

Operating manual

Conductivity meter - Thermometer **HD2306.0**



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GENERAL CHARACTERISTICS

The Conductivity meter – Thermometer **HD2306.0** is a portable instrument, fitted with a large LCD display for excellent visualization of the measured data, that allows measurement of the following:

- Conductivity
- Liquid resistivity
- Total dissolved solids (TDS)

with combined 4-electrode or 2-electrode conductivity/temperature probes.

Temperature only is measured by Pt100 or Pt1000 immersion, penetration or contact probes.

The probe calibration can be performed automatically in one or more of the 147 $\mu\text{S}/\text{cm}$, 1413 $\mu\text{S}/\text{cm}$, 12880 $\mu\text{S}/\text{cm}$ or 111,800 $\mu\text{S}/\text{cm}$ conductivity calibration solutions.

Using the Max, Min and Avg function of this instrument respectively obtains the maximum, minimum or average value.

Other available functions are:

- the relative measurement REL;
- the HOLD function;
- the automatic turning off which can also be disabled.

For further details see chapter 'Description of the functions' at page 6.

Conductivity Meter - Thermometer HD2306.0



HD2306.0

1. 8-pole DIN45326 connector, input for combined 4-ring or 2-ring conductivity/temperature probes, for direct 4 wire Pt100 temperature probes and 2- or 4-wire Pt1000 probes complete with TP47 module.
2. Battery symbol: displays the battery charge level.
3. Function indicators.
4. Secondary display line.
5. **DATA/ENTER** key: during normal operation displays the maximum (MAX), the minimum (MIN) and the average (AVG) of current measurements; In the menu, confirms the current selection.
6. **χ/TDS** key: selects the display of conductivity, resistivity, or total dissolved solids (TDS); in the menu, resets the value set with the arrows. In calibration mode, allows you to exit calibration.
7. **▲** key: in the menu, increases the current value. In calibration mode, increases the displayed nominal standard solution value.
8. **°C/°F/MENU** key: it allows selection of the unit of measurement; when pressed together with the **DATA** key, it allows to open the menu. To exit the menu, press the **°C/°F/MENU** key.
9. **CAL**: starts the calibration procedure.
10. **REL/▼** key: enables the relative measurement (displays the difference between the current value and the logged value when the key is pressed); press the key again to return to the normal measurement. In the menu, decreases the current value. In calibration mode, decreases the displayed standard solution value.
11. **ON-OFF/AUTO-OFF** key: turns the instrument on and off.
12. **MAX** (maximum value), **MIN** (minimum value) and **AVG** (average value) symbols.
13. Main display line.
14. Line for symbols and comments.

DESCRIPTION OF THE FUNCTIONS

The keyboard of the Conductivity meter – Thermometer **HD2306.0** is composed of double-function keys. The function on the key is the "main function", while the one above the key is the "secondary function".

When the instrument is in standard measurement mode, the main function is active.

Once the Settings Menu has been opened, by pressing simultaneously the **DATA+°C/°F** keys, the secondary function is enabled.

The pressing of a key is accompanied by a short confirmation "beep": a longer "beep" sounds if the wrong key is pressed. Each key specific function is described in detail below.

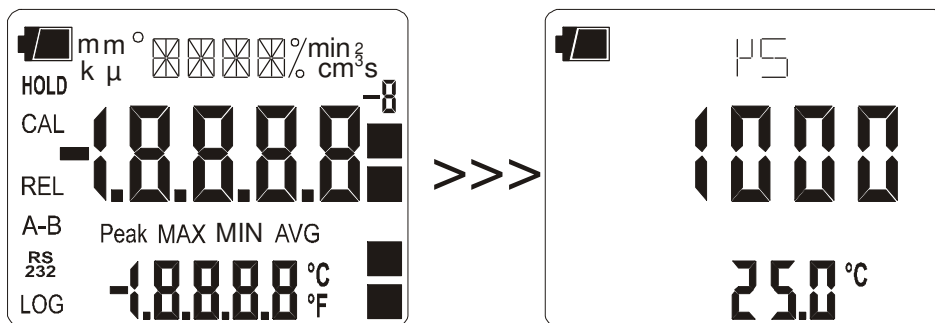


ON/OFF and AUTO/OFF key

This key has two functions:

- **ON/OFF:** to turn the instrument on press **ON**, to turn it off press **OFF**.

The turning on enables all display segments for a few seconds, starts an **Auto-test** including the detection of the probe connected to the input, and sets the instrument ready for normal measurement. The following is displayed:



- **AUTO/OFF:** the **AutoPowerOff** function can be disabled by simultaneously pressing this key and the **CAL** key when turning the instrument on.

During turning on, should no temperature probe be connected, the last manually-set **temperature** appears in the secondary line. The unit of measurement symbol (°C or °F) starts blinking, and a letter "m" meaning "manual" appears next to the battery symbol.

Caution! Replace the probes when the instrument is off.



+



Disabling of the automatic turning off

The instrument has an **AutoPowerOff** function that automatically turns the instrument off after about 8 minutes if no key is pressed during the intervening time.

Press simultaneously the **ON/OFF** key and the **CAL** key to disable this function.

In this case, remember to turn the instrument off using the **ON/OFF** key: disabling of the automatic turning off is shown by the blinking battery symbol.



χ /TDS /ESC key

The χ /TDS key has two functions:

- **χ /TDS:** pressing this key in sequence selects the display of: conductivity, resistivity, or total dissolved solids (TDS).
- **ESC:** once the MENU has been opened with the **DATA+°C/°F**, the χ /TDS key will allow to cancel the parameters set using the \blacktriangle and \blacktriangledown arrows.
- In calibration mode, it allows to exit calibration.



Tasto DATA/ENTER

The **DATA** key is used for the following functions:

- **DATA:** during normal measurement, by pressing this key once, the maximum (MAX) value of the measurements captured by the probe connected to the instrument is displayed, updating it with the acquisition of new samples; by pressing this key again the minimum (MIN) value is displayed and by pressing a third time, the average (AVG) value is displayed.

The acquisition frequency is once a second.

The MAX, MIN and AVG values remain in the memory until the instrument is on, even after exiting the DATA display function. When the instrument is off, the previously memorized data are cleared. Upon turning on, the instrument automatically starts memorizing the MAX, MIN and AVG values.

