (through USB):

Command	Response	Description
PRBINPUT: x (x = A, B, C)	List of quantities	Lists the quantities measured by the probe connected to input x.
MONTIME:	MONTIME:nn	Reads the periodic print interval of measurements on PC (the value is in seconds).
MONTIME:nn (nn = 1, 5, 10, 15, 30, 60, 120, 300, 600, 900, 1200, 1800, 3600)	MONTIME:nn; ok	Sets the periodic print interval of measurements on PC to nn second value.
MONCHN: cc (cc = 01...36)	MONCHN: cc; n	Indicates whether the measurement with sequential number cc on the display of the instrument is selected for periodic print: <ul style="list-style-type: none"> ▪ not selected if n=0 ▪ selected if n=1
MONCHN: cc; n (cc = 01...36; n=0,1)	MONCHN: cc; n; ok	Selects/deselects the measurement with sequential number cc on the display of the instrument for periodic print: <ul style="list-style-type: none"> ▪ deselects if n=0 ▪ selects if n=1
MONITOR: n (n = 0,1)	Measured values	Enables/disables periodic print of measurements on PC: <ul style="list-style-type: none"> ▪ disables if n=0 ▪ enables if n=1 <p>If quantities for periodic print have been selected, only the selected quantities are printed, otherwise all the quantities displayed by the instrument are printed.</p>
CHNSHOT: cc (cc = 01...36)	Measured value	Single print on PC of the measurement with sequential number cc on the display of the instrument.
HOLD:	HOLD: n; ok	Enables/disables the HOLD function: <ul style="list-style-type: none"> ▪ disables if n=0 ▪ enables if n=1
REL: cc (cc = 01...36)	REL: cc; n	Indicates the activation status of the REL function for the measurement with sequential number cc on the display of the instrument: <ul style="list-style-type: none"> ▪ disabled if n=0 ▪ enabled if n=1
REL: cc; n (cc = 01...36; n=0,1)	REL: cc; n; ok	Enables/disables the REL function for the measurement with sequential number cc on the display of the instrument: <ul style="list-style-type: none"> ▪ disables if n=0 ▪ enables if n=1
PEAKCLEAR: x (x = A, B, C)	PEAKCLEAR: on; ok	Reset of the peak value detected by the pressure probe connected to input x.

Logging:

Command	Response	Description
LOGTIME:	LOGTIME:nn	Reads the logging interval set in the instrument (the value is in seconds). If nn=0, the manual logging is set.
LOGTIME:nn (nn = 0, 1, 5, 10, 15, 30, 60, 120, 300, 600, 900, 1200, 1800, 3600)	LOGTIME:nn; ok	Sets the logging interval to nn seconds value. If nn=0, the manual logging is set.
LOGOFF:	LOGOFF:n	Reads the enabling status of the auto switch off during logging: <ul style="list-style-type: none"> ▪ disabled if n=0 ▪ enabled if n=1
LOGOFF:n (n = 0,1)	LOGOFF:n; ok	Enables/disables auto switch off during logging: <ul style="list-style-type: none"> ▪ disables if n=0 ▪ enables if n=1
LOG:n (n = 0,1)	LOG:start; ok LOG:stop; ok	Starts/stops logging: <ul style="list-style-type: none"> ▪ stops if n=0 ▪ starts if n=1 <p>If quantities have been selected for logging, only the quantities selected are stored in memory, otherwise all the quantities displayed by the instrument are stored.</p>
LOGSTART:	LOGSTART:yyyy/mm/dd HH:MM	Reads the logging programmed start date/time.
LOGSTART: yyyy/mm/dd HH:MM	LOGSTART:yyyy/mm/dd HH:MM; ok	Sets the date and the time of logging programmed start.
LOGSTOP:	LOGSTOP:yyyy/mm/dd HH:MM	Reads the logging programmed stop date/time.
LOGSTOP: yyyy/mm/dd HH:MM	LOGSTOP:yyyy/mm/dd HH:MM; ok	Sets the date and the time of logging programmed stop.
LOGCLR:	LOGCLR:ok	Deletes the settings of the logging programmed start/stop.
LOGCHN:cc (cc = 01...36)	LOGCHN:cc;n	Indicates whether the measurement with sequential number cc on the display of the instrument is selected for logging: <ul style="list-style-type: none"> ▪ not selected if n=0 ▪ selected if n=1
LOGCHN:cc;n (cc = 01...36; n=0,1)	LOGCHN:cc;n; ok	Selects/deselects the measurement with sequential number cc on the display of the instrument for logging: <ul style="list-style-type: none"> ▪ deselects if n=0 ▪ selects if n=1

RECORD function (statistics):

Command	Response	Description
RCDCHN:cc (cc = 01...36)	RCDCHN:cc;n	Indicates whether the measurement with sequential number cc on the display of the instrument is selected for RECORD function: <ul style="list-style-type: none"> ▪ not selected if n=0 ▪ selected if n=1
RCDCHN:cc;n (cc = 01...36; n=0,1)	RCDCHN:cc;n; ok	Selects/deselects the measurement with sequential number cc on the display of the instrument for the RECORD function: <ul style="list-style-type: none"> ▪ deselects if n=0 ▪ selects if n=1
RCDMAN:cc (cc = 01...36)	RCDMAN:cc; ok	Manual acquisition, for the RECORD function, of a sample of the measurement with sequential number cc on the display of the instrument. If measurements for the RECORD function have not been selected, the command enables the RECORD function for all the measurements.
RCDSTATUS:cc (cc = 01...36)	RCDSTATUS:cc;n;m	Indicates the RECORD function status for the measurement with sequential number cc on the display of the instrument: <ul style="list-style-type: none"> ▪ function disabled if n=0 ▪ function enabled and automatic acquisition enabled if n=1 ▪ function enabled and automatic acquisition disabled if n=2 ▪ current value displayed if m=0 ▪ minimum value displayed if m=1 ▪ average value displayed if m=2 ▪ maximum value displayed if m=3
RCDSTATUS:cc;n;m (cc = 01...36; n=0,1,2; m=0,1,2,3)	RCDSTATUS:cc;n;m; ok	Sets the RECORD function for the measurement with sequential number cc on the display of the instrument: <ul style="list-style-type: none"> ▪ function disabled if n=0 ▪ function enabled and automatic acquisition enabled if n=1 ▪ function enabled and automatic acquisition disabled if n=2 ▪ current value displayed if m=0 ▪ minimum value displayed if m=1 ▪ average value displayed if m=2 ▪ maximum value displayed if m=3
RCDSYNCH:cc (cc = 01...36)	RCDSYNCH:cc; ok	Reset of statistics

INTEGRAL Function:

Command	Response	Description
ITGCHN:cc (cc = 01...36)	ITGCHN:cc;n	Indicates whether the measurement with sequential number cc on the display of the instrument is selected for the calculation of the integral: <ul style="list-style-type: none">▪ not selected if n=0▪ selected if n=1
ITGCHN:cc;n (cc = 01...36; n=0,1)	ITGCHN:cc;n; ok	Selects/deselects the measurement with sequential number cc on the display of the instrument for the calculation of the integral: <ul style="list-style-type: none">▪ deselects if n=0▪ selects if n=1
ITGSTATUS:cc (cc = 01...36)	ITGSTATUS:cc;n	Indicates the integral calculation status for the measurement with sequential number cc on the display of the instrument: <ul style="list-style-type: none">▪ function disabled if n=0▪ function enabled if n=1
ITGSTATUS:cc;n (cc = 01...36; n=0,1)	ITGSTATUS:cc;n; ok	Enables/disables the calculation of the integral for the measurement with sequential number cc on the display of the instrument: <ul style="list-style-type: none">▪ disables if n=0▪ enables if n=1
ITGCLEAR:cc (cc = 01...36)	ITGCLEAR:cc; ok	Resets the calculation of the integral.

15 FIRMWARE UPDATE

The firmware, i.e. the program which manages all the functions of the instrument, can be updated following the indications below:

1. Connect the USB port of the instrument to a USB port of your PC through the CP31 cable.
2. On your PC, launch DeltaLog9 application software;
3. Connect DeltaLog9 to the instrument (see software instructions).
4. On DeltaLog9 software, select "Options >> Firmware Update" and follow the procedure described in the software instructions.

Refer to "www.deltaohm.com" website at Support >> Firmware section to check for the availability of firmware updates.

Additionally, the instrument has the menu item "MENU >> FW UPGRADE", which is addressed to the Technical Assistance Service.

16 RESET OF THE INSTRUMENT

In case of blocked functionalities of the instrument, a hardware reset can be performed through the button placed inside the battery compartment.