To reset the previous values and start with a new measurement session:

- press **DATA** until the **FUNC_CLRD** message appears;
- use the \blacktriangle and \blacktriangledown arrows to select **YES**;
- confirm by pressing **DATA/ENTER**.

- **ENTER:** once the MENU has been opened with the **DATA+°C/°F**; the **DATA** key will perform the ENTER function and the MENU can be browsed and the displayed parameter confirmed. In calibration mode, it acquires the nominal standard solution value.



\blacktriangle key

Once the MENU has been opened with the **°C/°F/MENU** and **DATA** keys, the \blacktriangle key will allow to increase the value of the selected parameter.



°C/°F/MENU key

The °C/°F key is used for the following functions:

- **°C/°F:** pressing this key selects the unit of measurement of temperature in Celsius (°C) or Fahrenheit (°F) degrees.
- **MENU:** in the menu five items can be set
 - K CELL (Cell constant)
 - ALPH_T (Temperature coefficient α_T)
 - REF_TEMP (Reference temperature)
 - TDS (Conversion factor χ /TDS)
 - Probe type (tipo di sonda)
- the menu is opened by pressing simultaneously **DATA+°C/°F**: the first item of the instrument programming menu will appear;
- use the **▲** and **▼** arrows to **modify** the displayed value;
- press **DATA/ENTER** to confirm the modification and go onto the next item;
- press **χ /TDS /ESC** to **cancel** the modification;
- to **exit** the menu, press the **°C/°F** key again.



CAL key

Press this key to start the calibration procedure (see chapter at page 11)



▼ / REL key

The ▼ key is used for the following functions:

- **▼:** once the MENU has been opened with the **DATA+°C/°F** keys, the ▼ key will allow to decrease the value of the selected parameter.
- **REL:** it displays the difference between the current value and that measured on pressing the key. The REL message is displayed on the left. To return to the normal measurement, press the key again.

THE PROGRAMMING MENU

To access to the menu press simultaneously the following keys



The items to be set are listed (in this order):

1. **K CELL (Costante di cella)**: sets the conductivity probe's cell constant nominal value. The values **0.1, 0.7, 1.0** and **10 cm⁻¹ (with tolerances from -30% to +50% of nominal value)** are admitted.

Caution! *The cell constant must be inserted before starting the probe calibration.*

An **ERR** signal is generated if the cell constant's actual value exceeds the limits -30% or +50% of nominal value. In this case it is necessary to check that the value set is correct, that the calibration solutions are in good state, and then proceed with a new calibration. The cell constant change entails resetting the previous calibration.

- use ▲ and ▼ arrows to **modify** the displayed value;
- press **DATA/ENTER** to **confirm** the modification and go onto the next item;
- press **χ/TDS /ESC** to **cancel** the modification;
- to **exit** the menu, press the **°C/°F** key again.

2. **ALPH_T (Temperature coefficient α_T)**: the temperature coefficient α_T is the percentage measurement of the conductivity variation according to temperature and is expressed in %/°C (or %/°F). **The admitted values vary from 0.00 to 4.00%/°C.**

- use ▲ and ▼ arrows to **modify** the displayed value;
- press **DATA/ENTER** to **confirm** the modification and go onto the next item;
- press **χ/TDS /ESC** to **cancel** the modification;
- to **exit** the menu, press the **°C/°F** key again.

3. **REF_TEMP (Reference temperature)**: it indicates the temperature to which the displayed conductivity value is standardized and can be equal to **20°C** or **25°C**.

- use ▲ and ▼ arrows to **modify** the displayed value;
- press **DATA/ENTER** to **confirm** the modification and go onto the next item;
- press **χ/TDS /ESC** to **cancel** the modification;
- to **exit** the menu, press the **°C/°F** key again.

4. **TDS (Conversion factor χ/TDS)**: it represents the ratio between the measured conductivity value and the total quantity of dissolved solids in the solution, expressed in mg/l (ppm) or g/l (ppt). This conversion factor depends on the nature of the salts present in the solution: in the field of water quality treatment and control, where the main component is CaCO₃ (Calcium Carbonate), a value of 0.5 is usually used. For agriculture water, for fertilizers preparation, and in hydroponics, a factor of about 0.7 is used. **The range is 0.4...0.8:**

- use ▲ and ▼ arrows to **modify** the displayed value;
- press **DATA/ENTER** to **confirm** the modification and go onto the next item;
- press **χ/TDS /ESC** to **cancel** the modification;
- to **exit** the menu, press the **°C/°F** key again.

5. **Probe type:** the message "**PRBE_TYPE**" is scrolled in the comment line. The main line in the center of the display shows the type of temperature probe connected to the instrument. Conductivity/temperature combined probes with Pt100 or Pt1000 sensor, or temperature only probes can be connected to the input.

- a. 4-wire Pt100 using the TP47 module.
- b. 2- or 4-wire Pt1000 using the TP47 module.

Upon being turned on, the instrument automatically detects the temperature probes: the *Probe Type* menu item is configured by the instrument and cannot be modified by the user. If no temperature probe or combined probe with temperature sensor is connected, the instrument displays a dotted line "- - -".

CONDUCTIVITY MEASUREMENT

The Conductivity meter - Thermometer **HD2306.0** works with:

- combined conductivity/temperature probes;
- 4- and 2-electrodes only conductivity probes;
- temperature probes.

The 4-wire Pt100, 2- or 4-wire Pt1000 probes may be used for measuring temperature, which is used for the automatic compensation of the conductivity.

From the measurement of conductivity, the instrument obtains the following:

- the liquid resistivity measurement (Ω , $k\Omega$, $M\Omega$);
- the total dissolved solids (TDS) concentration according to the χ /TDS conversion factor which can be modified using the menu (see chapter at page 9).

The conductivity, resistivity, or TDS (total dissolved salts) indication is displayed in the main line, while the secondary line shows the temperature.

The conductivity probes must be periodically calibrated. To facilitate this operation, four automatic calibration solutions are provided:

- 0.001 Molar KCl solution ($147 \mu\text{S}/\text{cm}$ @25 °C),
- 0.01 Molar KCl solution ($1413 \mu\text{S}/\text{cm}$ @25 °C),
- 0.1 Molar KCl solution ($12880 \mu\text{S}/\text{cm}$ @25 °C),
- 1 Molar KCl solution ($111800 \mu\text{S}/\text{cm}$ @25 °C).

User calibration of the temperature sensors is not required.

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

STANDARD PROBE

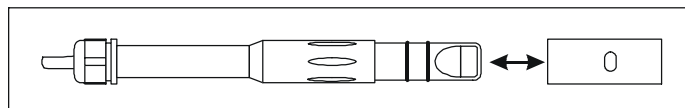
The standard 4-electrode combined conductivity/temperature probe code is SP06T.

The cell measurement zone is delimited by a bell in PBT.

A positioning key, present in the probe's end part, orients the bell correctly when the probe is introduced.

For cleaning, simply pull the bell along the probe's axis without rotating it.

It is not possible to perform measurements without this bell.



2-ELECTRODE OR 4-ELECTRODE PROBES

The Conductivity meter – Thermometer HD2306.0 uses 4-electrode or 2-electrode probes for conductivity measurement.

The **4-electrode probes** are preferred to measure high conductivity solutions, either over an extended range or in presence of pollutants.

The **2-electrode probes** operate in a shorter measurement range but with an accuracy comparable with the 4-ring probes.

The probes can be in glass or plastic: the first can work in presence of aggressive pollutants, the latter are more resistant to collisions, and so more suitable for industrial use.

CELLS WITH TEMPERATURE SENSOR

The probes fitted with built-in Pt100 or Pt1000 temperature sensor, measure conductivity and temperature at the same time: this allows automatic correction of the effect of the latter on the solution conductivity.

CHOOSING THE CELL CONSTANT

The **cell constant K_{cell}** is a piece of information which characterizes the cell and depends on its geometry: it is expressed in **cm⁻¹**.

There is no cell capable of measuring the entire conductivity scale accurately enough. Consequently, cells with different constants are used allowing good measurements on different scales.

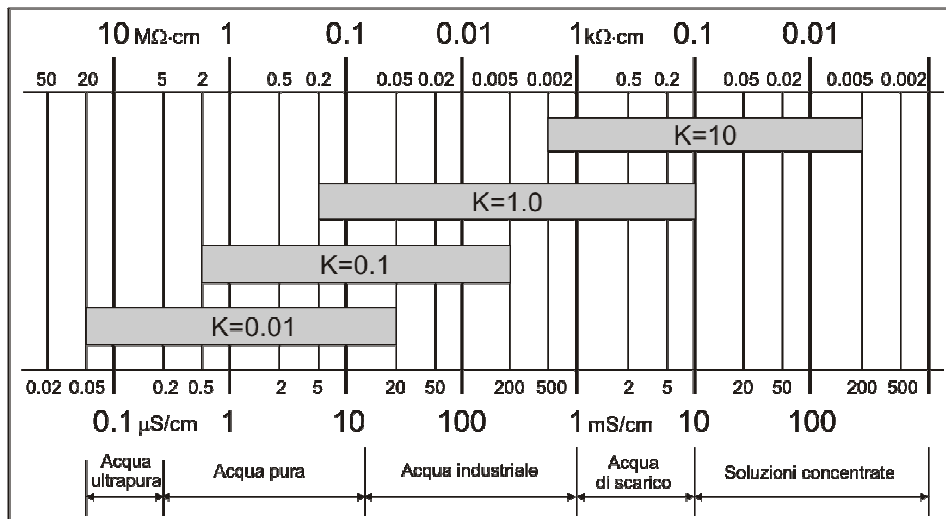
The cell with constant **K = 1cm⁻¹** allows measurements from low conductivity up to relatively high conductivity.

The **theoretical measurement cell** is made of two 1 cm² metallic plates separated one from the other by 1 cm. This type of cell has a cell constant K_{cell} of 1 cm⁻¹.

NOTE: the number, form, material and dimensions of the plates are very different from model to model, from manufacturer to manufacturer.

The **low constant K probes** are preferably used for low conductivity values, the **high constant K probes** for high values.

The indicative measurement range is reported in the following diagram:



AUTOMATIC OR MANUAL CONDUCTIVITY COMPENSATION

The conductivity measurement refers to a standard temperature, called **reference temperature T_REF**: that is, the instrument proposes the conductivity you would get if the temperature were T_REF.

This temperature could be 20 °C or 25 °C according to the setting in the T_REF menu item (see chapter at page 9).

The conductivity increase per each grade of temperature variation is a characteristic of the solution and is indicated by the term **temperature coefficient α_T** : most solutions are within these values, from 0.00 to 4.00%/°C. The default value is 2.00%/°C.

When a **combined probe** with temperature sensor is present, the instrument automatically applies the temperature compensation function, and proposes the measurement using the reference temperature T_REF according to the coefficient α_T on the display.

In absence of the temperature probe, the lower display shows the manually set compensation temperature (default=25 °C).

To point this condition out, the °C or °F symbol blinks intermittently near the temperature value. On the display an **"m"** (manual) is turned on near the battery symbol (if on).

How to manually change the temperature

To manually change the compensation temperature, proceed as follows:

- press the **°C/°F** key once: the indicated temperature value starts blinking;
- select the solution temperature value by using the **▲** and **▼** arrows;
- confirm by pressing **DATA/ENTER**: the display stops blinking, and the temperature displayed is used for compensation.
- To change the unit of measurement between °C and °F, it is necessary to press twice the **°C/°F** key.

CALIBRATION OF THE PROBE

The probe calibration can be carried out on one, two or three points using the standard solutions automatically detected by the instrument (automatic calibration) or other solutions with known value (manual calibration).

The CAL symbol will blink when the cell constant is modified using the menu (please see the description of the K_CELL item at page 9).

AUTOMATIC CALIBRATION OF CONDUCTIVITY USING MEMORIZED STANDARD SOLUTIONS

Lo strumento è in grado di riconoscere quattro soluzioni standard di taratura:

- 0.001 Molar KCl solution (147 $\mu\text{S}/\text{cm}$ @25 °C),
- 0.01 Molar KCl solution (1413 $\mu\text{S}/\text{cm}$ @25 °C),
- 0.1 Molar KCl solution (12880 $\mu\text{S}/\text{cm}$ @25 °C),
- 1 Molar KCl solution (111800 $\mu\text{S}/\text{cm}$ @25 °C).

Using one of these solutions, the calibration is automatic; the procedure can be repeated with one of the remaining standard solutions, up to a maximum of four different points.

The manual calibration is possible with a different conductivity solution from that used in the automatic calibration.