Proceed as follows:

1. Remove the protective rubber shell, if any.
2. Untighten the 4 screws fixing the battery compartment cover on the back of the instrument.
3. Press (e.g. using a small screwdriver) the reset button on top left of the battery.

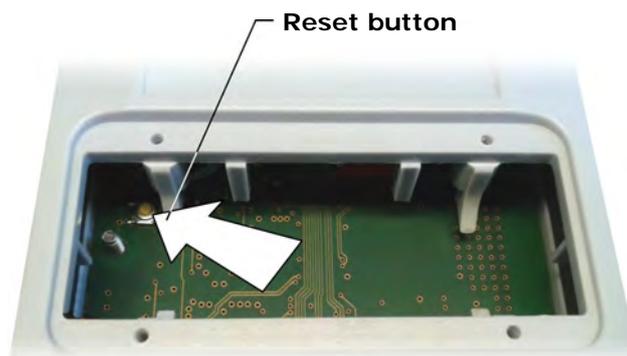


Fig. 16.1: reset button

4. Close the battery compartment with the 4 screws.

After reset, the instrument enters a waiting state for a new firmware for two minutes: press **ESC** to immediately exit the wait state and enter the normal measurement mode. If you exceed the two-minute time limit, the instrument switches off; in this case, press **ON/OFF** to switch it on again: the instrument restarts in normal measuring mode.

The reset sets back instrument parameters to factory defaults. After a reset operation, check configuration and, if necessary, reset operating parameters to the desired values.

17 USAGE INSTRUCTIONS AND WARNINGS

1. Do not expose the probes to gases or liquids that could corrode the material of the probes.
2. Do not bend the connectors by applying upward or downward force.
3. Do not bend or force contacts while inserting the probe connector into the instrument.
4. Do not bend, deform or drop the probes: this could cause irreparable damage.
5. Use the most appropriate probe to the measurement you want to perform.
6. Temperature probes should not generally be used in the presence of corrosive gases or liquids, the container housing the sensor is made of AISI 316, AISI 316 stainless steel plus silver for contact probes. Avoid the probe surface from getting into contact with sticky surfaces or with substances that might corrode or damage the probe. If the sensor breaks or becomes defective, it can be replaced. In this case the probe must be recalibrated.
7. Above 400°C and below -40°C, avoid Pt100 temperature probes from receiving violent impacts or thermal shocks, as this could cause irreparable damage to the probes.
8. Avoid over-rapid temperature variations in order to obtain reliable temperature measurements.
9. Contact temperature probes must be kept vertical to the measurement surface. Apply oil or thermal conductive paste between the surface and the probe to improve contact and reduce the reading time. Never use water or solvents for this purpose.
10. Measurements on non-metallic surfaces require considerable time due to their poor thermal conductivity.
11. **Temperature probes, particularly thermocouples, are not insulated with respect to the external casing, pay special attention not to come into contact with live parts (above 48V): it could be dangerous not only for the instrument, but also for the operator who could be electrocuted.**

12. Avoid performing measurements in the presence of high-frequency sources, microwaves or strong magnetic fields, because they would be unreliable.
13. Thoroughly clean the probes after use.
14. The instrument is water-resistant but is not waterproof, so it should never be submerged in water. Should it fall into the water, immediately pull it out and check that no water penetration occurred. The instrument must be handled so as water cannot penetrate from the connector side.

18 INSTRUMENT STORAGE

Conditions for storage of the instruments:

- Temperature: -25...+65 °C.
- Humidity: below 90 %RH no condensation.
- When storing, avoid places where:
 - there is a high humidity level;
 - instruments are exposed to direct solar radiation;
 - instruments are exposed to high temperature source;
 - there are strong vibrations;
 - there is vapor, salt and/or corrosive gas.

19 SAFETY INSTRUCTIONS

General safety instructions

The instrument has been manufactured and tested in accordance with the safety standard EN61010-1:2010 "Safety requirements for electrical equipment for measurement, control and laboratory use" and has left the factory in perfect safety technical conditions.

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

20 TECHNICAL FEATURES

Power supply	Rechargeable 3.7 V Li-ion internal battery, 2250 mA/h capacity, 3-pole JST connector. External power supply unit (SWD05), to be connected to the mini-USB connector of the instrument. If connected to PC, it is powered from the computer's USB port (500 mA at least).
Battery life	18 hours of continuous operation (typical duration starting from a fully charged battery and with 3 connected Pt100 probes). The actual battery life depends on the number and type of connected probes.
Logging	Manual or automatic with 1, 5, 10, 15, 30 seconds / 1, 2, 5, 10, 15, 20, 30 minutes / 1 hour configurable interval
Storage capacity	SD memory card, capacity up to 4 GB. The logging duration depends on the number of stored quantities and on the capacity of the SD memory card employed. E.g., with a 4 GB SD memory card, the logging duration is of some months even if several quantities with minimum logging interval of 1 s are recorded.
Inputs	3 inputs with 8-pole DIN45326 connector. According to the type of connected probes, the instrument can manage up to 36 quantities.
Accuracy of the instrument @ 20°C	± 0.02 % of the measurement (connected probe accuracy excluded)
Temperature drift of the instrument @ 20°C	20 ppm/°C (connected probe drift excluded)
Long-term stability of the instrument	0.05 %/year (connected probe stability excluded)
Clock stability	1 min/month maximum deviation
Display	Graphic color LCD. Visible area 43 x 58 mm.
USB connection	1 USB port with mini-USB connector. The port can operate in "HID" mode (no USB driver installation required) or in "Virtual COM" mode (USB driver installation required).
RS232C connection	1 RS232C serial output with RJ12 (6P6C) connector for connection of a serial printer. Settable Baud Rate from 1200 to 115200.
Auto-off	Configurable after 2, 5, 10, 15, 20 or 30 minutes from the last key pressure if battery powered. Can be disabled. Automatically disabled with external power supply.
Operating conditions	-10...60 °C, 0...85% RH no condensation
Storage Temperature	-25...65 °C
Materials	ABS, 55 shore rubber protection lateral bands 55 shore rubber protective shell
Dimensions	165x88x35 mm without rubber protective shell 180x102x46 mm with rubber protective shell
Weight	About 400 g (with battery and protective shell)
Degree of protection	IP 64

The characteristics of accuracy and resolution of the instrument in line with the available SICRAM modules are detailed in the descriptive paragraphs of the modules.

20.1 TECHNICAL FEATURES OF PROBES AND SICRAM MODULES IN LINE WITH THE INSTRUMENT

20.1.1 Temperature with platinum sensors (PRT)

4-wire Pt100 sensor temperature probes with SICRAM module

Model	Type	Range of use	Accuracy
TP472I	Immersion	-196 °C...+500 °C	$\pm 0.1^{\circ}\text{C}$ (@ 0 °C) $\pm 0.2^{\circ}\text{C}$ (-50 °C \leq t \leq 250 °C) $\pm 0.3^{\circ}\text{C}$ (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	
TP49A.I	Immersion	-70 °C...+250 °C	
TP49AC.I	Contact	-70 °C...+250 °C	
TP49AP.I	Penetration	-70 °C...+250 °C	
TP875.I	Globe thermometer Ø150 mm	-30 °C...+120 °C	
TP876.I	Globe thermometer Ø50 mm	-30 °C...+120 °C	
TP87.O	Immersion	-50 °C...+200 °C	

Common features

Resolution 0.01 °C from -200 °C to 350 °C / 0.1 °C from 350 °C to 800 °C
 Temperature drift @ 20 °C 0.003 %/°C

Pt100/Pt1000 probes with TP47 connector without SICRAM module

Model	Type	Range of use	Accuracy
TP47.100.O	4-wire Pt100	-50...+250 °C	Class A
TP47.1000.O	4-wire Pt1000	-50...+250 °C	Class A
TP87.100.O	4-wire Pt100	-50...+200 °C	Class A
TP87.1000.O	4-wire Pt1000	-50...+200 °C	Class A

Common features

Resolution 0.01 °C da -200 °C a 350 °C / 0.1 °C da 350 °C a 800 °C
 Temperature drift @ 20 °C
 Pt100 0.003 %/°C
 Pt1000 0.005 %/°C

20.1.3 Relative humidity and temperature

Relative humidity and temperature probes with SICRAM module

Model	Temperature sensor	Field of use		Accuracy	
		%RH	Temperature	% RH	Temp
HP472ACR	Pt100	0...100% RH	-20 °C...+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 °C...+80 °C		±0.3 °C
HP474ACR	Pt100	0...100% RH	-40 °C...+150 °C		±0.3 °C
HP475ACR	Pt100	0...100% RH	-40 °C...+150 °C		±0.3 °C
HP475AC1R	Pt100	0...100% RH	-40 °C...+180 °C		±0.3 °C
HP477DCR	Pt100	0...100% RH	-40 °C...+100 °C		±0.3 °C
HP478ACR	Pt100	0...100% RH	-40 °C...+150 °C		±0.3 °C
HP480	Pt100	0...100% RH	-40 °C...+60 °C		±0.25 °C
HP481	Pt100	0...100% RH	-40 °C...+60 °C		±0.25 °C

Common features

Relative humidity

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

Temperature with Pt100 sensor

Resolution	0.01 °C
Temperature drift@ 20 °C	0.003 %/°C

PP473S0 SICRAM probe for the measurement of relative pressure with respect to the atmosphere or differential pressure in the range ± 250 Pa.

The probe uses a silicon piezoresistive sensor with high accuracy and temperature compensation, which has excellent linearity, repeatability and stability over the time.

A special **auto-zero** circuit periodically equalizes the differential pressure at the sensor input and corrects the offset; this feature makes the probe insensitive to the mounting position and compensates the sensor aging and the deviation of the zero with temperature changes, virtually eliminating maintenance operations.

A typical application of the probe is clean rooms monitoring.

Measuring range	± 250 Pa (± 2.5 mbar)
Maximum overpressure	50 kPa
Resolution	0.1 Pa
Accuracy @ 25 °C	$\pm (0.2 \text{ Pa} + 1.5\% \text{ of the measure})$
Accuracy @ 0...50 °C	$\pm (0.2 \text{ Pa} + 3\% \text{ of the measure})$
Operating temperature	-10...+60 °C
Response time	0.125 s
Long-term stability	$\pm 0.5\%$ f.s. nominal (1000 h @ 25 °C)
Fluid in contact with the membrane	Non-corrosive dry gas or air
Connection	$\varnothing 5$ mm Tube

PP473S1...PP473S8 SICRAM probes for the measurement of the differential pressure

Measuring range	S1 =f.s. 10 mbar S2 =f.s. 20 mbar S3 =f.s. 50 mbar S4 =f.s. 100 mbar S5 =f.s. 200 mbar S6 =f.s. 500 mbar S7 =f.s. 1 bar S8 =f.s. 2 bar
Max overpressure	S1,S2,S3 =200 mbar S4 =300 mbar S5,S6 =1 bar S7 =3 bar S8 =6 bar
Accuracy @ 25 °C	S1,S2,S3 =0.5% f.s. S4 =0.25% f.s. S5,S6,S7,S8 =0.15% f.s.
Operating temperature	-10...+60 °C
Fluid in contact with the membrane	Air or non-corrosive dry gases
Connection	Pipe $\varnothing 5$ mm

20.1.5 Air speed

Hot-wire probes with SICRAM module

	AP471S1 AP471S3	AP471S2	AP471S4
Types of measurements	Air speed, calculated flow rate, air temperature		
Type of sensor <i>Speed</i> <i>Temperature</i>	NTC Thermistor NTC Thermistor	Omni-directional NTC thermistor NTC thermistor	
Measuring range <i>Speed</i> <i>Temperature</i>	0.02...40 m/s -25...+80 °C	0.02...5 m/s -25...+80 °C	0...80 °C
Air temperature compensation	0...80 °C		
Measurement resolution <i>Speed</i> <i>Temperature</i>	0.01 m/s 0.1 km/h 1 ft/min 0.1 mph 0.1 knot 0.1 °C		
Measurement accuracy <i>Speed</i> <i>Temperature</i>	±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) ±0.8 °C (-10...+80 °C)	±0.05 m/s (0.10...0.99 m/s) ±0.15 m/s (1.00...5.00 m/s) ±0.8 °C (-10...+80 °C)	
Minimum speed	0.02 m/s		
Cable length	~2 m		

Vane probes with SICRAM module

	AP472S1	AP472S2
Types of measurements	Air speed, calculated flow rate, air temperature	Air speed, calculated flow rate
Diameter	100 mm	60 mm
Type of measurement <i>Speed</i> <i>Temperature</i>	Propeller Tc K	Propeller ----
Measuring range <i>Speed</i> <i>Temperature</i>	0.6...25 m/s -25...+80 °C (*)	0.5...20 m/s -25...+80 °C (*)
Resolution <i>Speed</i> <i>Temperature</i>	0.01 m/s - 0.1 km/h - 1 ft/min - 0.1 mph - 0.1 knot 0.1 °C	----
Accuracy <i>Speed</i> <i>Temperature</i>	±(0.4 m/s + 1.5% f.s.) ±0.8 °C	±(0.4 m/s + 1.5% f.s.) ----
Minimum speed	0.6 m/s	0.5 m/s
Length del cable	~2 m	

(*) The indicated refers to the working range of the vane.

SICRAM modules for Pitot tubes

	AP473S1	AP473S2	AP473S3
Types of measurements	Air speed, calculated flow rate, differential pressure, air temperature		
Measuring range <i>Differential pressure</i> <i>Speed (*)</i> <i>Temperature</i>	10 mbar 2...40 m/s -200...+600 °C	20 mbar 2...55 m/s -200...+600 °C	50 mbar 2...90 m/s -200...+600 °C
Resolution <i>Speed</i> <i>Temperature</i>	0.1 m/s - 1 km/h - 1 ft/min - 1 mph - 1 knots 0.1°C		
Accuracy <i>Speed</i> <i>Temperature</i>	±0.4% pressure f.s. ±0.8 °C		±0.3% pressure f.s. ±0.8 °C
Minimum speed	2 m/s		
Air temperature compensation	-200...+600 °C (if thermocouple K is connected to the module)		

(*) At 20 °C, 1013 mbar and Ps (Static Pressure) negligible

20.1.6 Photometry and radiometry

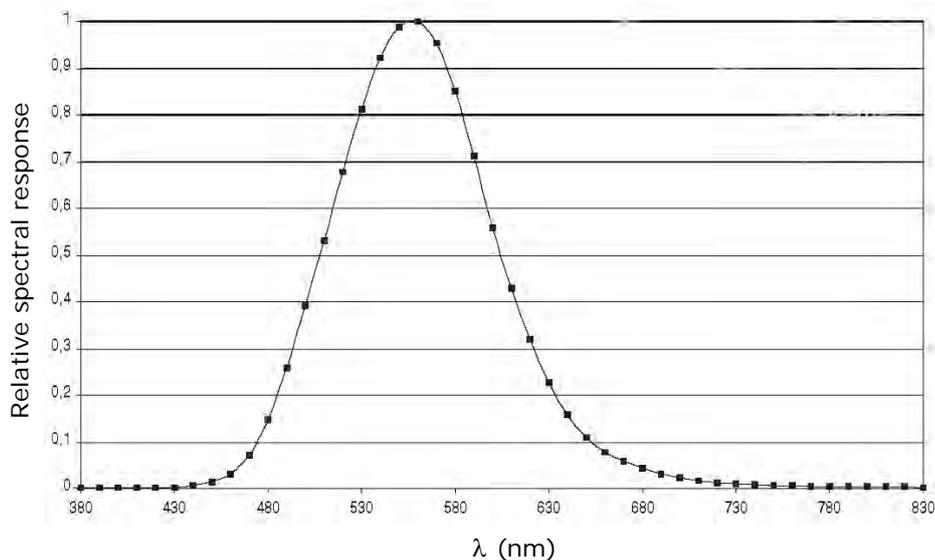
LP471PHOT Probe for the measurement of **illuminance**, with SICRAM module.