The solution temperature for the automatic calibration must be between 15 °C and 35 °C: if the solution temperature is under 15 °C or over 35 °C, the calibration is rejected: CAL ERR indication appears.

1. Turn the instrument on with the **ON/OFF** key.
2. Set the probe's cell constant by selecting it from the admitted values: 0.1, 0.7, 1.0 or 10.0.
3. Dip the conductivity meter cell in the calibration solution until the electrodes are covered with liquid.
4. Stir the probe lightly to remove any possible air inside the measurement cell.
5. If the conductivity probe is not fitted with temperature sensor:
 - press **°C/°F**;
 - enter the sample solution temperature value manually using the **▲** and **▼** arrows (manual setting of temperature);
 - confirm by pressing **DATA/ENTER**.
6. Press the **CAL** key. The unit of measurement ($\mu\text{S}/\text{cm}$ or mS/cm) appears on the comment line. The central line shows the solution conductivity value at the measured temperature, or if the probe is not present, at the manually-set temperature. In the lower line, the closest temperature compensated standard solution value.

If the measurement is in TDS, or resistivity, by pressing CAL, the instrument goes automatically into conductivity calibration mode.

7. Press **DATA/ENTER** to confirm the displayed value. The cell constant nominal value (KCELL) and the set temperature coefficient α_T are displayed. Pressed repeatedly, the **DATA/ENTER** key allows the calibration on the point to be repeated, for example, in order to obtain a more stable value.
8. To end the probe calibration, press **X/TDS/ESC**. If on the other hand you wish to perform another calibration on a different standard solution, repeat the calibration procedure from point 3.
9. Rinse the probe with water. If you are then going to perform low conductivity measurements, we recommend rinsing the probe using distilled or bidistilled water.

The instrument is calibrated and ready for use.

MANUAL CALIBRATION OF CONDUCTIVITY USING NON MEMORIZED STANDARD SOLUTIONS

Manual calibration is possible at any calibration solution if it is within the instrument measurement limits and provided that you know the solution's conductivity at the temperature at which the calibration is performed.

Proceed as follows:

1. Turn the instrument on with the **ON/OFF** key.
2. Set the probe's cell constant by selecting it from the admitted values: 0.1, 0.7, 1.0 or 10.0.
3. Dip the conductivity meter cell into a known conductivity solution until the electrodes are covered with liquid.
4. Stir the probe lightly to remove any possible air inside the measurement cell.
5. Press **°C/°F KEY**, and then **DATA** to access the menu, press **DATA** until the item ALPH appears. The temperature coefficient α_T is displayed. Note down the value displayed as it must be set again at the end of the procedure. Set the value to **0.00** by using the arrows. This excludes the temperature compensation during the conductivity measurement.
6. According to the temperature detected, determine the calibration solution conductivity using the table specifying the conductivity according to temperature.
7. Select the conductivity measurement by pressing **χ /TDS/ESC**.
8. Press the **CAL** key. The CAL symbol is turned on. The unit of measurement ($\mu\text{S}/\text{cm}$ or mS/cm) appears on the comment line. If the calibration solution conductivity is sufficiently close (**-30% to +50%**) to one of the solutions used for calibration, the secondary line displays the value. Otherwise it displays the calculated value according to current settings. In the central line the solution conductivity value is indicated according to the cell constant current settings.
9. Use the arrows to select the conductivity value determined at point 6 and confirm using **DATA/ENTER**. If the ERR indication appears, see the note below.
10. The cell constant nominal value (K_CELL) and the temperature coefficient α_T set to 0 are displayed. Pressed repeatedly, the **DATA/ENTER** key allows the calibration on the point to be repeated, for example, in order to obtain a more stable value.
11. To end the probe calibration, press **χ /TDS/ESC**.
12. Go back to the MENU and select ALPH: enter again the temperature coefficient as it was before the calibration.
13. Rinse the probe with water. If you are then going to perform low conductivity measurements, we recommend rinsing the probe using distilled or bidistilled water.

The instrument is now calibrated and ready for use.

NOTES:

- **Without having pressed DATA/ENTER at all, the calibration is interrupted by pressing χ /TDS/ESC;** the previous values will continue to be used.
- Upon confirming the calibration by using **DATA/ENTER**, the instrument checks that the correction to the conductivity does not exceed the 70% or 150% limits of the theoretical value. If the calibration is rejected because it is considered to be excessively corrupted, the **CAL ERR** message will appear, followed by a long beep. The instrument remains in calibration mode and maintains the previous calibration values.
- The **most frequent causes of error** are due to the probe malfunctioning (deposits, dirt,...) or to the standard solutions deterioration (bad preservation conditions, alteration due to pollution with different conductivity solutions,...)
- If the measurement is in resistivity, or TDS, on the pressing of **CAL**, the instrument goes automatically in conductivity calibration.

TABLE OF STANDARD SOLUTIONS AT 147 μ S/CM, 1413 μ S/CM, 12.88 MS/CM AND 111.8 MS/CM

The table reports, below, the standard solutions automatically detected by the instrument according to temperature.

$^{\circ}$ C	μ S/cm	μ S/cm	mS/c	mS/c	$^{\circ}$ C	μ S/cm	μ S/cm	mS/c	mS/c
15.0	121	1147	10.48	92.5	26.0	150	1440	13.13	113.8
16.0	124	1173	10.72	94.4	27.0	153	1467	13.37	115.7
17.0	126	1199	10.95	96.3	28.0	157	1494	13.62	117.7
18.0	128	1225	11.19	98.2	29.0	161	1521	13.87	119.8
19.0	130	1251	11.43	100.1	30.0	164	1548	14.12	121.9
20.0	133	1278	11.67	102.1	31.0	168	1581	14.37	124.0
21.0	136	1305	11.91	104.0	32.0	172	1609	14.62	126.1
22.0	138	1332	12.15	105.9	33.0	177	1638	14.88	128.3
23.0	141	1359	12.39	107.9	34.0	181	1667	15.13	130.5
24.0	144	1386	12.64	109.8	35.0	186	1696	15.39	132.8
25.0	147	1413	12.88	111.8					

DIRECT INPUT INTO Pt100 AND Pt1000 TEMPERATURE PROBES

The instrument accepts the input of platinum temperature probes with resistances of 100 Ω (Pt100) and 1000 Ω (Pt1000).