Measuring range (lux)	0.10...199.99	...1999.9	...19999	...199.99x10 ³
Resolution(lux)	0.01	0.1	1	0.01 x 10 ³
Spectral range	in accordance with standard photopic curve V(λ)			
α (temperature coefficient) $f_6(T)$	<0.05% K			
Calibration uncertainty	<4%			
f_1 (accordance with photopic response V(λ))	<6%			
f_2 (response as law of cosines)	<3%			
f_3 (linearity)	<1%			
f_4 (error in instrument reading)	<0.5%			
f_5 (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/m ²)	1...1999.9	...19999	...199.99x10 ³	...1999.9x10 ³
Resolution(cd/m ²)	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) $f_6(T)$	<0.05% K			
Calibration uncertainty	<5%			
f_1 (accordance with photopic response V(λ))	<8%			
f_3 (linearity)	<1%			
f_4 (error in instrument reading)	<0.5%			
f_5 (fatigue)	<0.5%			
Class	C			
1 year drift	<1%			
Operating temperature	0...50 °C			
Reference standard	CIE n°69 – UNI 11142			

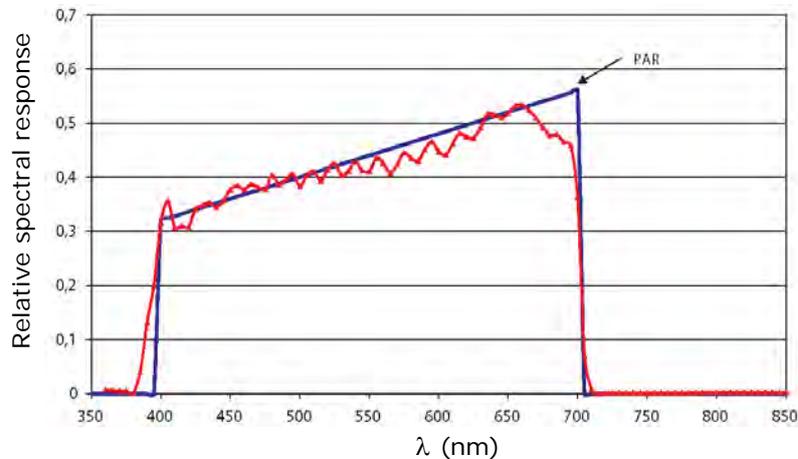
Typical response curve of **LP471PHOT** and **LP471LUM2** probes:



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

Measuring range ($\mu\text{mol}/\text{m}^2\text{s}$)	0.1... 199.99	200.0...1999.9	2000...10000
Resolution($\mu\text{mol}/\text{m}^2\text{s}$)	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)	± 1 digit		
f_5 (fatigue)	<0.5%		
1 year drift	<1%		
Operating temperature	0...50 °C		

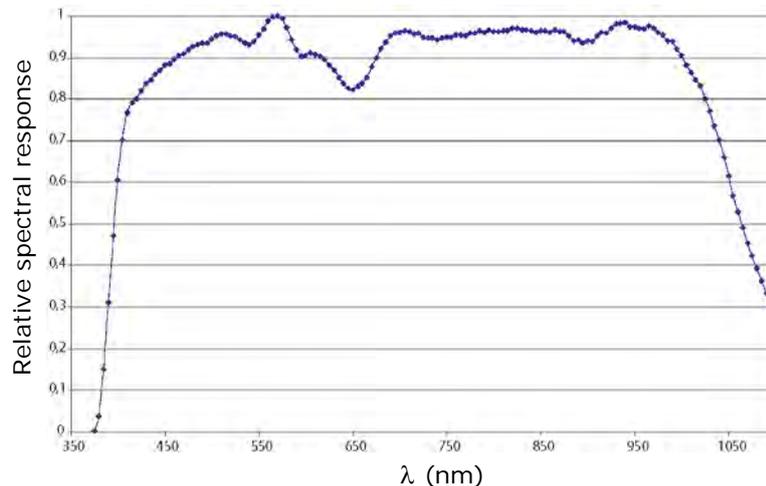
Typical response curve of probe **LP471PAR**:



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

Measuring range (W/m^2)	1×10^{-3} ... 999.9×10^{-3}	1.000...19.999	20.00...199.99	200.0...1999.9
Resolution(W/m^2)	0.1×10^{-3}	0.001	0.01	0.1
Spectral range	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)	± 1 digit			
f_5 (fatigue)	<0.5%			
1 year drift	<1%			
Operating temperature	0...50 °C			

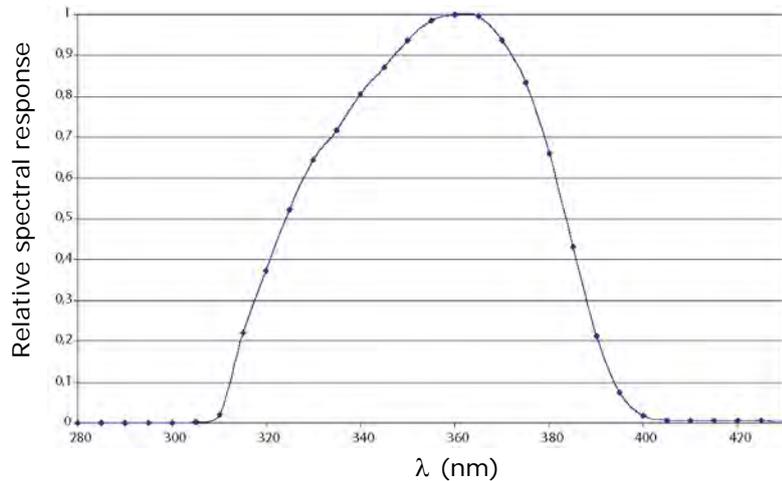
Typical response curve of **LP471RAD** probe:



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			

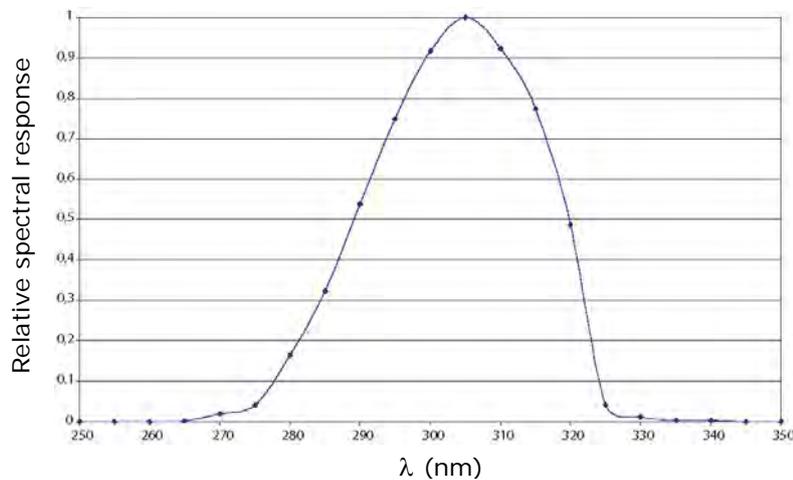
Typical response curve of **LP471UVA**:



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			

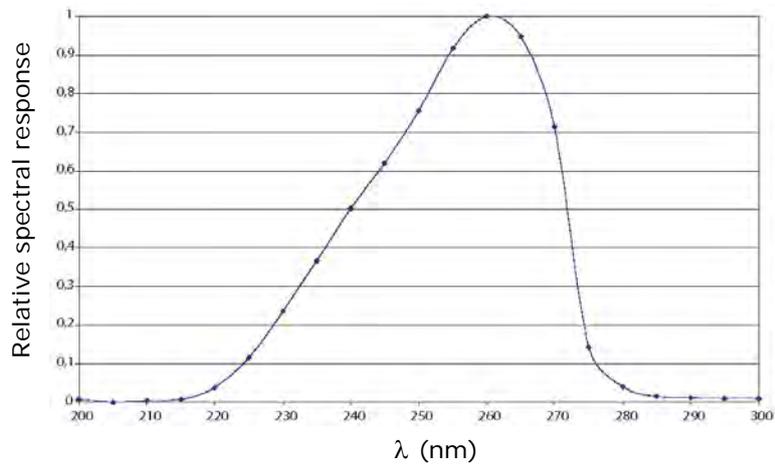
Typical response curve of **LP471UVB** probe:



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			

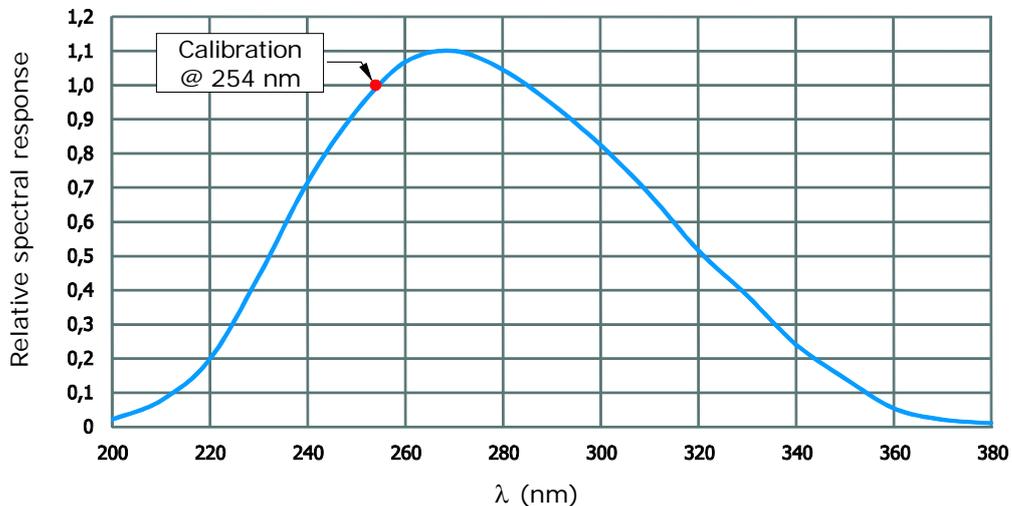
Typical response curve of **LP471UVC** probe:



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			

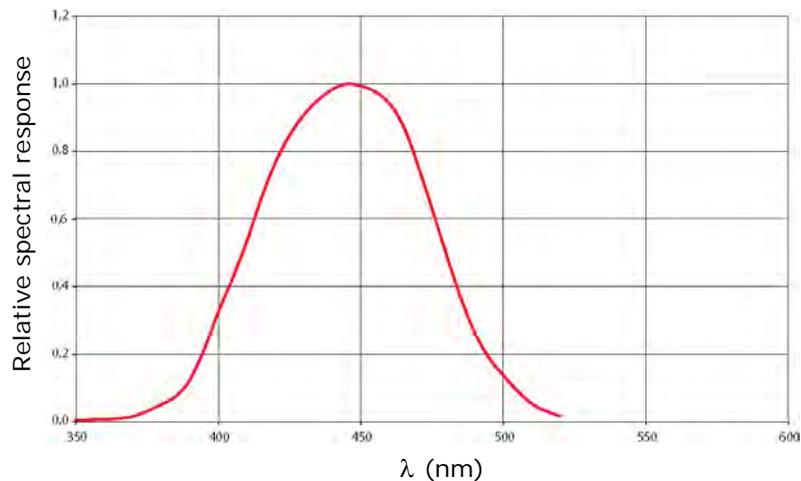
Typical response curve of **LP471UVBC** probe:



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:



LP 471 BLUE radiometric probe measures irradiance (W/m²) 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 photo-chemical damage to the retina. Another field of use of the probe is the monitoring of blue light irradiance in neonatal jaundice therapies.

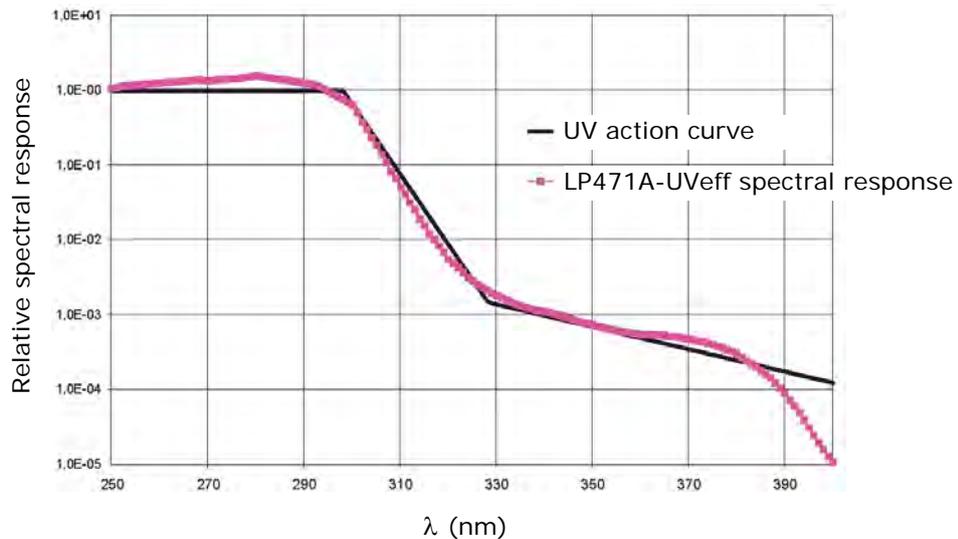
LP471P-A 2-sensor combined probe for the measurement of **illuminance** and of **UVA irradiance**, with SICRAM module.

Illuminance				
Measuring range (lux)	0.3...199.99	...1999.9	...19999	...199.99x10 ³
Resolution(lux)	0.01	0.1	1	0.01x10 ³
Spectral range	in accordance with standard photopic curve V(λ)			
α (temperature coefficient) f ₆ (T)	<0.05% K			
Calibration uncertainty	<4%			
f ₁ (accordance with photopic response V(λ))	<6%			
f ₂ (response as law of cosines)	<3%			
f ₃ (linearity)	<1%			
f ₄ (error in instrument reading)	<0.5%			
f ₅ (fatigue)	<0.5%			
Class	B			
1 year drift	<1%			
Operating temperature	0...50 °C			
Reference standard	CIE n°69 – UNI 11142			
Response curve	See response curve of LP471PHOT probe			
UVA Irradiance				
Measuring range (μ W/cm ²)	0.10...199.99	...1999.9	...19999	...199.99x10 ³
Resolution(μ W/cm ²)	0.01	0.1	1	0.01x10 ³
Spectral range	315 nm...400 nm (Peak 360 nm)			
Calibration uncertainty	<5%			
f ₂ (response as law of cosines)	<6%			
f ₃ (linearity)	<1%			
f ₄ (error in instrument reading)	± 1 digit			
f ₅ (fatigue)	<0.5%			
1 year drift	<2%			
Operating temperature	0...50 °C			
Response curve	See response curve of LP471UVA probe			

LP471A-UVeff Probe for the measurement of **weighted effective total irradiance according to UV action curve**, with SICRAM module.

Effective total irradiance	
Measuring range (W/m ²)	0.010...19.999
Resolution(W/m ²)	0.001
Spectral range	UV action curve for the measurement of erythema (250 nm...400 nm)
Calibration uncertainty	< 15%
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
Reference standard	CEI EN 60335-2-27
UV irradiance	
Measuring range (W/m ²)	0.1... 1999.9
Resolution(W/m ²)	0.1
Spectral range	315 nm...400 nm
UV-BC irradiance	
Measuring range (W/m ²)	0.010... 19.999
Resolution(W/m ²)	0.001
Spectral range	250 nm...315 nm

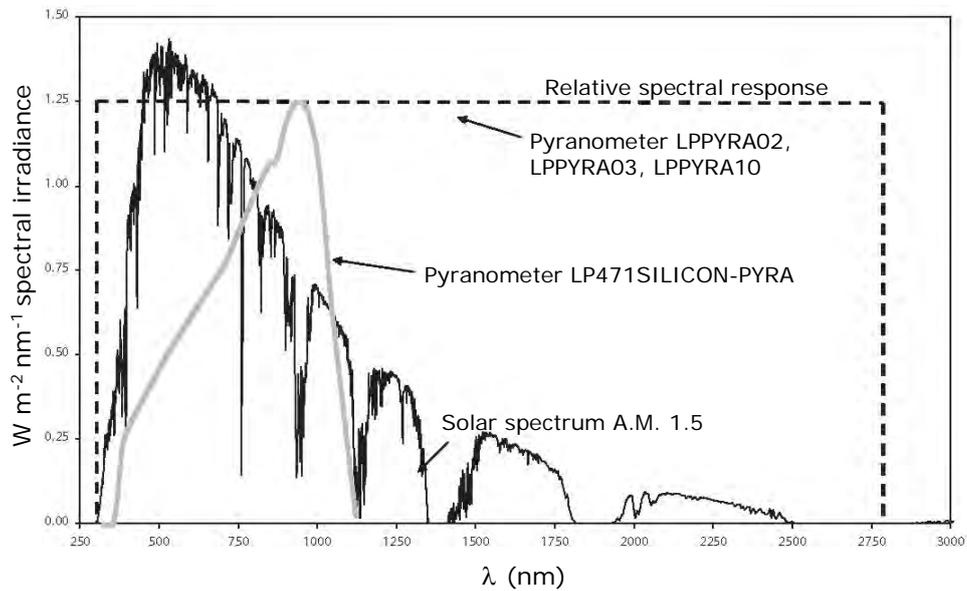
Typical response curve of **LP471A-UVeff** probe:



LP471SILICON-PYRA Probe for the measurement of **global solar irradiance**, with SICRAM module.

Measuring range (W/m ²)	0...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	400 nm...1100 nm			
Calibration uncertainty	<3%			
f ₂ (response as law of cosines)	<3%			
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			

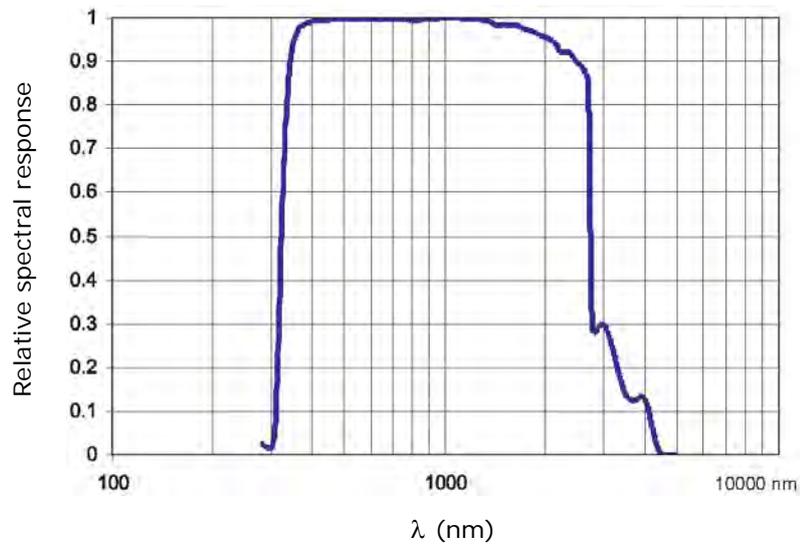
Typical response curve of **LP471SILICON-PYRA** probe:



LP471PYRA02/03/10 "Spectrally Flat" **pyranometers**, with SICRAM module.

	LP471PYRA02	LP471PYRA03	LP471PYRA10
Measuring range (W/m ²)	0...2000		
Resolution(W/m ²)	1		
Field of view	2π sr		
Spectral range	283 nm...2800 nm	300 nm...2800 nm	283 nm...2800 nm
Operating temperature	-40...80 °C		
Technical features according to ISO 9060			
Class	B	C	A
Response time (95%)	<10 s	<20 s	<5 s
Zero Offset			
a) Response at 200 W/m ²	< ±10 W/m ²	< ±15 W/m ²	< ±7 W/m ²
b) Response to 5 K/h ambient temperature variation	< ±4 W/m ²	< ±4 W/m ²	< ±2 W/m ²
c) Total zero offset including the effects a), b) and other sources	< ±15 W/m ²	< ±20 W/m ²	< ±10 W/m ²
Long-term instability (1 year)	< ±1 %	< ±1 %	< ±0.5 %
Non linearity	< ±1 %	< ±1.5 %	< ±0.2 %
Response according to cosine law	< ±18 W/m ²	< ±20 W/m ²	< ±10 W/m ²
Spectral error	< ±0.5 %	< ±2 %	< ±0.2 %
Temperature response	<1.5%	<3%	<1%
Tilt response	< ±2 %	< ±2 %	< ±0.2 %

Typical response curve of **LP471PYRA02** and **LP471PYRA03** probes:



VP472 SICRAM module for connection of pyranometers and albedometers (LPPYRAxx) with mV output.

Measuring range	-25...+25 mV
Resolution	1 W/m ² , 1 μV
Accuracy	±1 W/m ² , ±3 μV
Sensitivity	settable from 5 to 30 μV/Wm ⁻²

20.1.7 CO₂ (carbon dioxide)

HD31.B3 Probe for the measurement of **CO₂**, with SICRAM module.

Sensor	Dual wavelength NDIR
Measuring range	0...5,000 ppm (HD31.B3) 0...10,000 ppm (HD31.B3-10)
Operating conditions	-20...60 °C / 0...95%RH non condensing
Accuracy @ 25 °C / 1013 mbar	±(50 ppm + 3% of measure) for HD31.B3 ±(100 ppm + 5% of measure) for HD31.B3-10
Resolution	1 ppm
Temperature dependence	1 ppm/°C
Response time (T ₉₀)	< 120 s (wind speed = 2 m/s)
Long-term stability	5% of measure / 5 years

21 PROBES AND ACCESSORIES ORDERING CODES

HD31 is supplied with lithium ion rechargeable battery, SD card, rubber protection shell with magnet, CP31 USB cable, SWD05 power supply and carrying case.

DeltaLog9 software is downloadable from Delta OHM website.

Modules, probes and serial cable for the printer have to be ordered separately.

Pt100 temperature probes with SICRAM module

TP472I	Immersion probe, Pt100 sensor. Stem Ø3 mm, length 300 mm. Cable length 2 m.
TP472I.O	Immersion probe, Pt100 sensor. Stem Ø3 mm, length 230 mm. Cable length 2 m.
TP473P.I	Penetration probe, Pt100 sensor. Stem Ø4 mm, length 150 mm. Cable length 2 m.
TP473P.O	Penetration probe, Pt100 sensor. Stem Ø4 mm, length 150 mm. Cable length 2 m.
TP474C.O	Contact probe, Pt100 sensor. Stem Ø4 mm, length 230 mm, contact surface Ø 5 mm. Cable length 2 m.
TP475A.O	Air probe, Pt100 sensor. Stem Ø4 mm, length 230 mm. Cable length 2 m.
TP472I.5	Penetration probe, Pt100 sensor. Stem Ø6 mm, length 500 mm. Cable length 2 m.
TP472I.10	Penetration probe, Pt100 sensor. Stem Ø6 mm, length 1000 mm. Cable length 2 m.
TP49A.I	Immersion probe, Pt100 sensor. Stem Ø2.7 mm, length 150 mm. Cable length 1.5 m. Aluminum handle.
TP49AC.I	Contact probe, Pt100 sensor. Stem Ø4 mm, length 150 mm. Cable length 1.5 m. Aluminum handle.
TP49AP.I	Penetration probe, Pt100 sensor. Stem Ø2,7 mm, length 150 mm. Cable length 1.5 m. Aluminum handle.
TP875.I	Globe thermometer Ø150 mm with handle. Cable length 2 m.
TP876.I	Globe thermometer Ø50 mm with handle. Cable length 2 m.
TP87.O	Immersion probe, Pt100 sensor. Stem Ø3 mm, length 70 mm. Cable length 2 m.

Pt100 and Pt1000 temperature probes without SICRAM module

TP47.100.O	4-wire direct Pt100 sensor immersion probe. Probe stem Ø3 mm, length 230 mm. 4-wire connection cable with connector, length 2 m.
TP47.1000.O	Pt1000 sensor immersion probe. Probe stem Ø3 mm, length 230 mm. 4-wire connection cable with connector, length 2 m.
TP87.100.O	4-wire direct Pt100 sensor immersion probe. Probe stem Ø3 mm, length 70 mm. 4-wire connection cable with connector, length 2 m.
TP87.1000.O	Pt1000 sensor immersion probe. Probe stem Ø3 mm, length 70 mm. 4-wire connection cable with connector, length 2 m.

Modules for NON SICRAM temperature probes

TP47	Connector for connection to NON SICRAM 4-wire Pt100 or 2 or 4-wire Pt1000 temperature probes.
TP471	Module for connection to NON SICRAM 4-wire Pt100 temperature probes.
TP471D0	1-input module for NON SICRAM probes with thermocouple sensor type K-J-E-T-N-R-S-B. Without cold junction compensation.
TP471D	1-input module for NON SICRAM probes with thermocouple sensor type K-J-E-T-N-R-S-B. With internal sensor for cold junction compensation.
TP471D1	2-input module for NON SICRAM probes with thermocouple sensor type K-J-E-T-N-R-S-B. With internal sensor for cold junction compensation.

Thermocouple temperature probes

For the available thermocouple temperature probes, please visit www.deltaohm.com.