The Pt100 are connected to 4 wires, the Pt1000 to 2 or 4 wires; the excitation current was chosen in order to minimize the sensor self-heating effects.

The 4-wire and 2-wire probes with direct input are checked for conformity with class A tolerance according to norm IEC751 - BS1904 - DIN43760.

The temperature probes are automatically detected by the instrument (please see the description of the Probe Type menu item at page 9).

The $^{\circ}\text{C}$ or $^{\circ}\text{F}$ unit of measurement can be chosen for display using the **$^{\circ}\text{C}/^{\circ}\text{F}/\text{MENU}$** key.

TEMPERATURE MEASUREMENT

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

In the temperature measurement by **penetration** the probe tip must be inserted to a depth of at least 60 mm, the sensor is housed in the end part of the probe.

NOTE: when measuring the temperature on frozen blocks it is convenient to use a mechanical tool to bore a cavity in which to insert the probe tip.

In order to perform a correct **contact** measurement, the measurement surface must be even and smooth, and the probe must be perpendicular to the measurement plane.

So as to obtain the correct measurement, the insertion of a drop of oil or heat-conductive paste between the surface and the probe is useful (do not use water or solvents). This method also improves the response time.

CONNECTING THE TP47 MODULE

All probes produced by Delta OHM are provided with a TP47 module.

The **HD2306.0** instrument also work with direct 4-wire Pt100, and 2- or 4-wire Pt1000 probes manufactured by other producers: for the instrument connection is prescribed the TP47 module to which the probe's wires should be welded.

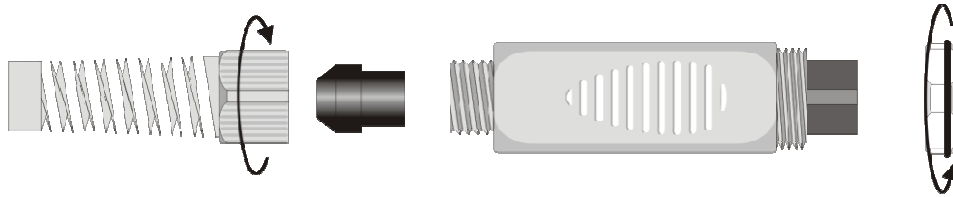


The instructions to connect the Platinum probe to the TP47 module are provided below.

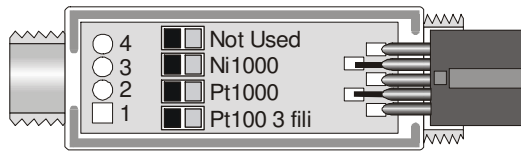
The **TP47** module is supplied complete with fairlead and gasket for 5 mm maximum diameter cables. Do the following to open the module and connect a probe:

1. unscrew the fairlead;
2. extract the gasket;
3. remove the label using a cutter;

4. unscrew the ring on the opposite side as illustrated in the figure:



5. open the two module shells: the printed circuit to which the probe must be connected is housed inside. On the left there are the 1...4 points on which the sensor wires must be welded. The JP1...JP4 jumpers are in the center of the board. These must be closed with a tin bead for some type of sensors:

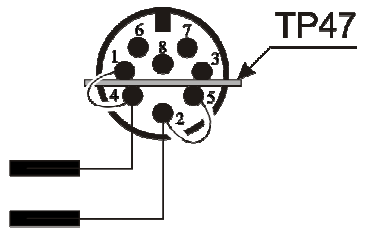
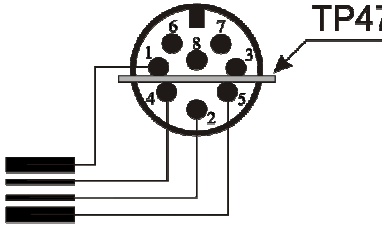


Caution! Before welding, pass the probe cable through the fairlead and gasket.

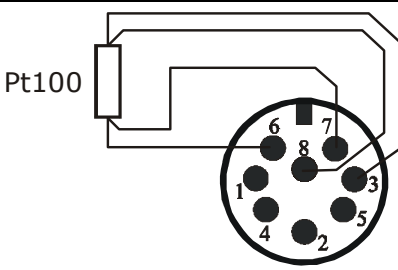
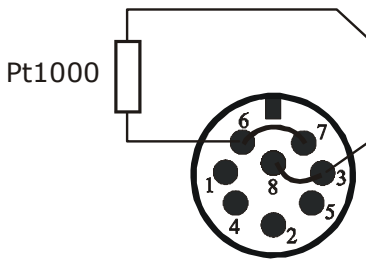
6. Weld the wires as shown in the table:

Sensor	TP47 board connection	Jumper to close
Pt100 4 wires		None
Pt1000 2 wires		JP2
Pt1000 4 wires		JP2

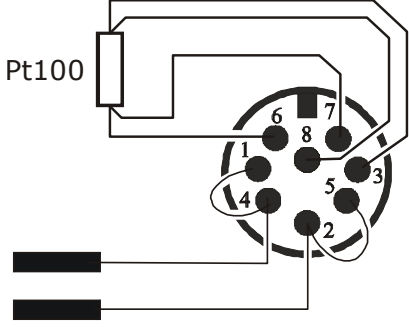
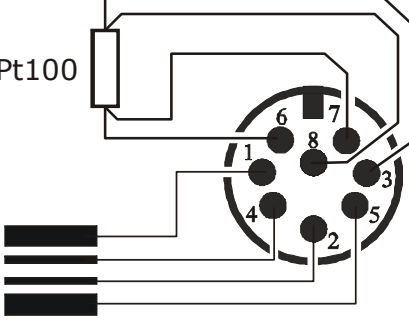
The wires coming from the **conductivity probe** are welded directly on the **DIN45326** connector as reported in the following table:

Sensor	Direct connection to the connector	Jumper
2-electrode conductivity probe	 <p>Internal view of the connector</p>	<p>Jumper between pins 1 and 4</p> <p>Jumper between pins 2 and 5</p>
4-electrode conductivity probe	 <p>Internal view of the connector</p>	None

As an alternative, the **Pt100** and **Pt1000** sensors can be welded directly on the connector's pins **DIN45326**, as reported in the following table:

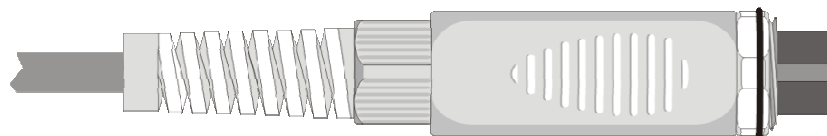
Sensor	Direct connection to the connector	Jumper
Pt100 4 wires	 <p>Connector's internal view from the TP47 module</p>	None
Pt1000 2 wires	 <p>Connector's internal view from the TP47 module</p>	<p>Jumper between pins 6 and 7</p> <p>Jumper between pins 3 and 8</p>

The wires coming from the conductivity/Pt100 temperature combined probe are welded directly on the connector as reported in the following table.