Relative humidity and temperature combined probes with SICRAM module

HP472ACR	%RH and Temperature combined probe, dimensions Ø26x170 mm. 2 m connection cable.
HP473ACR	%RH and Temperature combined probe. Handle size Ø26x130 mm, probe Ø14x120 mm. 2 m connection cable.
HP474ACR	%RH and Temperature combined probe. Handle size Ø26x130 mm, probe Ø14x215 mm. 2 m connection cable.
HP475ACR	%RH and Temperature combined probe. 2 m connection cable. Handle Ø26x110 mm. Stainless steel stem Ø12x560 mm. Tip Ø13,5x75 mm.
HP475AC1R	%RH and Temperature combined probe. 2 m connection cable. Handle 80mm. Stainless steel stem Ø14x480 mm.
HP477DCR	%RH and Temperature combined sword probe. 2 m connection cable. Handle Ø26x110 mm. Probe stem 18x4 mm, length 520 mm.
HP478ACR	%RH and Temperature combined probe. 5 m connection cable. Stainless steel stem Ø14x130 mm.
HP480	%RH and Temperature probe for compressed air systems. Supplied complete with SICRAM module. 2 m connection cable. Supplied with 15 µm AISI 316 sintered stainless steel filter, measurement chamber, airflow control valve and 3 quick connect couplings 1/4" (Italian, German and American standard).
HP481	%RH and Temperature probe for compressed air systems. Supplied complete with SICRAM module. 2 m connection cable. Supplied with 15 µm AISI 316 sintered stainless steel filter.
P1	Technopolymer and 34 µm stainless steel grid protection for probes Ø26, thread M24x1.5. Operating temperature: -40...80 °C.
P2	Technopolymer and 20 µm sintered PE protection for probes Ø26, thread M24x1.5. Operating temperature: -40...80 °C.
P3	20 µm sintered bronze protection for probes Ø26, thread M24x1.5. Operating temperature: -40...150 °C.
P4	20 µm sintered PE protection for probes Ø26, thread M24x1.5. Operating temperature: -40...80 °C.
P6	10 µm sintered stainless steel protection for probes Ø14, thread M12x1. Operating temperature: -40...180 °C.
P7	20 µm PTFE protection for probes Ø14, thread M12x1. Operating temperature: -40...150 °C.

P8	PBT and 10 µm stainless steel grid protection for probes Ø14, thread M12x1. Operating temperature: -40...120 °C.
HD75	Saturated solution for checking the Relative Humidity sensor at 75% RH, with screw adaptor for Ø14 probes, thread M12x1.
HD33	Saturated solution for checking the Relative Humidity sensor at 33% RH, with screw adaptor for Ø14 probes, thread M12x1.
HD11	Saturated solution for checking the Relative Humidity sensor at 11% RH, with screw adaptor for Ø14 probes, thread M12x1.

Modules and probes for pressure measurement

PP471	SICRAM module for the measurement of absolute, relative and differential pressures. Operates with TP704 and TP705-series pressure probes. Supplied complete with cable (L=1.5 m) and 8-pole DIN 45326 female connector. See table at page 124 for TP704 and TP705 series pressure probes.
PP472	SICRAM probe for the measurement of barometric pressure. Measuring range 600...1100 mbar. Resolution 0.1 mbar. Operating temperature -10...+60 °C.
PP473S0	SICRAM probe for the measurement of relative pressure with respect to the atmosphere or differential pressure. Measuring range ± 250 Pa (± 2.5 mbar). With auto-zero circuit. Operating temperature -10...+60 °C. For non-corrosive dry gas or air.
PP473S1	SICRAM probe for the measurement of differential pressure. Full scale 10 mbar. Operating temperature -10...+60 °C.
PP473S2	SICRAM probe for the measurement of the differential pressure. Full scale 20 mbar. Operating temperature -10...+60 °C.
PP473S3	SICRAM probe for the measurement of the differential pressure. Full scale 50 mbar. Operating temperature -10...+60 °C.
PP473S4	SICRAM probe for the measurement of the differential pressure. Full scale 100 mbar. Operating temperature -10...+60 °C.
PP473S5	SICRAM probe for the measurement of the differential pressure. Full scale 200 mbar. Operating temperature -10...+60 °C.
PP473S6	SICRAM probe for the measurement of the differential pressure. Full scale 500 mbar. Operating temperature -10...+60 °C.
PP473S7	SICRAM probe for the measurement of the differential pressure. Full scale 1 bar. Operating temperature -10...+60 °C.
PP473S8	SICRAM probe for the measurement of the differential pressure. Full scale 2 bar. Operating temperature -10...+60 °C.

Hot-wire probes with SICRAM module for the measurement of air speed

AP471S1	Extensible hot-wire probe, measuring range: 0.02...40 m/s. Cable length 2 m.
AP471S2	Omnidirectional extensible hot-wire probe, measuring range: 0.02...5 m/s. Cable length 2 m.
AP471S3	Extensible hot-wire probe with shapeable end, measuring range: 0.02...40 m/s. Cable length 2 m.
AP471S4	Omnidirectional extensible hot-wire probe with base, measuring range: 0.02...5 m/s. Cable length 2 m.

Vane probes with SICRAM module for the measurement of air speed

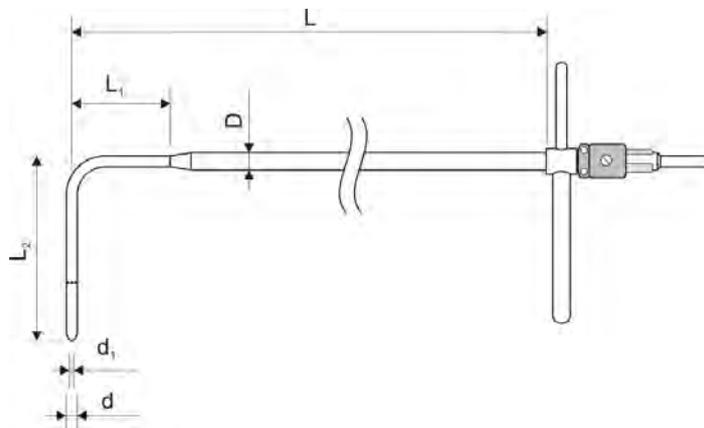
- AP472S1** Type K Thermocouple vane probe, Ø100 mm. Speed 0.6 to 25 m/s; temperature -25 to 80 °C. Cable length 2 m.
- AP472S2** Vane probe, Ø60 mm. Measuring range: 0.5...20 m/s. Cable length 2 m.
- AST.1** Extension rod (210 mm completely closed, 870 mm completely open) for AP472S1 and AP472S2 vanes.
- AP471S1.23.6** Fixed extension element Ø16 x 300 mm, M10 male thread on one side, female on the other side. For AP472S1 and AP472S2 vanes.
- AP471S1.23.7** Fixed extension element Ø16 x 300 mm, M10 female thread on one side only. For AP472S1 and AP472S2 vanes.

Pitot tube modules

- AP473S1** **Pitot tube** SICRAM module. Differential pressure up to 10 mbar. Air speed 2 to 40 m/s. The Pitot tube must be ordered separately.
- AP473S2** **Pitot tube** SICRAM module. Differential pressure up to 20 mbar. Air speed 2 to 55 m/s. The Pitot tube must be ordered separately.
- AP473S3** **Pitot tube** SICRAM module. Differential pressure up to 50 mbar. Air speed 2 to 90 m/s. The Pitot tube must be ordered separately.
- PW** Extension with mignon standard male-female connectors for attachment of Pitot tube with type-K thermocouple to AP473S....module. Length 2 m.

Pitot Tubes

Stainless steel Pitot tubes for the measurement of air speed and temperature (only for models provided with type K thermocouple). Supplied complete of 2 pieces of silicon tube, 1.5 m length each, external Ø 6 mm, internal Ø 4 mm. **The PW cable must be ordered separately.**



Code	d mm	d ₁ mm	D mm	L mm	L ₁ mm	L ₂ mm	Temperature	Thermocouple K	Material
T1-300	3	1	6	300	30	72	0..600 °C	---	AISI 316
T2-400	5	2	8	400	45	120		---	
T3-800	8	3.2	8	800	---	192		---	
T3-800TC	8	3.2	8	800	---	192		TC	

For other dimensions, please contact Delta OHM.