Sensor	Direct connection to the connector DIN45326	Jumper
2-electrode conductivity probe Pt100 temperature sensor	 <p>Connector's internal view from the TP47 module</p>	Jumper between pins 1 and 4 Jumper between pins 2 and 5
4-electrode conductivity probe Pt100 temperature sensor	 <p>Connector's internal view from the TP47 module</p>	None


Ensure the welds are clean and perfect.

6. Once the welding operation is complete, close the two shell;
7. insert the gasket in the module;
8. screw the fairlead;
9. at the other end of the module, enter the ring with the O-Ring as indicated in the picture.



10. Make sure the cable is not twisted while you are screwing the fairlead. Now the probe is ready.

WARNINGS

1. Do not expose the probes to gases or liquids that could corrode the material of the sensor or the probe itself. Clean the probe carefully after each measurement.
2. Do not bend the probe connectors or force them upward or downward. Do not bend or force the contacts when inserting the probe connector into the instrument.
3. Do not bend, deform or drop the probes, as this could cause irreparable damage.
4. Always select the most suitable probe for your application.
5. Do not use probes in presence of corrosive gases or liquids. The sensor container is made of AISI 316 stainless steel, while the contact probe container is made from AISI 316 stainless steel plus silver. Avoid contact between the probe surface and any sticky surface or product that could corrode or damage it.
6. Above 400°C and below -40°C, avoid violent blows or thermal shocks to Platinum temperature probes as this could cause irreparable damage.
7. To obtain reliable measurements, temperature variations that are too rapid must be avoided.
8. Temperature probes for surface measurements (contact probes) must be held perpendicular against the surface. Apply oil or heat-conductive paste between the surface and the probe in order to improve contact and reduce reading time. Whatever you do, do not use water or solvent for this purpose. A contact measurement is always very hard to perform. It has high levels of uncertainty and depends on the ability of the operator.
9. Temperature measurements on non-metal surfaces usually require a great deal of time due to the low heat conductivity of non-metal materials.
10. **Probes are not insulated from their external casing**; be very careful not to come into contact with live parts (above 48V). This could be extremely dangerous for the instrument as well as for the operator, who could be electrocuted.

11. Avoid taking measurements in presence of high frequency sources, microwave ovens or large magnetic fields; results may not be very reliable.
12. Clean the probe carefully after use.
13. The instrument is water resistant and IP67, but should not be immersed in water. The probe connectors must be fitted with sealing gaskets. Should the instrument fall into the water, check for any water infiltration. Gently handle the instrument in such a way as to prevent any water infiltration from the connectors' side.

INSTRUMENT SIGNALS AND FAULTS

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

Display indications	Explanation
ALPH	Temperature coefficient αT
BATT TOO LOW CHNG NOW	Indication of insufficient battery charge appearing on turning on. The instrument issues a long beep and turns off. Replace the batteries.
CAL ERR	This appears when, during calibration, the read value exceeds the limits of -30% or +50% of the standard solution's value compensated for temperature or the solution temperature is lesser than 15 °C or higher than 35 °C.
CAL blinking	No calibration has been effected yet, or the cell constant value has been modified in the menu (please see the description of the K_CELL menu item at page 9).
CAL LOST	Program error: it appears after turning on for a few seconds. Contact the instrument's supplier.
ERR	This appears if the conductivity/temperature probe is measuring a value exceeding the set measuring range or the or the resistivity is greater than 10M Ω .
FUNC CLR D	max, min and average values cleared.
KCEL	Cell constant K.
m	No probe with temperature sensor connected. The letter "m" indicates that the displayed temperature was entered manually.
PLS_EXIT >>> FUNC RES_FOR_FACT ONLY	please exit using ESC >>> function reserved to factory calibration.
PRBE_TYPE	Type of probe connected.
REF_TEMP	Reference temperature.
SYS ERR #	Instrument management program error. Contact the instrument's supplier and communicate the numeric code # reported by the display.
TDS	Total dissolved solids.
UNDR	Minimum limit exceeded.

INSTRUMENT STORAGE

Instrument storage conditions:

- Temperature: -25...+65 °C.
- Humidity: less than 90%RH without condensation.
- Do not store the instrument in places where:
 - humidity is high;
 - the instrument may be exposed to direct sunlight;
 - the instrument may be exposed to a source of high temperature;
 - the instrument may be exposed to strong vibrations;
 - the instrument may be exposed to steam, salt or any corrosive gas.

The instrument case is made of ABS plastic: do not use any incompatible solvent for cleaning.

MAINTENANCE

The instrument case is made of ABS plastic and the protections are rubber: do not use any incompatible solvent for cleaning.

In the conductivity/temperature combined probe the bell and the body of the probe are made of PBT, the conductivity and temperature sensors are made of Platinum.

During the use control the compatibility of these materials with the liquid that you want to measure. The probe must be preserved in a dry space. At regular intervals check that no deposits or corrosion are present on the sensitive part of the probe.

Any possible deposits should be removed using detergent on a wet rag. Particularly resistant deposits can be removed leaving the probe immersed in soap water for some hours and then rinsing it. Do not allow hands to touch the electrodes after cleaning.

Do not use any abrasive product for cleaning.

NOTES ON CONDUCTIVITY MEASUREMENT


The service life of a cell can be unlimited, provided that the necessary maintenance is performed and that it does not break. Some of the most frequent problems and their possible solutions are reported below.

Measurement of conductivity different from the expected value. Check that the cell used is suitable for the measurement range. Check that the cell is not dirty, that there are no air bubbles inside it. Calibrate again using the appropriate standard.

Slow response or instability. Check that the cell is not dirty, that there are no traces of oil or air bubbles inside it. If you work with a black Platinum cell, new platinum-coating of the electrode could be necessary.

Cell constant value not accepted. Check that the standard solutions are in good condition, that the probe's constant cell value coincides with that selected in the instrument and that the solution temperature is within the range 15...35 °C.

LOW BATTERY WARNING AND BATTERY REPLACEMENT

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



In this case, batteries should be replaced as soon as possible. If you continue to use it, the instrument can no longer ensure correct measurement. The memory data are maintained.

If the battery charge level is insufficient, the following message appears when you turn the instrument on:

**BATT TOO LOW
CHNG NOW**

The instrument issues a long beep and turns off. In this case, replace the batteries in order to turn the instrument back on.

To replace the batteries, proceed as follows:

1. switch the instrument off;
2. unscrew the battery cover counter clockwise;
3. replace the batteries (3 1.5V alkaline batteries - type AA);
4. screw the cover on clockwise.



Malfunctioning upon turning on after battery replacement

After replacing the batteries, the instrument may not restart correctly; in this case, repeat the operation.

After disconnecting the batteries, wait a few minutes in order to allow circuit condensers to discharge completely; then reinsert the batteries.

WARNING ABOUT BATTERY USE

- Batteries should be removed when the instrument is not used for an extended time.
- Flat batteries must be replaced immediately.
- Avoid batteries leaking.
- Always use good quality leakproof alkaline batteries. Sometimes on the market, it is possible to find new batteries with an insufficient charge capacity.

NOTES ABOUT WORKING AND OPERATIVE SAFETY

Authorized use

The technical specifications as given in chapter TECHNICAL CHARACTERISTICS must be observed. Only the operation and running of the measuring instrument according to the instructions given in this operating manual is authorized. Any other use is considered unauthorized.

General safety instructions

This measuring system is constructed and tested in compliance with the EN 61010-1 safety regulations for electronic measuring instruments. It left the factory in a safe and secure technical condition.

The smooth functioning and operational safety of the measuring system can only be guaranteed if the generally applicable safety measures and the specific safety instructions in this operating manual are followed during operation.

The smooth functioning and operational safety of the instrument can only be guaranteed under the environmental and electrical operating conditions that are in specified in chapter TECHNICAL CHARACTERISTICS.

Do not use or store the product in places such as listed below:

- Rapid changes in ambient temperature which may cause condensation.
- Corrosive or inflammable gases.
- Direct vibration or shock to the instrument.
- Excessive induction noise, static electricity, magnetic fields or noise.

If the measuring system was transported from a cold environment to a warm environment, the formation of condensate can impair the functioning of the measuring system. In this event, wait until the temperature of the measuring system reaches room temperature before putting the measuring system back into operation.

Obligations of the purchaser

The purchaser of this measuring system must ensure that the following laws and guidelines are observed when using dangerous substances:

- EEC directives for protective labour legislation
- National protective labour legislation
- Safety regulations

TECHNICAL CHARACTERISTICS

TECHNICAL INFORMATION ON THE CONDUCTIVITY-METER THERMOMETER

Instrument

Dimensions (Length x Width x Height)	140 x 88 x 38 mm
Weight	160 g (complete with batteries)
Material	ABS
Display	2x4½ digits plus symbols Visible area: 52 x 42 mm

Operating conditions

Operating temperature	-5...+50 °C
Warehouse temperature	-25...+65 °C
Working relative humidity	0...90% RH no condensation

Protection degree **IP67**

Power

Batteries	3 1.5V type AA batteries
Autonomy	200 hours with 1800mAh alkaline batteries
Power absorbed with instrument off	< 20 µA

Connections

Input for probes 8-pole male DIN45326 connector

Unit of measurement

µS - mS - Ω - kΩ - MΩ - mg/l - g/l
°C - °F

Measurement of conductivity by instrument

Measurement range (Kcell=0.1) / Resolution	0.00...19.99 µS/cm / 0.01 µS/cm
Measurement range (Kcell=1) / Resolution	0.0...199.9 µS/cm / 0.1 µS/cm 200...1999 µS/cm / 1 µS/cm 2.00...19.99 mS/cm / 0.01 mS/cm 20.0...199.9 mS/cm / 0.1 mS/cm
Measurement range (Kcell=10) / Resolution	200...1999 mS/cm / 1 mS/cm
Accuracy (conductivity)	±0.5% ±1 digit f.s.

Measurement of resistivity by Instrument

Measurement range (Kcell=0.1) / Resolution up to 100 MΩ·cm / (*)

(*) The resistivity measurement is obtained from the reciprocal of conductivity measurement. Close to the bottom of the scale, the indication of resistivity appears like reported in the table below.

K cell = 0.01 cm ⁻¹		K cell = 0.1 cm ⁻¹	
Conductivity (µS/cm)	Resistivity (MΩ·cm)	Conductivity (µS/cm)	Resistivity (MΩ·cm)
0.001 µS/cm	1000 MΩ·cm	0.01 µS/cm	100 MΩ·cm
0.002 µS/cm	500 MΩ·cm	0.02 µS/cm	50 MΩ·cm
0.003 µS/cm	333 MΩ·cm	0.03 µS/cm	33 MΩ·cm
0.004 µS/cm	250 MΩ·cm	0.04 µS/cm	25 MΩ·cm
...

Measurement range (Kcell=1) / Resolution	5.0...199.9 $\Omega \cdot \text{cm}$ / 0.1 $\Omega \cdot \text{cm}$ 200...999 $\Omega \cdot \text{cm}$ / 1 $\Omega \cdot \text{cm}$ 1.00 k...19.99 $\text{k}\Omega \cdot \text{cm}$ / 0.01 $\text{k}\Omega \cdot \text{cm}$ 20.0 k...99.9 $\text{k}\Omega \cdot \text{cm}$ / 0.1 $\text{k}\Omega \cdot \text{cm}$ 100 k...999 $\text{k}\Omega \cdot \text{cm}$ / 1 $\text{k}\Omega \cdot \text{cm}$ 1...10 $\text{M}\Omega \cdot \text{cm}$ / 1 $\text{M}\Omega \cdot \text{cm}$
Measurement range (Kcell=10) / Resolution	0.5...5.0 $\Omega \cdot \text{cm}$ / 0.1 $\Omega \cdot \text{cm}$
Accuracy (resistivity)	$\pm 0.5\%$ ± 1 digit f.s.