Photometric and radiometric probes with SICRAM module

LP471PHOT	Photometric probe for the measurement of illuminance , complete with SICRAM module, spectral response according to standard photopic vision, diffuser for cosine correction. Measuring range: $0.1...200 \times 10^3$ lux.
LP471RAD	Radiometric probe for the measurement of irradiance in the spectral range 400...1050 nm, complete with SICRAM module, diffuser for cosine correction. Measuring range: $1 \times 10^{-3}...2000$ W/m ² .
LP471PAR	Quantum-radiometric probe for the measurement of photon flux in the PAR chlorophyll field (photosynthetically Active Radiation 400...700 nm) complete with SICRAM module, $\mu\text{mol}/\text{m}^2\text{s}$ measurement, diffuser for cosine correction. Measuring range $0.1...10 \times 10^3$ $\mu\text{mol}/\text{m}^2\text{s}$.
LP471UVA	Radiometric probe for the measurement of irradiance in the 315...400 nm UVA spectral range, peak at 360 nm, complete with SICRAM module, quartz diffuser for cosine correction. Measuring range: $1 \times 10^{-3}...2000$ W/m ² .
LP471UVB	Radiometric probe for the measurement of irradiance in the 280...315 nm UVB spectral range, peak at 305 nm, complete with SICRAM module, quartz diffuser for cosine correction. Measuring range: $1 \times 10^{-3}...2000$ W/m ² .
LP471UVC	Radiometric probe for the measurement of irradiance in the 220...280 nm UVC spectral range, peak at 260 nm, complete with SICRAM module, quartz diffuser for cosine correction. Measuring range: $1 \times 10^{-3}...2000$ 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: $1 \times 10^{-3}...2000$ W/m ² .
LP471LUM2	Photometric probe for the measurement of luminance , complete with SICRAM module, spectral response according to standard photopic vision, angle of view 2°. Measuring range: $1...2000 \times 10^3$ cd/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: $1 \times 10^{-3}...2000$ W/m ² .
LP471P-A	Combined probe for the measurement of illuminance (lux), with standard photopic spectral response, and measurement of irradiance ($\mu\text{W}/\text{cm}^2$) in the UVA spectral range (315...400 nm, with peak at 360 nm). Both sensors are provided with diffuser for cosine correction. Illuminance measuring range: $0.3...200 \times 10^3$ lux. Irradiance measuring range: $1 \times 10^{-3}...2000$ W/m ² . The probe provides the ratio between UV irradiance and illuminance in $\mu\text{W}/\text{lumen}$ (quantity of interest in museums).
LP471A-UVeff	Combined probe for the measurement of effective total irradiance according to UV action curve. The two sensors are used for the correct measurement of the effective total irradiance in the range 250...400 nm. Both sensors are provided with diffuser for cosine correction. The probe provides the effective total irradiance (E_{eff}), the effective irradiance in the UV-CB band and UV irradiance. Effective total irradiance measuring range: $0.01...20$ W/m ² . Effective irradiance measuring range B_C: $0.01...20$ W/m ² . UV irradiance measuring range: $0.1...2000$ W/m ² .
LP471Silicon-Pyra	Pyranometer with Silicon photodiode for the measurement of the global solar irradiance , diffuser for cosine correction. Spectral range: 400...1100 nm. Measuring range: $0...2000$ W/m ² . Fixed cable length 5m with SICRAM module.
LP471PYRA02...	LPPYRA02 Spectrally Flat class B pyranometer with 5 m (LP471PYRA02.5) or 10 m (LP471PYRA02.10) cable with SICRAM module.

LP471PYRA03...	LPPYRA03 Spectrally Flat class C pyranometer with 5 m (LP471PYRA03.5) or 10 m (LP471PYRA03.10) cable with SICRAM module.
LP471PYRA10...	LPPYRA10 Spectrally Flat class A pyranometer with 5 m (LP471PYRA10.5) or 10 m (LP471PYRA10.10) cable with SICRAM module.
LPBL	Base with level for photometric and radiometric probes (LP471LUM2 and LP471PYRA...excluded). To assemble to probes when placing the order.
LPBL3	Adjustable wall mount support for photometric and radiometric probes (LP471LUM2 and LP471PYRA...excluded).
VP472	SICRAM module for the connection of pyranometers or albedometers. Measuring range: -25...+25 mV.

Probes and accessories for CO₂ measurement

HD31.B3	CO ₂ probe with SICRAM module. Measuring range 0...5,000 ppm. Operating conditions: -20...60 °C / 0...95%RH non condensing.
HD31.B3-10	CO ₂ probe with SICRAM module. Measuring range 0...10,000 ppm. Operating conditions: -20...60 °C / 0...95%RH non condensing.
HD31.B3A	Adapter for the calibration of the CO ₂ sensor of the probe HD31.B3 with nitrogen bottle.
HD37.37	Connecting pipe kit between instrument and nitrogen cylinder for CO ₂ calibration.

Modules for the measurement of continuous voltage and current

VP473	SICRAM module for the measurement of continuous voltage. Can acquire signal if connected to a transmitter with voltage output. Measuring range: ±20 Vdc. Input impedance: 1 MΩ.
IP472	SICRAM module for the measurement of continuous current. Can acquire signal if connected to a transmitter with current output. Measuring range: 0...24 mA. Input impedance: 25 Ω.

Accessories

CP31RS	RS232C connection cable for serial printer connection. RJ12 connector on the instrument side and Sub-D 9-pole female connector on the printer side.
HD35-BAT1	Spare lithium ion rechargeable battery, 3.7 V, capacity 2250 mA/h, 3-pole JST connector.
HD40.1	Kit including 24-column portable thermal printer, serial interface, paper width 57mm, NiMH rechargeable battery pack, SWD10 power supply unit, 5 thermal paper rolls and instruction manual.
BAT-40	Replacement battery pack for HD40.1 printer with integrated temperature sensor.
RCT	Kit of 4 thermal paper rolls, width 57 mm, diameter 32 mm.

Delta OHM metrological laboratories LAT N° 124 have been ISO/IEC 17025 accredited by ACCREDIA in Temperature, Humidity, Pressure, Photometry/Radiometry, Acoustics and Air Speed. They can provide calibration certificates for the accredited quantities.

APPENDIX

Callendar-Van Dusen equation

The temperature response of a platinum sensor (e.g. Pt100) is described by the equation of Callendar Van Dusen (1).

$$(1) \quad \begin{aligned} R(t) &= R_0 \cdot (1 + At + Bt^2 + Ct^3(t-100)) & t < 0^\circ\text{C} \\ R(t) &= R_0 \cdot (1 + At + Bt^2) & t \geq 0^\circ\text{C} \end{aligned}$$

The coefficient C is set to 0 for temperatures exceeding zero.

In order to obtain the value of coefficients A, B and C of the equation (1) the probe must be calibrated in three different points at least. Once known, the coefficients are used to determine the temperature depending on the resistance value of the sensor.

Coefficients A, B and C for Standard Platinum probes are defined by EN60751 standard:

$A = 3.9083 \times 10^{-3} \text{ }^\circ\text{C}^{-1}$	$B = -5.775 \times 10^{-7} \text{ }^\circ\text{C}^{-2}$	$C = -4.183 \times 10^{-12} \text{ }^\circ\text{C}^{-4}$
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The temperature coefficient α is also defined by the same standard as:

$$(2) \quad \alpha = \frac{R_{100} - R_0}{100 \cdot R_0} = 0,00385055 \text{ }^\circ\text{C}^{-1}$$

Coefficient α can be determined with a calibration operation in 2 points only.

The relationship (1) between the sensor resistance and temperature can be described in an alternative manner by the following equation:

$$(3) \quad \begin{aligned} R(t) &= R_0 \cdot \left\{ 1 + \alpha \cdot \left[t - \delta \frac{t}{100} \left(\frac{t}{100} - 1 \right) - \beta \left(\frac{t}{100} - 1 \right) \left(\frac{t}{100} \right)^3 \right] \right\} & t < 0^\circ\text{C} \\ R(t) &= R_0 \cdot \left\{ 1 + \alpha \cdot \left[t - \delta \frac{t}{100} \left(\frac{t}{100} - 1 \right) \right] \right\} & t \geq 0^\circ\text{C} \end{aligned}$$

where:

$\alpha = A + 100B = 0.00385055 \text{ }^\circ\text{C}^{-1}$	$\delta = -\frac{100}{\frac{A}{100B} + 1} = 1.499785$	$\beta = -\frac{10^8 \text{C}}{A + 100B} = 0.10863$
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The calculation of coefficient α between 0 °C and a temperature exceeding 100 °C can be generalized, by obtaining it from the second of equations (3):

$$(4) \quad \alpha = \frac{R(t) - R_0}{R_0 \cdot \left[t - \delta \frac{t}{100} \left(\frac{t}{100} - 1 \right) \right]} \quad \delta = \delta_{\text{nominal}}$$

This allows performing the calibration at 0 °C and in any point provided that it is higher than 100 °C.

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**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: **5004 / 07.2019**
Document-No. / Month.Year :

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: **HD31**
Product identifier :

Descrizione prodotto: **Strumento multifunzione portatile – datalogger**
Product description : **Portable multifunction instrument – data logger**

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.

WARRANTY

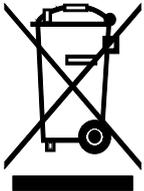
Delta OHM is required to respond to the "factory warranty" only in those cases provided by Legislative Decree 6 September 2005 - n. 206. Each instrument is sold after rigorous inspections; if any manufacturing defect is found, it is necessary to contact the distributor where the instrument was purchased 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.



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