Measurement of total dissolved solids (with coefficient χ /TDS=0.5)

Measurement range (Kcell=0.1) / Resolution	0.00...19.99 mg/l / 0.05 mg/l
Measurement range (Kcell=1) / Resolution	0.0...199.9 mg/l / 0.5 mg/l 200...1999 mg/l / 1 mg/l 2.00...19.99 g/l / 0.01 g/l 20.0...99.9 g/l / 0.1 g/l
Measurement range (Kcell=10) / Resolution	100...999 g/l / 1 g/l
Accuracy (total dissolved solids)	$\pm 0.5\%$ ± 1 digit f.s.

Measurement of temperature by Instrument

Pt100 measurement range	-50...+200 $^{\circ}\text{C}$
Pt1000 measurement range	-50...+200 $^{\circ}\text{C}$
Resolution	0.1 $^{\circ}\text{C}$
Accuracy	$\pm 0.25^{\circ}\text{C}$ f.s.
Drift after 1 year	0.1 $^{\circ}\text{C}/\text{year}$

<i>Automatic/manual temperature compensation</i>	0...100 $^{\circ}\text{C}$ with $\alpha T = 0.00...4.00\%/^{\circ}\text{C}$
<i>Reference temperature</i>	20 $^{\circ}\text{C}$ o 25 $^{\circ}\text{C}$
<i>χ/TDS conversion factor</i>	0.4...0.8
<i>Cell constant K (cm^{-1})</i>	0.1, 0.7, 1.0 and 10.0
<i>Standard solutions automatically detected (@25$^{\circ}\text{C}$)</i>	147 $\mu\text{S}/\text{cm}$ 1413 $\mu\text{S}/\text{cm}$ 12880 $\mu\text{S}/\text{cm}$ 111800 $\mu\text{S}/\text{cm}$

PROBES TECHNICAL DATA

2- AND 4-ELECTRODE CONDUCTIVITY PROBES

CODE	MEASUREMENT RANGE	DIMENSIONS
SP06T	<p>K=0.7 5 $\mu\text{S}/\text{cm}$...100 mS/cm 0...90°C 4-electrode cell in PBT/Platinum General use No heavy tasks Max pressure 5 bar</p>	
SPT01G	<p>K=0.1 0.1 $\mu\text{S}/\text{cm}$...500 $\mu\text{S}/\text{cm}$ 0...80°C 2-electrode cell in Glass/Platinum Pure water Max pressure 5 bar</p>	
SPT1G	<p>K=1 10 $\mu\text{S}/\text{cm}$...10 mS/cm 0...80°C 2-electrode cell in Glass/Platinum General heavy tasks, average conductivity Max pressure 5 bar</p>	
SPT10G	<p>K=10 500 $\mu\text{S}/\text{cm}$...200 mS/cm 0...80°C 2-electrode cell in Glass/Platinum General heavy tasks, high conductivity Max pressure 5 bar</p>	

Pt100/Pt1000 PROBES WITH TP47 MODULE

Model	Type	Application range	Accuracy
TP47.100.O	Pt100 4 wires	-50...+250°C	Class A
TP47.1000.O	Pt1000 4 wires	-50...+250°C	Class A
TP87.100.O	Pt100 4 wires	-50...+200°C	Class A
TP87.1000.O	Pt1000 4 wires	-50...+200°C	Class A

Resolution

Temperature drift @ 20°C

0.1°C

Pt100 0.003%/°C

Pt1000 0.005%/°C

ORDERING CODES

- HD2306.0** The kit is composed of the instrument HD2306.0, 3 1.5V alkaline batteries, operating manual, and case. **Conductivity probes, temperature probes, standard solutions have to be ordered separately.**
- HD22.2** Laboratory electrode holder composed of base plate with built-in magnetic stirrer, shaft and replaceable electrode holder. Suitable diameter 12mm. It holds up to 5 electrodes at the same time. Powered by power supplier SWD10 (optional).
- HD22.3** Laboratory electrode holder composed of base plate. Flexible arm for free positioning. Suitable for electrodes with diameter 12 mm. It holds up to 5 electrodes at the same time.

CONDUCTIVITY PROBES AND COMBINED CONDUCTIVITY AND TEMPERATURE PROBES

- SP06T** Conductivity and temperature combined probe. Cell constant 0.7. Probe measuring range 5 μ S...100 mS, 0 ... 90 °C max pressure 5 bar.
- SPT01G** Conductivity and temperature combined probe, glass body, 2 platinum wire electrodes, cell constant 0.1.
- SPT1G** Conductivity and temperature combined probe, glass body, 2 platinum wire electrodes, cell constant 1.
- SPT10G** Conductivity and temperature combined probe, glass body, 2 platinum wire electrodes, cell constant 10.

STANDARD CONDUCTIVITY CALIBRATION SOLUTIONS

- HD8700C** ACCREDIA ISO 17025 certified standard solutions kit: 0.001mol/l (147 μ S/cm @ 25 °C) + 0.01mol/l (1413 μ S/cm @ 25 °C) + 0.1mol/l (12880 μ S/cm @ 25 °C). Two 50 ml bottles for each type (6 bottles in total).

TEMPERATURE PROBES WITH TP47 MODULE

TP47.100.O	Immersion probe, sensor Pt100 direct 4 wires. Probe's stem Ø3 mm, length 230 mm. 4-wire connection cable with connector, length 2 metres.
TP47.1000.O	Immersion probe, sensor Pt1000. Probe's stem Ø3 mm, length 230 mm. 4-wire connection cable with connector, length 2 metres.
TP87.100.O	Immersion probe, sensor Pt100 direct 4 wires. Probe's stem Ø3 mm, length 70 mm. 4-wire connection cable with connector, length 2 metres.
TP87.1000.O	Immersion probe, sensor Pt1000. Probe's stem Ø3 mm, length 70 mm. 4-wire connection cable with connector, length 2 metres.
TP47	Only connector for probe connection: Pt100 direct 3 and 4 wires, Pt1000 and Ni1000 2 wires.

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

NOTES

WARRANTY

The manufacturer 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.

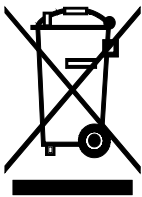
The manufacturer repairs the products that show defects of construction in accordance with the terms and conditions of warranty included in the manual of the product. For any dispute, the competent court is the Court of Padua. The Italian law and the "Convention on Contracts for the International Sales 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.

We 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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